



التعمير الناتج عن خطأ عدم التغطية في المسوح الهاتفية في فلسطين

*Coverage Bias in Telephone Surveys in Palestine*

Student Name and Number:

Nasouh Soos

1105088

Committee:

Dr Hassan Abu Hassan

Advisor

Dr Tariq Sadiq

Dr Ali Barakat

*Submitted in partial fulfillment of the requirements of the "*  
*Master Degree in Applied Statistics "* From the Faculty of  
*Graduate Studies at Birzeit University- Palestine*



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**Signature**

**Dr Hassan Abu Hassan**

\_\_\_\_\_

**Dr Tariq Sadiq**

\_\_\_\_\_

**Dr Ali Barakat**

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## *Dedication*

*To those who have supported me at all the time.....*

*To the Spirit of my Father,*

*To the Spirit of my daughters,*

*To my mother,*

*To my wife,*

*To my son and daughter,*

*To my Brother and Sisters,*

*To my colleagues.*

*With all my love and respect*

## *Acknowledgments*

I would like to express my deepest gratitude to my supervisor, Dr. Hassan Abu Hassan who made great effort to guide me throughout my studies. This project would not have been possible without his continuous guidance and support. I would like to express my deep appreciation and gratitude to both Dr. Tariq Sadiq and Dr. Ali Barakat for their contributions and encouragement. I would like to thank the staff of Palestinian Central Bureau of Statistics (PCBS) for the facilities which is offer to me during data demand. My special thanks to the staff of sampling unit in PCBS for their assistance, in particular, I am so grateful to Mr Anas Ahmad who have helped me for merging the data files . I gratefully acknowledgment the help of Mr Monther Al-Sa'edi. I would like to thank the administration of Palestine Technical University- Khadoori for their support and encouragement during the study, and my appreciation to my colleagues in work and study. I would like to express my appreciation to all doctors taught me during my study. Last but not least, my deep thanks go to my family for their endless encouragement and support and for everyone help me or encourage me.

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## **Abstract**

Coverage bias in telephone surveys among the population in Palestine was studied depending on a random sample of 4448 households from the survey of Information and Communication Technology, 2011, conducted by PCBS. Telephone status (landline only, mobile only, landline and mobile, no telephone services) of each sampled individuals was matched with his or her demographic characteristics obtained from the data. This facilitated estimation of the coverage properties of the landline telephone sampling frame, and identification of sub-populations under-covered in telephone surveys. Individuals with schooling years six and less, attending to school and left, have elementary and less educational achievement, and they have elementary occupation proved systematically under-represented in a telephone surveys based on telephone sampling frame.

Bias due to the exclusion of mobile phone-only individuals from the sampling list was also tested, and implication for sampling list selection are discussed.

The result of this study showed that the application of weighting methods, SPS and MPS, lead to significant reduction in the coverage bias. MPS method gave better results for most of the indicators than the SPS method.

## ملخص

اعتمدت هذه الدراسة في دراسة انحياز التغطية في المسوح الهاتفية في فلسطين على عينة عشوائية حجمها 4448 أسرة من البيانات التي تم الحصول عليها من خلال مسح تكنولوجيا المعلومات الاتصالات, 2011, الذي أجراه الجهاز المركزي للإحصاء الفلسطيني. وضع الهاتف ( هل يملك هاتفًا ثابتًا أو محمولًا أو يملك النوعين أو لا يتوفر خدمة هاتفية ) لكل فرد من أفراد العينة تمت مطابقته مع بعض الخصائص الديموغرافية التي تم الحصول عليها من خلال البيانات التي جمعت. سهل هذا في تقدير خصائص التغطية في عينات الهاتف الثابت, وتحديد التجمعات الفرعية غير المغطاة في المسوح الهاتفية, الأفراد الذين سنوات تعليمهم اقل من ست سنوات, والذين حضروا للمدارس وتخرجوا, والذين مؤهلهم العلمي ابتدائي فما دون ويمارسون المهن الأولية بينت الدراسة أن هذه الفئات غير ممثلة تمثيلاً كاملاً في المسوح الهاتفية

أوضحت نتائج هذه الدراسة بان تطبيق الأوزان النسبية المحسوبة بطريقة SPS , MPS يؤدي إلى تحسين نتائج المؤشرات التي تقتصر على بيانات الأفراد الذين يمتلكون هاتفًا ثابتًا. وهذا يتضح من خلال انخفاض التحيز الناتج عن خطأ عدم التغطية الهاتفية الناتج عن الاقتصار على بيانات الأسر التي تمتلك هاتف فقط. ومما يلاحظ أن نتائج طريقة MPS أفضل من نتائج طريقة SPS لمعظم المؤشرات التي طبقت عليها الأوزان النسبية.

# **Chapter one**

## **Introduction**

## **Introduction**

### **1.1 Background**

The communication sector in Palestine was ignored by the Israeli Occupation of the Palestinian land during the period between 1967 to 1997. Therefore, there are no statistical reports concerning the Palestinian communication sector during this period. Also, the development of this sector in Palestine was too slow compared to this sector in Israel, given that the telephone density reached in Palestine (the West Bank and the Gaza Strip) about 3.14 for each hundred of the population against 30 for each hundred in Israel in 1994.

Decline in the provision in service on the communication sector in Palestine helped to keep the status as it was until the Palestinian communication company was established, where the company has undertaken the development of this sector which began with the infrastructure and equipment with an advanced digital network as much as the rate of telephone lines reached 60 per hundred of the population by the end of 2007. By developing this sector the company covered about 98.5% of the residential areas in Palestine. Growth in telecommunication sector in Palestine appear after Jawwal company had been established in 2000 and Alwataniya Mobile arrival in 2009, where growth in the number of mobile subscriptions increased by 79.1% during 2005 to 2007. The results from

surveys performed by the Palestinian Central Bureau of Statistics showed high prevalence of landline phone between families, where the percentage of families living in urban areas reached 50.5% from the total Palestinian families living in urban areas in 2000 have a landline phone, followed by 37.5% of families living in camps have a landline phone, and the lowest rate was in rural areas, where the rate reaches 30.7% (Palestinian Central Bureau of Statistics, 2010 ).

The Palestinian Central Bureau of Statistics conducted different types of surveys related to different aspects of life such as information and communications technology surveys, agricultural surveys, computer, internet and mobile surveys, economic surveys, youth surveys, health surveys and others.

Telephone is a method of communication of today's world and it is useful for surveys. Telephone survey is a way of collecting data from a sample of telephone numbers for the purpose of learning about the population that has been targeted for study, or a systematic collection of data from a sample using standardized questionnaire. In the survey where the data were collected from persons through the household they live, this method has been the most popular way of data collection in the past four decades (Nathan 2001). As the percentage of people who have phone connection increased, telephone surveys became more needed.

The sample is drawn from the set of all people in households that can be reached through residential phone number. However this sampling frame excludes all the people without telephone service. The statistics calculated in telephone surveys depend on telephone directory sampling frames can be biased. In official government statistics and social science research continually make use of telephone survey data collection.

A sample frame is the main component of sampling design. Sample frame has an important role in sample surveys, so a good sampling frame includes every element in the population and each element is recorded only once. Sampling frame can be defined as a set of source materials from which the sample is selected, or a sample frame is a list of all the elements in the target population (Bethlehem, 2009). A sampling frame should represent the target population. If the sampling frame doesn't represent the target population well, errors occur.

In a statistical survey, we usually differentiate between two types of errors which constitute what is called total survey errors. These errors are:

- 1- Sampling errors which are defined as the deviation of the sample statistics from the population parameters, where the sampling errors are classified as
  - a- Estimation error: This error is caused by using a subset of the population in the survey.

b- Specification error: This error due to the difference between true selection probabilities and the selection probabilities specified in the sampling design.

These types of errors vanishes by the whole population or using a correct sample design.

2- Non sampling errors are the errors of estimation which are not the result of sampling. These errors may occur because of survey design or field work, so these errors occur due to different factors starting from planning the survey to report writing.

Non-sampling errors can be classified depending on the stage of the survey into three stages in the survey

- Survey design and preparation
- Data collection and
- Data processing and analysis

Another way of classification depends on the source or type of error

- Coverage errors
- Non-response errors
- Measurement errors

The following diagram represents the component of total survey error

**Figure (1.1) Components of total survey error**

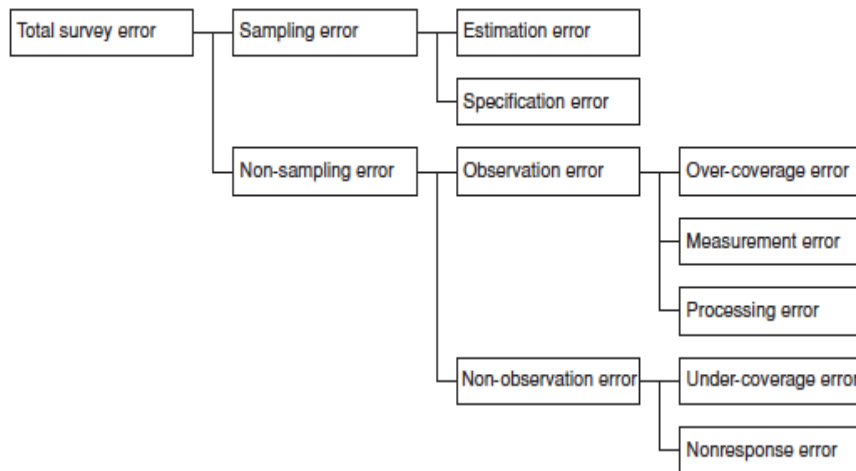


Figure : Taxonomy of survey errors, taken from Bethelehem (2010)

The purpose of any survey is to make inferences about the target population, so to achieve this, there is a need to apply an appropriate randomized procedure to a sampling frame in which all the units in the target population will be represented uniquely.

A common problem in studies of human populations is coverage error. Coverage error is the bias that occurs when we are unable to select the sample from the whole study population. For example, a telephone survey of households selected from a telephone directory will not include households with no phone, households with unlisted land line numbers, or mobile phone-only households. It is difficult to quantify coverage error without special studies of the un-sampled portion of the population.



A coverage error is a non-sampling error of non-observation due to the fact that a part of the target population is missing from the frame the sample is drawn from (Groves, 1989).

Coverage errors may occur as a result of a non-correct frame of sampling units, such as using an old list of households prepared for the population census in a household survey. In this case, new households which are not added into the list are not included in the sampling frame, and the migrated households remain in the frame. Coverage errors may occur also as a result of incorrect specifications or ignoring correct procedures by field workers, or enumerating wrong units. Enumerators may sometimes complete a questionnaire for an imaginary households and submit them in place of real households. Also Coverage error arise when the survey is designed such that a specific part of the target population is not included in the frame, i.e. they occur when some members of the target population have a zero probability of being selected.

The most problematic situation of coverage error is under-coverage, where a sample frame excludes some members of the population it is intended to cover. Coverage bias, can occur when a sample frame systematically differs from the population it is intended to include. The extent of coverage bias depends both on the percentage of a population that is not covered in the sample frame and the differences in any statistic

between those included in the sample frame and those excluded from the sample frame. Telephone surveys systematically exclude persons who do not have telephone service, and most telephone surveys have systematically excluded people who have a mobile phone service but not a landline phone service. In cases where the excluded proportion of a survey's target population is small, and where differences between sampled respondents and others are small, researchers usually do not have to worry about bias in results because of these exclusions. However, if the magnitude of this coverage error is large, or if the differences between covered and non-covered respondents are great, or if a survey is attempting to make very precise estimates of the characteristics of a population, then non-ignorable coverage bias may result.

Coverage errors in telephone samples come from several sources, rather than just from those who do not own telephones. Each of these sources of error may have different effects on the estimates of interest. Brick et al. (1995) note that population members owning a phone but not covered in list-assisted designs are likely different from those who don't own a phone at all. Similarly, those who own a mobile phone only are likely to be different from landline owners that are not covered in list-assisted samples, or from those who own no phone at all. Coverage error can be parameterized by the following equation

$$\bar{Y} = \frac{N_c}{N} \bar{Y}_c + \frac{N_{cell}}{N} \bar{Y}_{cell} + \frac{N_{list}}{N} \bar{Y}_{list} + \frac{N_{nt}}{N} \bar{Y}_{nt}$$

Where  $\bar{Y}$  is the statistic of interest for the full population,

$N$  = total population of interest.

$N_c$  = number of population covered in the telephone frame only.

$\bar{Y}_c$  = value of statistic of interest for population covered in the telephone frame.

$N_{cell}$  = number of population in mobile phone only population.

$\bar{Y}_{cell}$  = value of statistic of interest for population in cell phone only population.

$N_{list}$  = number of population not covered by list-assisted sample frame.

$\bar{Y}_{list}$  = value of statistic of interest for population not covered by list-assisted sample frame.

$N_{nt}$  = number of population not owning a telephone and not owning a mobile.

$\bar{Y}_{nt}$  = value of statistic of interest for population not owning a telephone.

From the equation, each source of error depends on the size of the non-covered populations and differences between each one and the covered population.

Coverage errors can be classified into two types:

A -Under-coverage errors which occur when there is a difference between the sampling frame and the target population i.e if the target population contains elements that are not included in the sampling frame. If the elements of the target population are not represented in the survey frame, then the element has zero probability of selection in the sample. Under-coverage is considered as a failure to include all units belonging to the defined population or failure to include specified units in the conduct of the survey. Under-coverage is the most serious type of coverage because it's difficult to detect and solve. As a result it is important to prevent under-coverage during the survey design. In household surveys, there are two levels of under-coverage concerns. First, households may be missing from the frame. For example, in a telephone survey, households without telephone service will be excluded from the frame. In addition, a rapid increase of mobile phone begun to threaten the landline phone frames. Second, even when a household is in the frame, some people within the household may not be covered. This type of under-coverage cannot be prevented by good frame construction. Under-coverage errors are classified as non-observational errors as they are explained in the figure. This type of error is the situation in which the sample is not 'representative' of the population of interest because there are certain groups in this population that are not covered by the sampling frame underlying the survey. If the non

covered groups respond systematically different is the questions in the survey, the statistics are biased due to the under-coverage. Under-coverage occurs, even before the survey, have been allocated to the interviewers and are, therefore, invisible in most datasets. If a sampling frame exactly represents the target population, then the bias in this case is due to non response.

To prevent under-coverage, a frame in a survey must provide a necessary unit coverage. For example, to estimate a mobile phone use, it shouldn't use a traditional landline phone frame.

There are both simple checks for under-coverage and extensive studies of under-coverage. Simple checks include comparing simple survey estimates (e.g. demographics) to other sources, such as recent prior surveys or census data. Using external data, post-survey adjustments to the analysis weights can be made if necessary.

#### **Under coverage error calculation:**

In a sampling frame, when under coverage error occur and then the total sum will be under estimated i.e  $Y = \sum_{j=1}^N Y_j$  will be underestimated .

suppose that  $N_A$ : denote to the number of elements included in the frame

$N_0$ : denote to the number of elements not in the frame

$N = N_A + N_0$  , and the total sum can be rewrite as follows

$$Y = \sum_{j=1}^N Y_j = \sum_{j=1}^{N_0} Y_j + \sum_{j=1}^{N_A} Y_j = Y_0 + Y_A$$

Let  $y_A$  be unbiased estimator for  $Y_A = \sum_{j=1}^{N_A} Y_j$ ,

$$\text{Net bias } (y_A) = E(y_A) - Y = Y_A - Y = -Y_0$$

$$\text{Relative bias } (y_A) = \frac{-Y_0}{Y}$$

Ratio of squared bias to  $\text{MSE}(y_A) = \frac{Y_0^2}{\text{MSE}(y_A)}$ , where

$$\text{MSE } (y_A) = \text{Var}(y_A) + (Y - Y_A)^2$$

Kiranandana (1976) express the relative bias of the estimate of population total  $\text{RB}(y_A)$  and estimate of population mean  $\text{RB}(\bar{y}_A)$  in terms of proportion of elements missing from the frame and the ratio of the mean of the missing elements to that of associated elements.

Let  $w =$  proportion of elements not included in the frame  $= \frac{N_0}{N}$

$$r = \frac{\text{mean of missing elements}}{\text{mean of included elements}} = \frac{\bar{Y}_0}{\bar{Y}_A}$$

then

$$\text{RB}(y_A) = \frac{-wr}{rw + (1-w)}, \quad \text{RB}(\bar{y}_A) = \frac{w(1-r)}{rw + (1-w)}$$

For  $\text{RB}(y_A)$  if  $r=1$  then  $\text{RB}(y_A) = -w$  and if  $r > 0$  then  $\text{RB}(y_A)$  will be negative and decreased as  $r$  increased.

Bias for average estimation:

Suppose that  $\bar{y}_A$  be unbiased estimator for  $\bar{Y}_A$ , then

$$MSE(\bar{y}_A) = \text{Var}(\bar{y}_A) + (\bar{Y}_A - \bar{Y})^2$$

$$\text{Net Bias}(\bar{y}_A) = \bar{Y}_A - \bar{Y} + w(\bar{Y}_A - \bar{Y}_0)$$

$$RB(\bar{y}_A) = \frac{w(\bar{Y}_A - \bar{Y}_0)}{\bar{Y}} = \frac{w(1-r)}{(1-w) + rw}$$

B- Over-coverage: This type of error occurs when the sampling frame contains elements that don't belong to the target population, which means that some elements are included in the survey which don't belong to the target population. Over-coverage is considered as the inclusion of some units erroneously either because of inclusion of unspecified units or inclusion of specified ones more than once. Over-coverage may be refer to two types. One type can occur if there are records in the sample frame that do not contain respondents or members of the target population. And the other type occurs if the same respondent is targeted by duplicate or multiple records in the sample frame. In either case, the sample frame contains sample records that should be interviewed. Over-coverage may refer to ineligible units or multiple records. In an ideal case, sample frame contains a one-to-one correspondence between sample records and members of the target population for a survey, but it may occur in some cases that multiple records refer back to a single member of the target

population. In this case the type of over-coverage is known as multiplicity of elements or duplicate. In other cases, sample records fail to lead to members of the target population. These cases are sometimes referred to as blanks or foreign elements.

Multiplicity of elements in a sample frame is common. For example, if telephone numbers are sampled for a survey of households, a household with multiple telephones will be included multiple times. Over-coverage caused by duplicate or multiple records can be adjusted for either by cleaning the sample frame or by providing sample weights to adjust for different probabilities that a respondent is included in the sample frame. Frame cleaning can be done before or during the survey field process. Prior cleaning involves checking the sample frame for duplicate or multiple records and eliminating them.

The second type of over-coverage occurs in most sample frames, where the sample records may not contain valid members of target population, such as sample records which don't correspond to anything similar to the target population. To explain the idea, take a telephone sample. Telephone samples often contain disconnected telephone numbers or numbers that have not been assigned. Household surveys may send an interviewer to an empty lot. In business, a business directory might contain mailing addresses for establishments that went out of business many years ago. These listings are referred to as "blanks," "empty records," "empty listings," "bad records"



or "duds. In some cases the sample record reaches a unit that can be screened for eligibility, but the record turns out to not be a member of the target population for the survey . These records are called foreign elements, out-of-scope units, or screen-outs. For example, a survey that targets telephone households in one city instead may reach some households in a neighboring town, or a survey of college students may reach some recent graduates.

Coverage bias is defined as deviation from the full population parameter, which is relatively constant over possible replications of the survey given the same design (Groves 1989).

**Over-coverage error calculation:**

As explained before, over-coverage simply occurs when the sampling frame contains elements that don't belong to the target population. This type leads to overestimated total population.

Suppose that  $M_0$  = denote to number of elements in the frame not included into target population.

$M_T$  = denote to number of elements in the frame included into target population

Then  $M = M_0 + M_T$

Consider no duplication and all population elements in the frame, then

$$M_T = N$$

The total in the frame given by

$$Y_F = \sum_{j=1}^M Y_j = \sum_{j=1}^{M_0} Y_j + \sum_{j=1}^{M_T} Y_j = Y_0 + Y_T$$

Suppose  $y_F$  be unbiased estimator for  $Y_F$ , then

$$\text{Bias}(y_F) = Y_F - Y_T = Y_0 \quad \text{and}$$

$$RB(y_F) = \frac{Y_0}{Y_T}$$

Relative bias can be written as follows

$$RB(y_F) = \frac{\nu * Q_0}{1 - Q_0}$$

Where

$$Q_0 = \frac{M_0}{M} = \frac{\text{number of elements in the frame not included in the target population}}{\text{number of elements in the frame}}$$

$$\nu = \frac{\bar{Y}_0}{\bar{Y}_T} = \frac{\text{average elements not included in the population}}{\text{average elements in the population}}$$

To assess the bias in the average estimate due to over-coverage, the following formulas used

$$\text{Bias}(\bar{y}_F) = Q_0(\bar{Y}_0 - \bar{Y}_T) \quad , \quad RB(\bar{y}_F) = \frac{Q_0(\bar{Y}_0 - \bar{Y}_T)}{\bar{Y}_T} = Q_0(\nu - 1)$$

The term bias has a specific technical definition. Bias is the expected difference between the estimates from the survey and the actual population value. For example, if all telephone households were included in the survey and responded to the required interviews, the difference between the estimate from the survey and the actual population value (which includes the responses of persons living in non-telephone households) is the bias due to incomplete coverage.

The bias, due to failure to include all persons in the sample, can be substantial when two conditions hold. First, the differences between the characteristics in covered population and the uncovered population must be relatively large. For example, consider estimating the percentage of persons enrolled in a given type of program. If the percentage enrolled is nearly identical in both the covered and uncovered population, then the bias for the estimate will be negligible. Second, the proportion of the population that is not covered by the survey must be large, compared to the size of the estimates.

The bias of an estimate can be expressed mathematically to show the relationships between the bias and the two factors discussed above. The bias is given by

$$\text{Bias}(\hat{y}_t) = P_n \{ E(\hat{y}_t - \hat{y}_n) \}$$

where  $\hat{y}_t$  is the estimated characteristic based on the telephone households only,  $P_n$  is the proportion of non-telephone households,  $\hat{y}_n$  is the estimated characteristic based on the non-telephone households, and  $E$  is the expectation operator for averaging over all possible samples. The above expression shows that as the proportion of households without telephone increases, the bias increase, so it is clear that the percentage of non-telephone households  $P_n$  is the important component in assessing the size of bias.

Cobben, and Bethlehem, 2005, found, in their study which is related to adjusting under-coverage and non-response bias in telephone surveys, that the telephone sample is not representative sample from the population with respect to Ethnic group. They found also individuals of age 55 and older are slightly over-represented, as are persons from the North and the South of Netherlands (also visible in the variable Province). Furthermore, divorced persons are underrepresented, as well as persons who live in the city or areas with a high degree of urbanization. In their study, they average relative differences between two groups. The following paragraph explain the method of calculating average relative bias.

Suppose an auxiliary variables has  $p$  categories. We introduce  $p$  dummy variables. The values for sample element  $i$  are denoted by  $x_{i,1}, (\dots), x_{i,p}$ , where

$$x_{i,j} = \begin{cases} 1, & \text{if individual } i \text{ belong to category } j \\ 0, & \text{otherwise} \end{cases}$$

Let the sample  $s$  of size  $n$  consist of a subsample  $s_L$  (of size  $n_L$ ) of elements with a listed telephone number and a sub-sample  $s_U$  (of size  $n_U$ ) of elements without a listed number. Then

$$\bar{x}_j^L = \frac{1}{n_L} \sum_{i \in s_L} x_{i,j} \quad (\text{for } j = 1, \dots, p)$$

are the sampling fractions for persons with a listed number, and likewise

$$\bar{x}_j^U = \frac{1}{n_U} \sum_{i \in s_U} x_{i,j} \quad (\text{for } j = 1, \dots, p)$$

denote the sampling fractions for persons without a listed number.

The relative difference for category  $j$  of the auxiliary variable is defined by

$$d_j = \frac{\bar{x}_j^U - \bar{x}_j^L}{\bar{x}_j^L}$$

The average relative difference for the auxiliary variable is now defined by

$$\bar{d} = \frac{1}{p} \sum_{j=1}^p |d_j|$$

where any value between 0 and  $\infty$  can be assumed.

As an illustration, consider the auxiliary variable Gender. There are two categories, Male and Female, so  $p = 2$ . Then, the relative difference for category 1 (Male) is

$$d_1 = \frac{\bar{x}_1^U - \bar{x}_1^L}{\bar{x}_1^L}$$

A positive value of  $d_1$  would indicate males to be underrepresented in the telephone sample. And  $d_1 < 0$  implies an overrepresentation of males in this survey. Likewise,  $d_2$  measures the over- or underrepresentation of females. They found a substantial difference between persons with and without a listed phone number by using face to face interviewing and a telephone interviewing as a methods of data collection. They used propensity score weighting and propensity score stratification as methods of adjustment to reduce under-coverage bias.

The Palestinian Information Communication and Technology (ICT) sector has got an important development during the past three decades. This development helps in the formation of this sector.

Information communication and technology is developing in the world in general and is fast developing in the developing countries in particular, but this development in this sector in the developing countries faces problems caused in telephone survey, since Palestine as one of the developing countries so face the same methodological problems.

Mobile phones are considered to be one of the most rapid developing technologies, this development in the developing countries is accompanied by a decrease of landline phones subscribers. In Palestine the proportion of persons and families using mobile phones increased from 92.4% in the year 2009 to 95% in the year 2011, (ICT Access Among Households and

Individuals, 2007-2009, PCBS and Household Survey on Information and Communications Technology, 2011, Main Findings, PCBS). On the other hand the proportion of households using landline phone decreased from 47.5% in the year 2009, to 44% in the year 2011, (Household Survey on Information and Communications Technology, 2011, Main Findings, PCBS).

These percentages indicate that nowadays the mobile phone is becoming as an alternative of landline phone, and some households nowadays own mobile phones only. In spite of high penetration of mobile phone, Vicente and Reis (2009) considered in their study that interviews by mobile phone can't substitute the traditional method of data collection because of a high non-response rate, low quality of mobile communication which caused a measurement error and high cost compared with landline phone calls.

It is obvious that these changes in both types of telephone ownership affect coverage bias in telephone surveys, where a decrease in landline phone ownership leads to increase of coverage errors in telephone surveys based on the landline phone directory sampling frame, and an increase of coverage error will reduce the sampling survey representatives. Also, an increase of mobile phone ownership will lead to increase of the proportion

of mobile only households in the general population and may cause biased estimates in landline phone telephone surveys.

The research literature showed that there are several sources for coverage bias in telephone surveys based on sampling lists which exclude people with no landline telephone and people with mobiles only. Literature showed also that the demographic variables such as age and gender are correlated with different social behaviors and attitudes and differ in landline telephone and mobiles only population.

## **1.2 Research Problem:**

According to the above explanation, the aim of this study can be summarized as follows:

- 1) Make a comparison between the prevalence of mobile phones and landline phone depending on the results of different surveys done by the Palestinian Central Bureau of Statistics (PCBS).
- 2) Make a comparison between properties of mobile only and landline phone populations using the data collected by PCBS.
- 3) Test the implication on coverage errors by using a landline phone sampling list. To achieve this objective we need to:



- a) Test the differences in demographic characteristics between those covered by landline phone sampling list and the whole population.
- b) Test the differences in demographic characteristics between those listed as owning a mobile phone only and the whole population.

### **1.3 Research Questions:**

This study aims to answer the following questions.

- 1-Is the sampling frame which is composed of individuals who have a phone representative of all individuals in the population?
- 2-Is there a significant change in landline phone and mobile phone prevalence in Palestine during the period from 2000 to 2011?
- 3-Are there differences in demographic characteristics between those covered by landline phone sampling list and the whole population?
- 4-Are there differences in demographic characteristics between those listed as owning a mobile phone only and the whole population?

#### **1.4 Hypotheses:**

- 1- There are no differences in demographic characteristics between individuals with landline phones and the whole population.
- 2- There are no differences in demographic characteristics between individuals having mobile phones only and the whole population.
- 3- The factors which affect landline phone ownership are similar to those which affect mobile-only phone.

#### **1.5 Importance of the study:**

This study added value in its ability to isolate the effect of coverage properties of the sampling frame survey statistics from other effects may occur, where accuracy results might be affected by other errors like non-response error.

Since there are a few studies of this type in the Arab world, so this study can enrich the library by this type of study. Also using telephone surveys as a method of data collection minimizes the cost of study compared to field surveys. It minimizes the time needed for the survey, and finally using this type of surveys as a method of data collection make a verification of data accuracy easy compared to field surveys.

This study encourages to make public opinion polls by using both types of telephones, landline and mobile phone, because using this method in public opinion polls gives results in a short time and less cost compared to face to face interview. And the trends in public opinion don't change during data collection period since this period is short compared to face to face interviews. The public opinion polls for presidential election and parliamentary elections are in most countries and with a few exceptions conducted using the phone.

#### **1.6 Concepts and Definitions:**

**Target population:** Is the population of individuals that we are interested in describing and making statistical inferences about.

**Survey:** A systematic method for gathering information from individuals for the purposes of describing the attributes of the large population in which individuals are members.

**Households:** One person or a group of persons with or without a family relationship who live in the same dwelling units, share meals and make joint provisions for food and other essentials of living.

**Phone (Telephone):** A machine or device used to transfer audio in real time between two places connected by a telephone line from the telephone operator, there are two on each side. Or

**Telephone:** An instrument that converts voice and other sound signals into a form that can be transmitted to remote locations and that receives and reconverts waves into sound signals.

**Mobile phone:** The mobile that belongs to any communication company.

**Landline (fixed)phone:** physical connection between two telecommunication devices, where the landline phone must be connected to physical wiring in order to work.

**Sampling frame:** a list of all elements in the target population.

**Error:** Describes deviation from the desired outcome.

**Enumeration area:** An enumeration area is the geographic area canvassed by one census representative. An EA is composed of one or more adjacent blocks.

## **Chapter two**

### **Literature review**

## **Literature review**

Recently, telephone coverage in most countries has changed. Mobile phone popularity increased quickly and so the proportion of the households with only mobile phones. As a result of the rising mobile phone popularity, the structure of telephone ownership changed in many countries, where some households don't have a landline phone, but have a mobile phone, instead.

Mobile phones have a special properties that make them differ from landline phones. The changes must be done regarding sampling and non-sampling issues when using mobile phones to conduct a survey. The changes required depend on local conditions because there are differences between countries in the infrastructure of mobile phone installation and the pricing strategies of the mobile services.

Using mobile phones to conduct a survey has advantages and disadvantages. The disadvantages are the effect on sampling frame, respondent eligibility, and the length of the interview, the costs, the non-response rate and respondent behavior as well as raising some ethical concerns. While the advantages of mobile phone are making the person accessible at any time of the day, quick response, participant can be reached when they are on the move, the mobile phone are most ubiquity technology with the broadest demographic reach.

A simple comparison between mobile phone and landline phone gives several differences. The first difference is a mobile phone is considered as personal appliance. It is carried all the time and so the respondent may be usually anywhere, in almost any situation when he or she answers the mobile phone. On the other hand, the landline phone is considered for the whole household and is always kept in the same place.

Brick et al (1995) noted that population members owning a phone but not covered in list-assisted designs are likely different from those not owning a phone at all.

Thornberry and Massey (1978) found in their study that telephone ownership is higher for household heads who are widowed or married and living with spouse than for the never married, divorced or separated. They found also that telephone coverage increases with education and family income level increases, and the telephone coverage for people age 65 years or over are relatively complete regardless of income level. In general, they found that there are small differences in socio-demographic characteristics between households and persons with telephone coverage and those without telephone coverage, and health related characteristics of persons in non-telephone households are largely different from those of persons in telephone households. Davis and Khare (2005) found in their study that the rates of telephone coverage show substantial variation by geography,

demography, and socioeconomic factors. In particular, lack of telephone service is more common among households that contain young adults or persons with lower socioeconomic status. They found also that non-telephone status appears to be related to young adults 18-34 years old, and to the socioeconomic status of the household members (e.g., having low income, less than high school education, having no health insurance at all, or no private health insurance).

Vicente and Reis (2009), in their study, found that the interviews by mobile phone cannot substitute the traditional landline phone method of data collection because mobile phones suffer from different problems such as high non-response rate, low quality of mobile communication that can result in measurement errors, and high cost compared to landline phones calls.

Grande and Taylor (2010) described the structural changes in telephone coverage in Australia. They found that the mobile only households increased from 1.4% in 1999 to 8.7% in 2008, where 68.7% of South Australia households in 2008 had at least a mobile phone or landline telephone listed in White Pages. Vicente and Reis (2009) stated that in 2007 the percentage of mobile only households reached about 36% in Portugal which is the highest level in the 27 European countries (EU27), while the average of EU27 countries is 22%. Kuusela and Simpanen



(2002) explained that in Finland the structure of mobile phones changed, where the number of mobile phones in Finland is higher than the number of households because about 45% of households have more than one mobile phone, 99% of men and women aged from 20 to 40 have their own mobile phones. In Italy, there is a rapid decline of landline phone during the period 1997 to 2002, where the percentage decreased from 64.9% in 1997 to 20.7% in 2002, and it was found that 13.1% of households were mobile only.

Blumberg and Luke (2007a) showed that in 2006 the proportion of mobile only population was 11.8% of households in the United States and Kuusela, Callegro and Vahovar (2008) said that the proportion is about 52% for mobile only in Finland, and 17% in France were mobile only. In Israel, the result of changes in landline and mobile only during the period 1997 to 2007 indicates a decrease in landline ownership from 95% in 1997 to 84.3% in 2007 and this implies an increase in mobile phone population from 37.8% in 1997 to 89.7% in 2007.

Since the Arab countries are a part of the world, so the structural changes in telephone ownership in the Arab countries are similar to the changes that occurred in other countries. However, the changes that took place in the Arab countries are not similar to those in other countries. A study of Aly, (2010) related to modeling factors affecting the ownership of fixed phones and mobile phones in Egypt, explained that the structural

change of telephone coverage in July 2008, October 2008, January 2009, and April 2009 found that the proportion of households with mobile only increased from 16.6% in July 2008 to 18.5% , then to 23% and finally to 26.3% in October, January 2009 and April 2009 respectively. But the households with landline phone only has decreased from 18.2%to 11.6% in the same period. This gives an indication that some households replaced their landlines with mobile phones. The result of this study showed that the proportion of the households with both landline and mobile phone increased from 35.46% in July 2008 to 41% in April 2009. While about 29.8% of households had no phones in July 2008 but this decreased to about 21.1% in April 2009.

In Palestine the results of different Household Surveys on Information and Communications Technology, done by Palestinian Central Bureau of Statistics, indicated that in 2011, 44.0% of households in Palestine have a phone line compared to 47.5% in 2009. Also the result of the survey showed that 95.0% of households in Palestine have a mobile phone in 2011, compared to 92.4% in 2009, which means that the prevalence of mobile phone in Palestine increased similarly to the other countries in the world and the prevalence of landline phone decreased.

Coverage bias can occur if the samples are not representative of the population due to the methodology used. Coverage bias can be defined as the difference between the mean for the target population that's included in

the sampling frame and the mean for the whole target population. This can be analyzed as a product of the proportion excluded and the difference between the target population included in the sampling frame and those excluded and estimated from a sample.

Since errors might occur before the sampling selection stage, this type of errors is known as coverage errors. Groves (1989) defined a coverage error as a non-sampling error of non-observation due to the fact that a part of the target population is missing in the frame the sample is drawn from. The coverage error is a function of two factors:

- a- Proportion of the target population that's not in the sampling frame
- b- The difference in the values of those statistics for those in the frame against those not in the frame , this relationship can be expressed as follows :

$$Y_c = Y + \frac{N_{nc}}{N}(Y_c - Y_{nc})$$

Where

$Y_c$  = value of the statistics for those covered by the sampling  
frame

$Y$  = value of the statistics for the whole target population

$N_{nc}$  = number in the target population not covered by the  
frame

$N$  = total size of the target population

$Y_{nc}$  = value of the statistics for those not covered by the frame.

To determine the degree of coverage bias due to telephone ownership in a telephone survey Blumberg and Luke (2007b), and Anderson et al. (1998) specified two factors:

- a- The percentage of persons without landline phone telephone in the population of interest.
- b- The magnitude of the difference between persons without landline phone and persons with landline phone for the variable of interest.

To explain the components of coverage bias in telephone survey, several studies discussed this issue. Thornberry and Massey (1988) in their study explained that exclusion of non-telephone households is a source of bias in telephone survey, where in economically advanced societies the percentage of adults living in households without telephone connection is very low. This is considered the first component of coverage bias. While Fuchs (2009) and Fuchs and Busse (2009) in their studies showed that the second component of coverage bias of landline telephone samples resulting from the mobile only population, gives an indication that there is a significant threat of representativeness of traditional landline telephone

survey. Also mobile only population is different from general population that leads to coverage bias when using landline phone only samples for telephone survey. Fuchs and Busse (2009) also found that in many European countries the mobile only population is not the only source of coverage bias in telephone survey, but coverage bias may be caused by a large proportion without any telephone service.

Christian et al. (2010) found that the coverage problem in landline surveys is mostly caused by the mobile-only households. This is due to people who own both mobile and landline phones but depend on mobile phone in communication.

Steeh, and Piekarski (2008) concluded that individuals and households that have mobile phones only have the potential to introduce bias to telephone surveys limited to a frame of landline numbers. Kim and Lepkowski (2002), indicated that since 1990's in the USA, non-coverage rates in landline telephone surveys have been increasing as a result of using mobile only, and the same result was noticed in Europe (Fuchs,2009 ; Kuusela et al. , 2002).

Gordoni et al., (2010), tested the effects of coverage error caused by using a landline telephone directory sampling list in a telephone survey in Israel. They took a random sample of 6405 individuals, aged 19 years or older, who was drawn from the Central population register. They used chi-

squared test for comparing the population with and without landline phone, and for comparing landline and mobile only telephone populations. They found there is a significant difference regarding age, and this significance is evident in age groups 30 – 40. Also there is a significant difference concerning immigrant status and for socio-demographic cluster. The significance is evident in the middle-lower cluster and in the highest cluster, also they used chi-squared test for comparison of landline and mobile only telephone populations. They found there is a significant difference in percentage points between estimates from the mobile only and registered landline phone for gender, age, immigrant status, and socio-economic cluster, where the significance regarding age is evident in age groups 19-29. They used a logistic regression for landline phone status. They concluded that the probability of landline phone ownership is affected by age, immigration status and the socio-economic status of place of residence. Individuals aged 60 -69 are more likely to own landline phone than individuals aged 45-59.

Callegaro and Poggio,(2004), used Italy as a case study. They found that the probability of not having a landline connection depends on the geographic region and social stratum. Furthermore, they found that the probability falling into one of the four possible categories of phone arrangement does vary by household type, socioeconomic characteristics,

educational level and age of the reference person (RP) of the household, as well as geographic location, where the categories which are considered for the study are (1) no-phone households, (2) landline-phone-only households, (3) households with landline and mobile phones, and (4) households with mobile phones only (MPO).

Grande and Taylor, (2010), in their study which is related to health information in Australia, found that the highest proportion of mobile phone households was among young people, unemployed, people who are separated, divorced or never married, low income households, low socio-economic status areas (SES), rural areas, current smokers, current asthma or people in the normal weight range, while the proportion of mobile phone or landline telephone listed in the White Pages telephone directory was the highest among older people, married or in defacto relationship or widowed, low SES areas, rural areas.

Fumagalli and Sala, (2010), studied the telephone coverage errors in Italian Polls. They found that in the 2006 general elections, 27% of the people residing in Italy are excluded from the sampling frame. They found that the respondents included in the sampling frame have different political behaviors from those excluded. Also, they found that coverage errors may be one reason that causes the poor performance of the polls.

Liu et al., (2011), compared between two different methods of telephone survey for surveys of young Australian women aged from 18 to 39 years. They found that there were no significant differences between mobile phone and landline phone respondents with respect to education, residence. Mobile only women were less likely to live at home with their parents.

Strauts, (2010), conducted a study for prediction of mobile phone versus landline phone. The researcher used logistic regression and concluded that younger people were more likely to use mobile only than landline only. The results of this study indicate that lower family income was strongly used landline than mobile especially if landline is present. Moreover, this study explained that there is an effect of family type on having a mobile phone. This study explained that if a family having greater ties such having a child in the home the family not being a mobile phone, owing one's home instead of renting lead towards landline only.

Vicente et al., (2009), compared between mobile surveys and landline telephone survey. They obtained data for adults ( age  $\geq 15$  years ). Their results showed that there is a significant difference between mobile phone and landline phone respondents in terms of demographic characteristics except for gender. It was found that mobile phone respondents are people aged 25 – 44, having a university degree or a



secondary level of education, employed, and single, but landline phone respondents are people aged 55 or over, with no formal education, smaller households, and widow.

Vicente and Reis, (2009), studied the impact of mobile-only in dual frame telephone survey. In their study, they studied to what extent the absence of mobile only users from telephone surveys can create a bias. Logistic regression model was used for this study. They concluded that there was a significant effect found in age, where it was found that the youngest age group are highly depends on mobile phone. Also there was a significant effect found in professional status, and family life cycle. This means that age, professional status, and family life cycle are good predictors of having a mobile phone. In this study it was found that gender and geographic region of residence are not significant predictors of having a mobile phone.

Bernal and Silva, (2009), estimated landline telephone coverage effects on potential bias in epidemiological surveys. The result of their study showed that the proportion of adults living in homes without landline telephones was greater in rural areas. The number of adults without a home landline telephone was inversely proportional to the number of years of schooling.

Peytchev et al., (2008) studied coverage errors in telephone surveys they concluded that there is a significant difference between landline and mobile phone respondents by age, sex, census region, and ethnicity, also they found that mobile phone respondents are younger, more likely to be from Midwest and South census regions , and much more likely to be black.

Currihan et al. (2008) concluded in their study which is related to the impact of landline and mobile phone among young adults that those aged 18 to 24, that young adults who were primarily mobile phone users. Were more likely to be employed, live in their parents' home, and less likely to live in their own apartment or house.

In another study related to mobile-only substitution in the U.S, Ehlen and Ehlen, (2007), found that the substitution rate of landline telephone by mobile was higher among those younger than 30, and much lower among the 65 and older age group. In the same study, Ehlen and Ehlen (2007) also found that there is a significant differences due to demographic characteristics between mobile only households and households with landline phone.

Link et al., (2007 ), compared people in households with mobile phone only and people with both landline and mobile phones. They found that people in mobile-only households were more likely to be aged 18-34

years, single or never married, Hispanic, students, and out of work. Also, they found there is significant differences between mobile only households and landline households. These differences are evident in demographic variables and in those that correlate with age such as health condition and risk behavior.

In their study on coverage bias in traditional telephone surveys of low income and young adults, Blumberg and Luke, (2007b), explained that after the statistical adjustments that account for demographic differences between adults living in households with and without landlines, telephone surveys of landlines will underestimate the prevalence of health-related behaviors such as HIV testing and physical education , while obesity may be overestimated for low income young adults.

Blumberg et al., (2007b), concluded that the degree of non-coverage bias could be determined by the magnitude of the difference between adults with and without landline phones and by the percentage of adults without landline phones in the population.

Blumberg et al., (2006), compared the odds of behavioral risk factors and health care services for adults with landline telephones to those for adults with only mobile phones and adults without any telephone service. They concluded that compared to adults with landline telephones, adults without landline telephones had greater odds of smoking and being uninsured, and they had lower odds of having diabetes, having a usual

place for medical care, and having received an influenza vaccination in the past year.

Keeter, (2005), studied the effect of a mobile phone non- coverage bias on Polling in the 2004 Presidential Elections in the U.S. The study explained that voters with mobile only households differ in demographic characteristics from voters with landline phone in that, they are younger, more likely to be unmarried, less likely to have children, and they are significantly more likely to be renters. Also, the study explained that about 20% of voters with mobile only were under the age of 30.

Vehovar et al. (2004) studied the mobile phone survey, where Slovenia was a case study. They made comparisons between respondents of mobile phone surveys and respondents of landline phone surveys they found that respondents of mobile phone survey tend to be younger, and more educated.

Gordoni et al. (2010); Blumberg and Luke, (2007b), suggested that in order to decrease the coverage bias in traditional telephone surveys sample weighting procedures for demographic characteristics should be used.

El-kasabi et al., (2007), used two methods to reduce the coverage bias in telephone surveys in Egypt. They used Simple Post-Stratification method (SPS) which is suggested by Massey and Thornberry (1978), and

Modified Post-Stratification method (MPS). They found that the MPS methods give better results than SPS method does.

Davis and Khare (2005) used three methods of weighting adjustment. One method is simple post-stratification by age, gender, race-ethnicity within 32 demographic cells. They found Adjustments based on interruption in telephone service seem to reduce non-coverage bias, especially for those variables that are highly correlated with the presence or absence of telephone service (e.g. lower socioeconomic status).

Duncan and Stansy, (2001), used propensity scores to control coverage bias in telephone surveys, they develops a weighting adjustment for transients (households move in and out of the telephone population during the year as a result of economic status or relocation), to reduce the bias due to non-coverage while controlling the increase in variance due to the weighting. They used logistic regression model to describe each household propensity for transients. In this study they found that the Variance Inflation Factor(VIF) for propensity adjustment (PROP) scheme are close to one which give an indication that PROP weight adjustment not increase the variance of the estimate. The VIF can be written as

$$\text{VIF} = 1 + [\text{CV}(\text{weights})]^2$$

where CV(weights) is the coefficient of variation of the weights. Also in this study they found that PROP, provided a reduction in bias. They found

that this adjustment allows to account for differences in the likelihood of having telephone service without using outside data.

Hogglin and Battaglia, (1996), explained in their study which is related to a comparison between two methods of adjusting for non-coverage of non-telephone household in telephone surveys that the variables used in simple post stratification method are not enough reducing bias from non-coverage of non-telephone household. Also this study explained that dividing each post-stratification cell into up-to-date and out-to-date sub-cells, modified post-stratification make a large adjustment in Immunization Action Plan (IAP) areas in U.S.

Cobben and Bethlehem (2005), found in their study that the best adjustment technique to adjust for under-coverage is propensity score stratification with 25 strata. But an average relative difference of 0.017 still remains, the variable that contribute most to the difference is Religion. Also, they found that The best adjustment technique to reduce the bias caused by telephone interviewing for under-coverage, appears to be a combination of linear weighting in which the true inclusion probabilities are estimated by means of logit model for listed number propensity scores. Then the average relative difference reduces to 0.016. The variables that display the largest deviation after adjustment are Educational level and Employment.

To reduce the coverage bias in health characteristics between telephone and non-telephone persons, Thornberry and Massey, 1978, used a post-stratification method as a method of weighting and they selected income, region and colors as the factors which are more affected, but they found that the ratio adjustments don't always produce better estimates for the health characteristics, because it is possible that not all health characteristic variations can be explained by the selected factors.

## **Chapter three**

# **Research Methodology**



## **Research Methodology**

This chapter contains a description of the methods and procedures used in identifying the target population, sampling frame and study sample description, instrument of a study, methods of data collection, practical procedures used in the study. Also, this chapter defines statistical variables and statistical processing.

### **3.1 Sampling and Sampling Frame**

#### **3.1.1 Target population:**

The target population of this study consists of the Palestinian households that usually reside in Palestine. The target population focuses on individuals aged 15 years and over during the year of 2011.

#### **3.1.2 Sample Frame:**

The sampling frame consists of enumeration areas adopted in the Population, Housing and Establishment census 2007. Each enumeration area consists of buildings and housing units containing about 120 housing units, which are used as a primary sampling units (PSUs) in the first stage of sample selection. In the second stage of sample selection, the sampling frame consists of a list of households that reside in the selected enumeration area.

### **3.1.3 Spatial and Temporal Limitations of the Study:**

This study is limited to the households in Palestine during the period of PBCS Household Survey on Communication and Information Technology 2011.

### **3.1.4 Sample Study:**

The sample size for the Information and Communications Households survey 2011 was 4448 households of which 3048 households in the West Bank and 1400 in the Gaza Strip.

### **3.1.5 Sample Strata:**

The sample strata have been designed on two levels.

- a- First level: The governorate (16 governorates).
- b- Second level: Type of locality (urban, rural, and refugee camps).

### **3.1.6 Sample Design:**

The sample is a stratified cluster systematic random sample with three stages:

First stage: A stratified systematic random sample of 289 enumeration areas was selected.

Second stage: A systematic random sample of 16 households from each enumeration area selected in the first stage.

Third stage: Selection in the field of one individual aged 15 years and over from the selected household. The KISH table was used to select individuals to insure random selection.

### **3.1.7 Instrument of Study:**

The researcher will use, for this study, the data collected by the survey conducted by The Palestinian Central Bureau of statistics (PCBS) Communication and Information Technology survey 2011, where the researcher depends on the question related to the "number of landline phones available in the household" and the question of "number of mobile phones available in the household". In order to check the penetration of landline phones and mobile phones during the period 2000- 2011, the researcher will also use the result of The Palestinian Central Bureau of statistics,2009: "The Level of Diffusion of Information and Communications Technology in the Palestinian Territory 1997-2007", and the result of The Palestinian Central Bureau of statistics,2006: "Household Survey on Information and Communications Technology, 2006".

### **3.1.8 Method of data collection:**

The data which will be used in this study were gathered by surveys conducted by The Palestinian Central Bureau of statistics in 2011: Information and Communication Technology Household Survey, 2011, and the Labor force survey round 62 third quarter 2011.

### 3.2 Study variables:

The variables in this study can be classified into two types:

**Dependent variable:** The dependent variables can be classified into two categories according to telephone status:

- 1) Landline phone ownership. This is a dummy variable coded 1 for (with landline phone) and 0 for (without landline phone).
- 2) Mobile phone ownership. This is a dummy variable coded 1 for (with mobile phone) and 0 for (without mobile phone).

**Independent variables:** The independent variables include

- 1- Gender (male, female ). This is a dummy variable coded 1 for (male) and 2 for (female).
- 2- Age. The variable was recorded into age categories, the categories are less than 15, 15 – 25, 26 – 35, 36 – 45, 46 – 55, 56 – 65, more than 65.
- 3- Educational achievement (Elementary and less, Preparatory, Secondary, Associate Diploma, BA/BSC, Higher Education).
- 4- Work Place ( West Bank, Gaza Strip, Israel Settlements, Others).
- 5- Locality type (Urban, Rural, Camp ).
- 6- Marital status (Never Married, Engaged, Married, Divorced, Widowed, Separated).
- 7- Refugee status (Registered refugee, Unregistered refugee, Not refugee).

- 8- Currently attending school (Currently attending, Attended and left, Attended and graduate, Never attended).
- 9- Employment status (Employer, Self employed, Wage employed, Unpaid family members).
- 10- Industry group (Agriculture, Manufacturing, Construction, Commerce – Hotel, Transport-Storage, Other).
- 11- Occupation (Legislators, Senior official and Managers; Professional, Technical Associate and Clerks; Service, Shop and Market Workers; Skilled Agricultural & Fishery Workers; Plant and Machine Operators and Assemblers; Elementary Occupations).
- 12- Labor Force Status (Employment, Unemployed).
- 13- Years of Schooling (Less than 6 years; 6 – 12 years; 13 – 16; More than 16 years).
- 14- Relationship to Head of Household (Head, Spouse, Son\Daughter, Others).

### **3.3 Statistical processing:**

Data analysis was conducted using SPSS for windows. The p-value of 0.05 was used as the criterion for statistical significance. The descriptive statistics will be used to explain the distribution of study sample according to different levels of the independent variables. Frequency tables will be used for this purpose.

The researcher will discuss the change of telephone coverage in Palestine by discussing the structure of telephone coverage in different years.

To answer the first research question the researcher depends on the results of the different surveys done by the Palestinian Central Bureau of statistics like "Computer, Internet and Mobile Phone Survey-2004", "Households Survey on Information and Communications Technology, 2006", "ICT Access Among Households and Individuals, 2007-2009", and "Comparative Report on ICT Access of Households and Individuals, in the Palestinian Territory 2000-2009", for descriptive statistics by graphing a table to make a summary of the changes in prevalence of landline phone and mobile phone ownership during the period 2000 to 2011. This table gives an indication of the shift in prevalence of the landline phone and mobile phone.

To estimate the coverage properties of sampling frame, the researcher computes the percentage distribution of the sample by age, gender, Educational achievement, Locality type, Geographic region, Marital status, Refugee status, Currently attending school, Employment status, Industry group, Labor Force Status. These distributions are computed for the total sample and for the sub-samples of individuals with and without landline phone, then the coverage error estimate is computed as the difference between the percent distribution of the percent for the total sample and those with landline phone. Also, these distributions computed for the total sample and for the sub-samples of individuals with and without mobile phone, and then the coverage error estimate is computed as the difference between the percent distribution of the percent for the total sample and for those with mobile phone.

To estimate the coverage properties of the sampling frame, the researcher computes three percentages; the percentage of mobile phone only, the percentage of landline phone only and the percentage of mobile or landline, depending on the same variables used before for the sub-samples. The estimate coverage error in this case is defined as the difference between the percent distribution of landline phone and the percent distribution of landline or mobile phone. Because the variables in this study are nominal variables, chi-squared test is used to test if there is a significant difference found for demographic variables.

The first hypothesis for this study tries to answer if there is a significant difference for those with landline phone and those without landline phone depending on demographic characteristics, and the second hypothesis for this study tries to answer if there is a significant difference for landline phone and mobile phone only depending on the demographic characteristics. To test these two hypotheses, logistic regression can be used also because the dependent variables used in this study are classified as binary variables. The dependent variables in each case represented as dummy variables where for the first hypothesis the researcher coded 1 for who have a landline phone and 0 for those without landline phone, but for the second hypothesis coded as 1 for who have a mobile phone only and 0 for others. Using logistic regression model helps to study the variables that the probability of landline phone and mobile phone ownership may be affected by. From the logistic model, the odds ratio can be calculated for each variables level.

The researcher used a multinomial logistic regression for modeling factors affecting the ownership of landline and mobile phones in Palestine. In order to apply multinomial logistic regression the researcher used four categories. The first category for ownership of landline phone, the second category for ownership of mobile phone, the third category for ownership of landline and mobile phone, and the final category for owning neither landline nor mobile phone. For multinomial logistic regression model the researcher use owning neither landline or mobile phone as a reference category.

### **3.4: Logistic Regression Models :**

Suppose there is a single explanatory variable  $X$  which is quantitative, for a binary response variable  $y$ , let  $\pi(x)$  denote the success probability at value  $x$ . This probability is the parameter for the binomial distribution. The logistic regression model has a linear form for the logit of this probability

$$\text{logit } \{\pi(x)\} = \log \left( \frac{\pi(x)}{1 - \pi(x)} \right) = \alpha + \beta x$$

The logistic regression formula implies the following formula for the probability  $\pi(x)$ , using the exponential function

$$\pi(x) = \frac{\exp(\alpha + \beta x)}{1 + \exp(\alpha + \beta x)}$$

For more than one independent variable the formula is



$$\pi(x) = \frac{\exp(\alpha + \beta_1 x_1 + \beta_2 x_2 + \dots)}{1 + \exp(\alpha + \beta_1 x_1 + \beta_2 x_2 + \dots)}$$

Generally, logistic regression is well suited for describing and testing hypotheses about relationships between a categorical outcome variable and one or more categorical or continuous predictor variables.

**Interpreting the results of logistic regression:**

The logistic coefficient( $\beta$ ) is the expected amount of change in the logit for each unit change in the predictor, the EXP( $\beta$ ) is the odds ratio associated with each predictor, the predictor which don't have an effect on the logit will display an EXP( $\beta$ ) = 1.0, the predictor which decreases the logit will have the value of EXP( $\beta$ ) < 1.0, and finally the predictor which increases the logit will have the value of EXP( $\beta$ ) > 1.0, to explain the idea let  $\beta = 1.5$  then EXP(1.5) = 4.48 which means that when the independent variable increases by one unit, the odds that the case can be predicted increase by a factor of around 4.5 times, when other variables are controlled. The result of the Wald Test appears in the result give the importance of the contribution of each variable in the model. The higher value the more important it is.

**3.5: Multinomial Logistic Regression:**

The generalized linear modeling technique of multinomial logistic regression can be used to model unordered categorical response variables. This model can be understood as a simple extension of logistic regression that allows each category of an unordered response variable to be compared to an arbitrary

reference category providing a number of logit regression models. A binary logistic regression model compares one dichotomy (for example, passed-failed, died-survived, etc.) whereas the multinomial logistic regression model compares a number of dichotomies. For example, one can classify workers as working full-time, working half-time, retired, unemployed, and not in the labor force. This procedure outputs a number of logistic regression models that make specific comparisons of the response categories. When there are  $j$  categories of the response variable, the model consists of  $j-1$  logit equations which are fit simultaneously. Multinomial logistic regression is a technique that basically fits multiple logistic regressions on a multi-category unordered response variable that has been dummy coded. Multinomial logistic regression allows each category of an unordered response variable to be compared to a reference category, providing a number of logistic regression models.

In a logistic regression equation, the expected probabilities depend in nonlinear ways on the set of  $K$  independent variables that predict them. The relationship is given by a multivariate logistic distribution function:

$$P_{ij} = \frac{\exp(\alpha + \sum \beta_{kj} X_{kji})}{\sum_{j=1}^J \exp(\alpha + \sum \beta_{kj} X_{kji})}$$

where

$p_{ij}$  = the probability that the  $i^{\text{th}}$  case is in the  $j^{\text{th}}$  category of the dependent variable.

The triple subscripts indicate the  $i^{\text{th}}$  observation on the  $k^{\text{th}}$  predictor variable in the logistic equation for the  $j^{\text{th}}$  category the multicategory dependent variable.

In this study using, logistic regression helps to know the factors that affect the probability of landline phone ownership.

As described previously, bias can be caused as a result of several sources. To reduce the bias, the data can be adjusted for. Weighting adjustment techniques are used to improve the accuracy of the survey estimates. Weighting adjustment methods include several methods such as simple post stratification method, modified post stratification method, and propensity score adjustment. A brief description of these weighting methods is given below.

### **3.6: Simple Post-Stratification method (SPS):**

Thornberry & Massey (1978), suggested this method. This method is used to reduce the bias caused by non-coverage. This method depends on the selection of variables based on the characteristics of the population which are considered to be important (such as demographic, socio-economic and social status) which are related to the ownership of landline phone. These variables are used to classify the population into number of classes, where the proportion of each households that have a landline phone is calculated, and the reciprocal of this proportion is known as the relative weight for each class. This method gives a less weight to those in over-represented groups and more weights to under-represented groups.

Post-stratification assigns identical adjustment weights to all elements in the same stratum. In order to calculate post-stratification weights, a reference data set is needed with which the sample data can be compared, for this study the

researcher will use "Household Culture Survey, 2009", which is conducted by PCBS, Palestine.

**3.7: Modified Post-Stratification method (MPS):**

Ferrano & Brick (2001), suggested this method, which is a modified version of SPS method. In this method the selection of variables which are related to landline phone ownership depends on a Logistic Regression model, where the dependent variable of this model is the ownership of landline phone, while the independent variables are the properties of the households, such as age of household head, marital status of household head, region, educational level of household head.

The difference between SPS and MPS as a methods of weighting appear in the implementation mechanism. In SPS method previous studies used to identify control variables that are correlated to having landline ownership in order to calculate weights. So, the general idea behind SPS is to select variables that are related to unit non-response and/or non-coverage and are correlated with the key subject matter variables. SPS requires population control totals that correspond to the variables collected in the survey questions. In SPS the sample split into set of cells by using variables related to a unit non-response and/ or non-coverage and are associated to the key subject matter variables. While in MPS method, the data split into two parts, one part known as an *estimation population* and the other part known as an *application population*. Logistic regression model apply in the data of an *estimation population* in order to specify the variables affected on landline

phone ownership. The probability of owning a landline phone for each household is calculated depending on the logistic regression model obtained.

The two methods used to reduce coverage bias, but it is found that MPS method reduce coverage bias more than SPS method.

In this study the researcher will use SPS and MPS methods of weighting to reduce the non-coverage bias in telephone surveys in Palestine and make a comparison between these two methods.

In order to identify the feasibility of data processing survey by using these two methods, SPS and MPS, which depend on relative weights to reduce the non coverage bias in telephone survey. SPS method depends on a limited number of variables related to landline phone ownership in Palestine. Those variables are usually taken from previous studies on coverage bias errors in telephone surveys. As far as the researcher knows, there were no such studies in Palestine. The researcher depends on the data collected by the Palestinian Central Bureau of Statistics, related to "Household Culture Survey 2009", as reference data to determine the factors affecting owning a landline phone in Palestine. In order to specify the factors affecting ownership of landline phone depending on the reference data, the researcher applies logistic regression model. From the factors found to be significant, the researcher selects three significant ones. These factors are educational achievement with five categories (elementary and less, preparatory, secondary, diploma, and BA\BSC or higher education), region with two categories (West Bank, Gaza Strip), and locality type with three

categories(urban, rural, camps). Using these factors, we have  $5*2*3 = 30$  classes, and the relative weights are calculated for each class.

This study will use the ICT, 2011, data which is collected by PCBS, where the researcher splits this data into two equal groups. By this splitting, we have two population studies. One of these two populations is used to calculate the relative weights for the treatment bias resulting from non-coverage in telephone surveys and this is called an *estimate population*. The other population, which is used to apply the weights, is called an *application population*. The equation that describes the value of one adjusted variable using SPS method, used in the treatment of indicators calculated from the data which are limited to households owning a landline phone in *application population*, is defined as follows

$$y_{p2} = \sum_{h=1}^{30} \frac{N'_{hp1}}{N'_{ht1}} \times y_{ht2} = \sum_{h=1}^{30} \frac{1}{P_{ht1}} \times y_{ht2} = \sum_{h=1}^{30} w_{h1} \times y_{ht2}$$

Where

$y_{p2}$  : adjusted variable using SPS method,

$y_{ht2}$  : number of households with a landline in class h in an *application population*.

$N'_{ht1}$  : number of households with a landline in class h in an *estimate population*.

$N'_{hp1}$  : number of households in class h ( with and without landline phone ) in an *estimate population*.

$P_{ht1}$  : proportion of households with landline phone in class h in an *estimate population*.

$w_{hl} = \frac{1}{P_{htl}}$  : calculated relative weights in class h in an *estimate population*, these

weights used to treat the household data with landline phone in an *application population*.

30 : number of classes used in this study, where this number depend on the number of the selected factors also, depends on number of categories for each factors.

As previously mentioned, in order to use MPS method, the researcher will use the logistic regression model for the data of an *estimate population* by using *forward stepwise* in the application of logistic model. The final logistic model consists of the factors affecting ownership of landline phone depending on the data of an estimate population. The probability of owning a landline phone for each household is calculated depending on the logistic regression model obtained. The estimated probability calculated is divided into five groups by using *Cluster Analysis*, and then the proportion of owning a landline phone in each group is calculated. Thus, the relative weights are the inversion of this proportion.

In order to study the effect of reweighting on reducing non- coverage bias, the researcher will use variables which give a significant difference in coverage error between individuals with landline phones and the total sample (with and without landline phone). Those variables are: *marital status, attending to school, educational achievement, occupation, and year of schooling*.

SPS and MPS are to be employed to treat the statistical indicators (means and percentages), through data that are limited to households that own a landline. Such treatment indicators are going to be compared to other two groups of

indicators; the first group will include the untreated indicators at the household having landline, whereas the second group represents the indicators of the whole population of the study (all households surveyed in ICT 2011) whether having a landline or not. This is to be done for the sake of measuring the level of improvement in the first group of indicators after processing them by applying the relative weights.

This study intends to identify the ability of the suggested relative weights to approach data indicators related to households with landlines compared to the indicators of the whole populations ( with and without landline phone).

Relative weights calculated by SPS and MPS methods are used in order to check whether these weights overcome the problem of non-coverage bias in telephone surveys or not. As stated before, the selected indicators for households with landline phone differ from those for the household without landline. The relative weights, which are calculated by the two methods, will be used to process the indicators for household with landline in the *application population*. After that, a comparison between the treated indicators by the two methods and untreated indicators will be made. This is to be done in order to specify the feasibility of using weights to reduce non- coverage bias in telephone survey.

Non-coverage is measured by calculating the *percent absolute bias*, defined by the following formula.

$$\text{percent absolute bias} = \frac{|\text{Bias of a Target Measure}|}{\text{Overall Population Actual Measure}} \times 100$$



Where Bias of a Target Measure is defined as

- \* For untreated indicators Bias = The value of the indicator for households with landline *minus* the corresponding value of the indicator in the total sample (with and without landline).
- \*\* For indicators treated by SPS method Bias = The value of the indicators treated by SPS method *minus* the corresponding value of the indicators in the total sample.
- \*\*\* For MPS treated method Bias = The value of the indicators treated by MPS method *minus* the corresponding value of the indicators in the total sample.

## **Chapter Four**

### **Statistical Analysis-Results and Discussion**

## Statistical Analysis-Results and Discussion

This chapter includes the statistical analysis the researcher used for this study to answer the research problem and test the hypotheses which are stated in chapter one of this study.

### **4.1 : Prevalence of landline and mobile phone in Palestine (2000-2011):**

In order to study the prevalence of landline phone and mobile phone in Palestine, the researcher depends on the results of the surveys which were done by Palestinian Central Bureau of Statistics (PCBS) during the period 2000 to 2011. The following table summarizes the results.

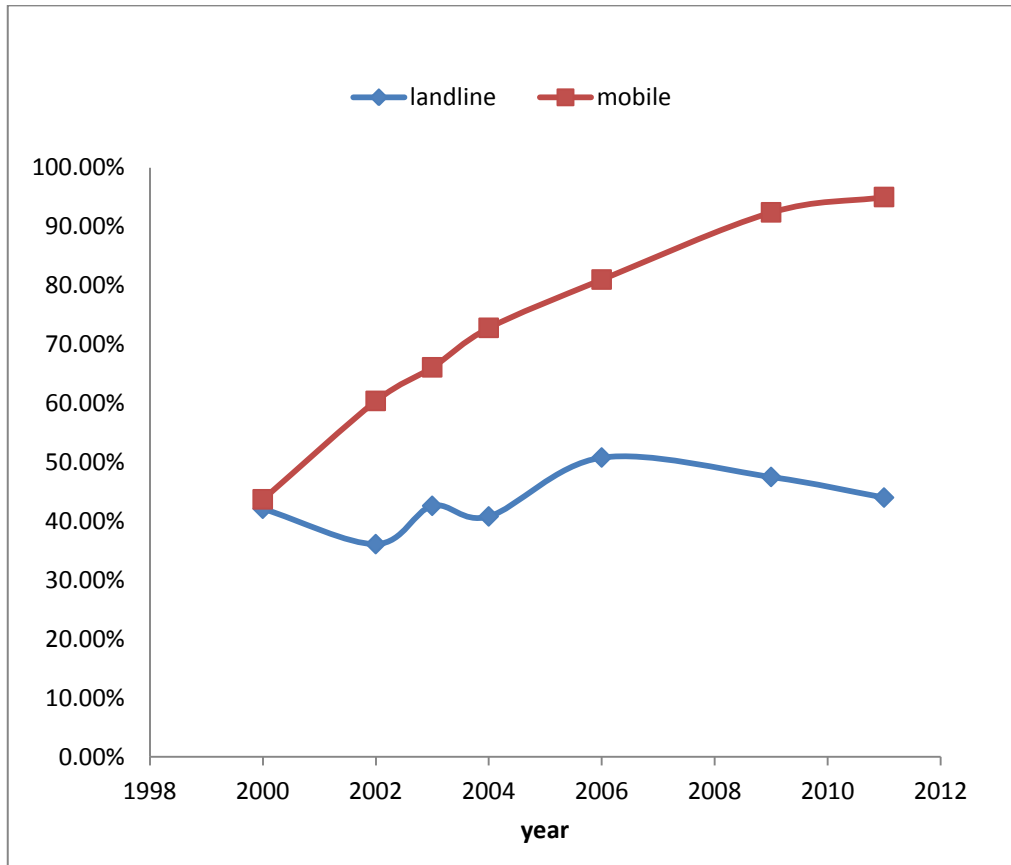
**Table (4.1) Phone ownership (%) in Palestinian territory 2000 – 2011**  
( selected years )

| <b>Year</b>           | <b>2000</b> | <b>2002</b> | <b>2003</b> | <b>2004</b> | <b>2006</b> | <b>2009</b> | <b>2011</b> |
|-----------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>Landline phone</b> | 42.1        | 36.1        | 42.6        | 40.8        | 50.8        | 47.5        | 44          |
| <b>Mobile phone</b>   | 43.7        | 60.4        | 66.1        | 72.8        | 81.0        | 92.4        | 95          |

Source : PCBS, 2007, ICT in the Palestinian Territory, PCBS ,2009 .ICT access among Households and individuals 2007 – 2009, PCBS, 2011. Household survey on information and communication Technology , 2011, Main Findings.

The following figure represent the prevalence for landline and mobile phone during the period 200-2011- selected years.

**Figure (4.1) Prevalence of landline and mobile phone – selected years**



Telephone surveys in Palestine face the same methodological problems which faced surveys in other developing countries. A comparison between the prevalence of landline and mobile phone, table (4.1) represents the changes in landline and mobile ownership in Palestine during the period 2000 to 2011, for selected years. It is clear from the table that there is a change in owning landline and mobile phone, which gives an implication for coverage bias in telephone surveys. By looking at the table, it is obvious that the proportion of landline ownership was 42.1% in 2000, but this proportion in 2002 decreased to 36.1% ,

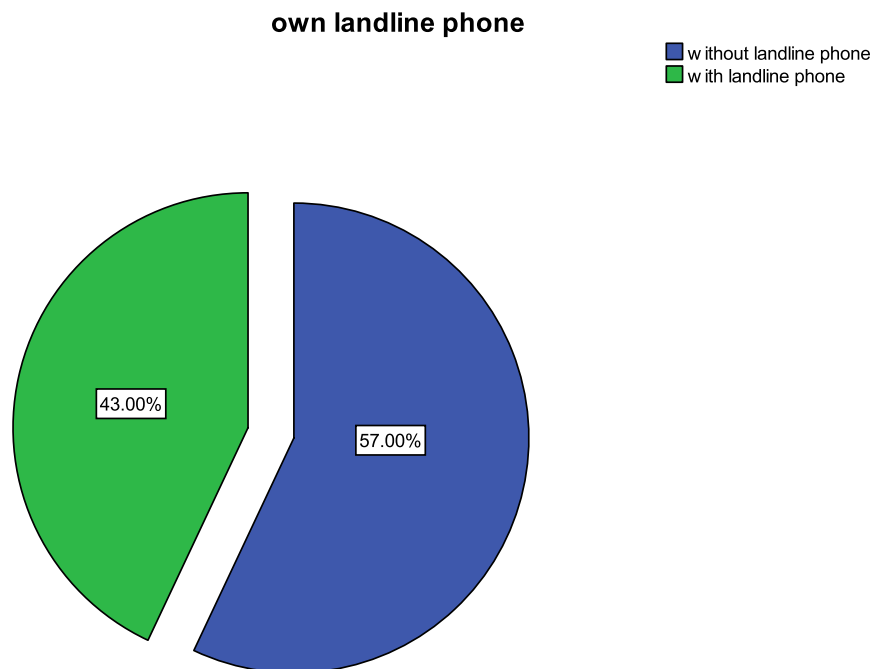
while in the same period, the proportion of mobile increase from 43.7% in 2000 to 60.4% in 2002. From the table, it clear that the increasing proportion of mobile phone ownership is larger during the period 2000 to 2011. This value reached nearly 51%, while the proportion increased for landline ownership during the same period by nearly 2%, which is a lot smaller by comparison to the rise of mobile phone. This rapid increase in mobile phone ownership from 43.7% in the year 2000 to 95% in the year of 2011, implies that the proportion of mobile only households has increased in the general population and may result in biased estimate of landline telephone surveys. But a slow increase or sometimes decrease in proportion of landline phone ownership, implies an increase of coverage error in telephone surveys based on landline telephone sampling frame.

The decline of landline phone coverage in Palestine constitutes a challenge in conducting telephone surveys, substitution of landline phone has potential implications for the representativeness of telephone surveys. With mobile phone substitution, however, the characteristics of the non landline phone population may change. Brick et al., 2007, suggested including of mobile phone numbers in telephone sampling frames as a solution to the problem of coverage bias.

#### **4.2: Comparison of population with and without landline phone:**

The structure of landline coverage in Palestine, 2011 displayed in the following figure.

**Figure (4.2) Structure of Landline phone Coverage in Palestine, 2011**



To test whether there is a significant difference between those covered by landline phone and those without a landline phone, chi-squared test was used for different characteristics, such as demographic characteristics. Table (4.2) summarizes the results of chi-squared test.

**Table (4.2) chi-squared test of association between having a landline phone and some demographic characteristics**

| Variable                              | Chi-square value | df | P-value   |
|---------------------------------------|------------------|----|-----------|
| Gender                                | 0.016            | 1  | 0.9       |
| Age categories                        | 52.557           | 6  | 0.000 *** |
| Marital status                        | 5.935            | 2  | 0.051     |
| Locality Type                         | 12.329           | 2  | 0.002 **  |
| Employment Status                     | 19.393           | 3  | 0.000 *** |
| Industry group                        | 64.641           | 5  | 0.000 *** |
| Currently attending school            | 107.155          | 3  | 0.000 *** |
| Labor Force Status                    | 10.266           | 1  | 0.001 **  |
| Refugee Status                        | 2.446            | 2  | 0.294     |
| Educational achievement               | 220.026          | 5  | 0.000 *** |
| Work Place                            | 14.714           | 3  | 0.002 **  |
| Occupation                            | 173.31           | 6  | 0.000 *** |
| Years of Schooling                    | 203.929          | 3  | 0.000 *** |
| Relationship to the Head of Household | 8.779            | 3  | .032 *    |

\* significance at  $\alpha=0.05$  ( $p<0.05$ ), \*\* significant at  $\alpha=0.01$  ( $p<0.01$ ), \*\*\* significant at  $\alpha=0.001$  ( $p<0.001$ )

It is clear from table (4.2) that there are statistically significant differences which were found among age group  $\chi^2_{(6)} = 52.557$ ,  $p < 0.001$ , locality type  $\chi^2_{(2)} = 12.329$ ,  $p < 0.01$ , employment status  $\chi^2_{(3)} = 19.393$ ,  $p < 0.001$ , industry group  $\chi^2_{(5)} = 64.641$ ,  $p < 0.001$ , currently attending school  $\chi^2_{(3)} = 107.155$ ,

$P < 0.001$ , labor force status  $\chi^2_{(1)} = 10.266$ ,  $p < 0.01$ , educational level

$\chi^2_{(5)} = 220.026$ ,  $p < 0.001$ , work place  $\chi^2_{(3)} = 14.714$ ,  $p < 0.01$ , occupation

$\chi^2_{(6)} = 173.31$ ,  $p < 0.001$ , years of schooling  $\chi^2_{(3)} = 203.929$ ,  $p < 0.001$ , and

relationship to the head of household  $\chi^2_{(3)} = 8.779$ ,  $p < 0.05$ . It is clear from the

table that there is no significant differences between those with landline and those

without landline found concerning gender since  $P\text{-value} = 0.9 > 0.05$ . Also, there

is no significant difference found for marital status where  $P\text{-value} = 0.051 > 0.05$ .

Finally, there is no significant difference found concerning refugee status,

$P\text{-value} = 0.294 > 0.05$ .

Estimation of coverage properties of a landline phone sampling frame in Palestine are presented in table (4.3). The sample included 57% individuals who had no landline phone and 43% of individuals who had one. The percent distribution of the sample computed by gender, age categories, marital status, locality type, employment status, industry group, attending to school, labor force status, refugee status, educational achievement, work place, occupation, years of schooling, and relationship to the head of household. In column 1 and 2, these distributions are computed for the sub-samples of individuals with and without landline phone. Coverage error estimate is computed as the difference between the percent distribution of column (2) with landline phone and column(3) total sample.



**Table (4.3) Descriptive statistics for sub-samples of person in households with and without landline phone and estimated coverage error based on landline phone list.**

|                                   | <b>Without<br/>landline phone<br/>(1)</b> | <b>With landline<br/>phone<br/>(2)</b> | <b>Total ample<br/>(3)</b> | <b>Coverage<br/>error (4)</b> |
|-----------------------------------|---|--|----------------------------|-------------------------------|
| <b>Sample size %</b>              | 2174<br>57%                               | 1640<br>43%                            | 3814                       |                               |
| <b>Gender</b>                     |   |  |                            |                               |
| Male                              | 48.6%                                     | 48.8%                                  | 48.7%                      | 0.10%                         |
| Female                            | 51.4%                                     | 51.2%                                  | 51.3%                      | -0.10%                        |
| <b>Age categories</b>             |   |  |                            |                               |
| Less than 15                      | 15.9%                                     | 14.1%                                  | 15.1%                      | -1.00%                        |
| 15-25                             | 20.0%                                     | 20.3%                                  | 20.1%                      | 0.20%                         |
| 26-35                             | 27.1%                                     | 20.2%                                  | 24.1%                      | -3.90%                        |
| 36-45                             | 17.9%                                     | 22.0%                                  | 19.7%                      | 2.30%                         |
| 46-55                             | 2.6%                                      | 3.2%                                   | 2.9%                       | 0.30%                         |
| 56-65                             | 7.5%                                      | 12.3%                                  | 9.6%                       | 2.70%                         |
| More than 65                      | 8.9%                                      | 8.0%                                   | 8.5%                       | -0.50%                        |
| <b>Marital status</b>             |   |  |                            |                               |
| Never Married                     | 27.6%                                     | 31.3%                                  | 29.2%                      | 2.10%                         |
| Ever Married                      | 65.1%                                     | 61.9%                                  | 63.7%                      | -1.80%                        |
| Others                            | 7.3%                                      | 6.8%                                   | 7.1%                       | -0.30% **                     |
| <b>Locality Type</b>              |   |  |                            |                               |
| Urban                             | 61.1%                                     | 66.2%                                  | 63.3%                      | 3.00%                         |
| Rural                             | 24.3%                                     | 20.0%                                  | 22.5%                      | -2.50%                        |
| camp                              | 14.5%                                     | 13.8%                                  | 14.2%                      | -0.40%                        |
| <b>Employment status</b>          |   |  |                            |                               |
| Employer                          | 3.6%                                      | 7.9%                                   | 5.4%                       | 2.50%                         |
| Self employed                     | 19.9%                                     | 17.5%                                  | 18.8%                      | -1.30%                        |
| Wage employed                     | 66.2%                                     | 67.8%                                  | 66.9%                      | 0.90%                         |
| Unpaid family members             | 10.4%                                     | 6.8%                                   | 8.8%                       | -2.00%                        |
| <b>Industry group</b>             |   |  |                            |                               |
| Agriculture                       | 7.8%                                      | 3.2%                                   | 5.8%                       | -2.60%                        |
| Manufacturing                     | 4.8%                                      | 4.3%                                   | 4.6%                       | -0.30%                        |
| Construction                      | 6.8%                                      | 3.5%                                   | 5.4%                       | -1.90%                        |
| Commerce-Hotels                   | 5.8%                                      | 7.3%                                   | 6.5%                       | 0.80%                         |
| Transport-Storage                 | 2.8%                                      | 2.1%                                   | 2.5%                       | -0.40%                        |
| Services                          | 72.0%                                     | 79.5%                                  | 75.3%                      | 4.20%                         |
| <b>Currently attending school</b> |   |  |                            |                               |
| Currently attending               | 23.5%                                     | 26.3%                                  | 24.7%                      | 1.60%                         |
| Attending and left                | 36.3%                                     | 25.6%                                  | 31.7%                      | -6.10% *                      |
| Attended and graduate             | 31.3%                                     | 43.9%                                  | 36.7%                      | 7.20% ***                     |
| Never attended                    | 8.9%                                      | 4.2%                                   | 6.9%                       | -2.70%                        |
| <b>Labor Force Status</b>         |   |  |                            |                               |
| Employment                        | 78.9%                                     | 85.3%                                  | 81.7%                      | 3.60%                         |
| Unemployed                        | 21.1%                                     | 14.7%                                  | 16.3%                      | -1.60%                        |

Follow table (4.3)

|   | Without<br>landline phone<br>(1) | With landline<br>phone<br>(2) | Total ample<br>(3) | Coverage<br>error (4) |
|---|----------------------------------|-------------------------------|--------------------|-----------------------|
| <b>Refugee Status</b>                                   |                                  |                               |                    |                       |
| Registered  | 38.8%                            | 41.2%                         | 39.8%              | 1.40%                 |
| Not Registered  | 0.4%                             | 0.3%                          | 0.4%               | -0.10%                |
| Not Refugee   | 60.8%                            | 58.5%                         | 59.8%              | -1.30%                |
| <b>Educational achievement</b>                          |                                  |                               |                    |                       |
| Elementary and less                                     | 45.6%                            | 30.2%                         | 39.0%              | -8.80% ***            |
| Preparatory   | 31.7%                            | 27.1%                         | 29.7%              | -2.60%                |
| Secondary   | 13.5%                            | 18.2%                         | 15.5%              | 2.70%                 |
| Associate Diploma                                       | 3.1%                             | 6.6%                          | 4.6%               | 2.00%                 |
| BA \ BSc  | 5.6%                             | 15.0%                         | 9.6%               | 5.40% *               |
| Higher Education  | 0.5%                             | 2.8%                          | 1.5%               | 1.30%                 |
| <b>Work Place</b>                                       |                                  |                               |                    |                       |
| West Bank   | 59.9%                            | 66.6%                         | 62.8%              | 3.80%                 |
| Gaza Strip  | 27.2%                            | 25.8%                         | 26.6%              | -0.80%                |
| Israel and<br>Settlements                               | 12.7%                            | 7.1%                          | 10.2%              | -3.10%                |
| Other   | 0.2%                             | 0.5%                          | 0.3%               | 0.20%                 |
| <b>Occupation</b>                                       |                                  |                               |                    |                       |
| Legislators, Senior<br>official and<br>Managers         | 0.7%                             | 3.0%                          | 1.7%               | 1.30%                 |
| Professionals,<br>Technical,<br>Associate and<br>Clerks | 4.8%                             | 15.3%                         | 9.3%               | 6.00% *               |
| Service, Shop and<br>Market Workers                     | 6.9%                             | 7.5%                          | 7.2%               | 0.30%                 |
| Skilled Agricultural<br>and Fishing<br>Workers          | 5.4%                             | 2.7%                          | 4.2%               | -1.50%                |
| Craft and Related<br>Trade Workers                      | 7.0%                             | 4.9%                          | 6.1%               | -1.20%                |
| Plant and Machine<br>Operators and<br>Assemblers        | 3.4%                             | 2.4%                          | 3.0%               | -0.60%                |
| Elementary<br>occupations                               | 71.8%                            | 64.1%                         | 68.5%              | -4.40% *              |
| <b>Years of Schooling</b>                               |                                  |                               |                    |                       |
| Less than 6 years                                       | 31.6%                            | 20.0%                         | 26.6%              | -6.60% *              |
| 6 – 12 years  | 54.8%                            | 49.1%                         | 52.4%              | -3.30%                |
| 13 – 16 years   | 12.5%                            | 25.1%                         | 17.9%              | 7.20% **              |
| More than 16 years                                      | 1.1%                             | 5.8%                          | 3.1%               | 2.70%                 |
| <b>Relationship to the Head of Household</b>            |                                  |                               |                    |                       |
| Head  | 37.8%                            | 33.8%                         | 36.1%              | -2.30%                |
| Spouse  | 28.6%                            | 28.4%                         | 28.5%              | -0.10%                |
| Son\Daughter  | 30.6%                            | 34.7%                         | 32.4%              | 2.30%                 |
| Others  | 3.0%                             | 3.1%                          | 3.1%               | 0.00%                 |

\* significance at  $\alpha=0.05$  ( $p<0.05$ ), \*\*significant at  $\alpha=0.01$  ( $p<0.01$ ), \*\*\* significant at  $\alpha=0.001$  ( $p<0.001$ )

To test whether the coverage error is significant or not, the following test was used

Hypotheses:

$$H_0 : p_1 = p_2 \quad \text{vs} \quad H_1 : p_1 \neq p_2$$

Test statistic

$$Z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\frac{\hat{p}_1(1 - \hat{p}_1)}{n_1} + \frac{\hat{p}_2(1 - \hat{p}_2)}{n_2}}}$$

Because  $n_1, n_2$  is very large, then

$$Z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}\hat{q} * \left( \frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

Where  $\hat{p}_1$  = proportion of a characteristic for the sub-sample of individuals having

landline phone.

$\hat{p} = \hat{p}_2$  = proportion of the same characteristic in the total sample.

$$\hat{q} = 1 - \hat{p}$$

$n_1$  = sub-sample size of individuals having landline phone.

$n_2$  = total sample size

From the results in table (4.3), it is clear for example, that among the individuals with landline phone, 15% have an educational achievement, BA\BSc, 49.1% having schooling years between 6 – 12 years, 48.8% of the individuals with landline phone are males, 66.6% of individuals with landline phone work in the West Bank, 33.8% of the individuals having a landline are a head of

household. In table (4.2) we specify the significance variables related to the association between having a landline and some demographic characteristics, while table (4.3) specify in which category of each variable the significant differences are evident. For example, in regard to educational achievement significant differences are evident in group educated elementary and less with coverage error -8.8%,  $p < 0.001$  and group education BA\BSc with coverage error 5.4%,  $p < 0.05$ . This means that people with landline phone are on average are more educated. For years of schooling, the significant differences are evident in category less than 6 years with coverage error -6.6% ,  $p < 0.05$ , and in category 13-16 years with coverage 7.2%,  $p < 0.01$ . The significant difference for currently attending school, are evident in category attending and left with coverage error -6.1%,  $p < 0.05$ , and in category attending and graduate with coverage 7.2%,  $p < 0.01$ . The significant differences for marital status are evident in others group (engaged, widowed, divorced) with coverage error -0.3%,  $p < 0.01$ . Finally, the significant differences for occupation are evident in Professionals, Technical, Associate and Clerks with coverage error 6%,  $p < 0.05$ , and Elementary occupations with coverage error -4.4%,  $p < 0.05$ . From table (4.3) there is no significant differences are evident in age category, gender category (male, female), locality type category (urban, rural, camp), employment status category, industry group category, labor force category (employment, unemployed), work place category, and category of relation to the head of household, which means for those variables coverage error are not significant in the categories of the variables. Also, table (4.3) shows that the coverage error

were under-estimation for some category. An example for this case, individuals having less than 6 years of schooling coverage error is -6.6%. Also, in some category coverage errors are considered to be over-estimation such as individuals having BA\BSc educational achievement coverage error equal to 5.4%. In general, a comprehensive overview of the table for column 4, finds some characteristics which have over-estimation and others have under-estimation.

The observed differences indicate the extent that coverage error might affect telephone survey results in Palestine. For example, the non-coverage rate 57% and the difference of 11.3% (36.3% - 25.6%) between the two samples in the rate of individuals who attending to school and left will result in a -6.1% coverage error in the corresponding estimate from a hypothetical survey based on telephone sampling frame.

Similar to studies of coverage error in other countries (Callegaro and Poggio 2004, Vicent and Rice 2009, Gordoni et al., 2010), this study indicates coverage bias in telephone surveys may also be present in Palestine. The difference between individuals who own landline and who do not in demographic characteristics indicate the possibility of bias in telephone surveys related to age, industry group, locality type, employment status, school attendance, labor force status, educational achievement, work place, occupation, years of schooling, and relation to household. Therefore the implication of using sampling frames of landline phone owners may lead to systematic under-representation of the individuals whose marital status are others, individuals with lowest educational level elementary and less, individuals attended school and left, individuals with

years of schooling less than six and of individuals with lowest level of occupation "elementary occupation". Since these variables affect diverse attitudes and behaviors, the exclusion of such groups cannot be ignored.

The results of this study indicates that the sampling frame of landline ownership may be systematically over-representative of the individuals having educational achievement BA\BSc, and those with 13-16 years of schooling. This means that people with landline phone are, on average, more educated than the total sample. Also, the results of this study point out that the proportion of Professionals, Technical, Associate and Clerks is higher in the sub-sample of individuals having a landline phone than in the total sample, the proportion of individuals having 13-16 years of schooling is higher in the sub-sample of individuals having a landline phone than in the total sample, and the proportion of individuals who attended to school and graduate is higher in the sub-sample of individuals having a landline phone than in the total sample.

Estimation from multivariate analyses for predicting the probability of landline phone ownership are presented in table (4.4).

**Table (4.4) Binary logistic regression for landline phone status**

| <b>Predictors</b>  | <b>Coefficient</b> | <b>S.E</b> | <b>Exp(B)</b> |
|--|--------------------|------------|---------------|
| <b>Gender</b> (reference : male)                                 | -0.631 *           | 0.273      | 0.532         |
| <b>Age</b> (reference: 36 - 45)                                  |                    |            |               |
| Less than 15   | -1.511 *           | 0.588      | 0.221         |
| 15-25  | -0.833 **          | 0.243      | 0.435         |
| 26 – 35  | -0.662 ***         | 0.152      | 0.516         |
| 46 - 55  | 0.380              | 0.389      | 1.462         |
| 56 – 65  | 0.443 *            | 0.193      | 1.557         |
| More than 65   | 0.067              | 0.410      | 1.069         |
| <b>Educational achievement</b> (reference : Elementary and less) |                    |            |               |
| Preparatory  | 0.311              | 0.165      | 1.365         |
| Secondary  | 0.891 ***          | 0.194      | 2.437         |
| Associate Diploma  | 1.109 ***          | 0.245      | 3.031         |
| BA \ BSC   | 1.728 ***          | 0.214      | 5.629         |
| Higher Education   | 2.261 ***          | 0.415      | 9.594         |
| <b>Relationship to the Head of Household</b> (reference :Head)   |                    |            |               |
| Spouse   | 1.050 **           | 0.312      | 2.858         |
| Son\Daughter   | 1.169 ***          | 0.220      | 3.217         |
| Others   | 1.936 **           | 0.570      | 6.928         |
| <b>Industry</b> (reference :Agriculture)                         |                    |            |               |
| Manufacturing  | 0.806 *            | 0.257      | 2.238         |
| Construction   | 0.319              | 0.269      | 1.376         |
| Commerce-Hotels  | 0.981 ***          | 0.234      | 2.668         |
| Transport-Storage  | .589               | .307       | 1.802         |
| Services   | 1.087 ***          | .248       | 2.966         |
| <b>Employment Status</b> (reference: Employer)                   |                    |            |               |
| Self employed  | -0.894 **          | 0.293      | 0.409         |
| Wage employed  | -1.21 ***          | 0.275      | 0.296         |
| Unpaid family members  | -1.025 **          | 0.368      | 0.359         |
| <b>Region</b> (reference :west Bank)                             | -0.289 *           | 0.139      | 0.749         |
| <b>Constant</b>  | -0.516             | 0.343      | 0.597         |

\* significance at  $\alpha=0.05$  ( $p<0.05$ ),\*\*significant at  $\alpha=0.01$  ( $p<0.01$ ),\*\*\* significant at  $\alpha=0.001$  ( $p<0.001$ )

Table (4.4) shows that the probability of landline phone ownership is affected by gender, age, educational achievement, relationship to the head of household, industry group, employment status, region. All those factors are significant.

From table (4.4), it is clear that individuals aged 56-65 years are more likely to own a landline than those aged 36-45. The results showed that there is a negative effect is evident for the 26-35 age group (odds ratio = 0.516 : 1), 15-25 age group (odds ratio = 0.435 : 1) and less than 15 age group (odds ratio = 0.221 : 1). This means that the chance of individuals aged 35 and less to own a landline phone is smaller than individuals aged 36-45 years. The result of this table give an indication that as individual become adults, the demand of owning landline increase approximately. On the contrary for youth individuals, the demand of owning landline decrease. This result is consistent with Gordoni, 2010, Thornberry and Massey, 1978, Grande and Taylor, 2010, Vicente, 2009. For educational achievement, individuals of higher education are nearly ten times to have a landline than those whose educational achievement is elementary and less, (odds ratio = 9.954 : 1). The individuals of BA\BSc educational level are more likely to have a landline than those whose educational level is elementary and less, (odds ratio = 5.629 : 1). There is no negative effect appearing in educational achievement. In general, in educational achievement all levels are more likely to have a landline than those whose educational level elementary and less. This gives an indication, as educational level of individual increases the demand of owning landline increases, which means there is a connection between telephone status and educational achievement in Palestine as well as other countries. Also, as for educational achievement, the individuals whose educational achievement is preparatory, secondary, and associate diploma are more likely to have a landline phone than those whose educational



achievement is elementary and less. In the industry group, the individuals in different categories for this factor are more likely to own a landline phone than for individuals who practiced a agricultural activity. The table shows that the highest odds ratio for this factor are concerned with the individuals in service field, where those individuals are nearly triple likely to have a landline phone than the individuals who practiced a agricultural activity (odds ratio = 2.966 : 1). According to the result of this table the demand of owning landline depend on the industrial activity that the individual practice. As for relation to the head of household, it is clear from the table that spouse, son\daughter, others are more likely to have a land line than head. As for gender, a negative effect is evident for female group, where women are less likely to have a landline phone than men, (odds ratio = 0.532 : 1), which means that demand of a landline are higher for male than female. For employment status, a negative effect is evident for all groups. For example, individuals of unpaid family members are less likely to have a landline than employer individuals,( odds ratio = 0.359 : 1), so self-employed and wage employed are less likely to have a landline phone than employer. This is give an indication that the demand of landline from individuals whose employment status are employer are higher than other cases of employment status. Finally, as for region, a negative evidence was found in the Gaza Strip. The individuals in the Gaza Strip are less likely to have a landline phone than those in the West Bank (odds ratio = 0.749 : 1), that is mean, the demand of landline in the West Bank are more than the demand of landline in the Gaza Strip. In logistic regression analysis, the classification table in the perfect model for this study

showed that 57.6% were correctly classified as household owning a landline and 76.8% for household owning no landline. Overall 68.4% were correctly classified. This is a considerable improvement on the 56% correct classification with the constant model, so we know that the model with predictors is significantly a better mode.

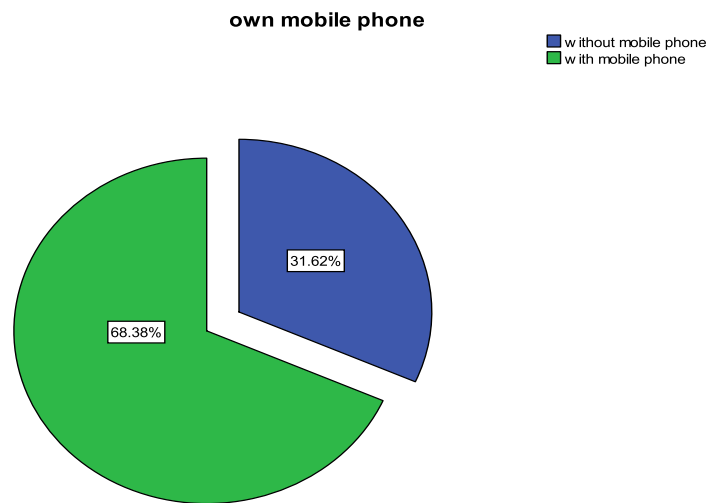
#### **4.3: Comparison of population with and without mobile phone:**

Using mobile phone for calling causes a loss of geographic information, while in the case of landline phone is given by prefix. For mobile phone prefixes are assigned nationwide and the only information that can be known is the type of phone usage (Jawwal, Wattaneya, etc ...).

An increase of the prevalence of mobile phone only will lead to non-negligible coverage bias in landline telephone surveys. It is evident that the number of mobile phone ownerships increased, while the number of landline phone coverage decrease.

The structure of mobile phone coverage in Palestine displayed in the following figure.

**Figure (4.3) Structure of mobile coverage in Palestine, 2011**



By looking at the structural changes in telephone coverage in Palestine, the results of different studies point out that the proportion of individuals with mobile phone increased, while proportion of landline phone decreased. These results in Palestine are consistent with the results in other countries (Aly 2010; Gordoni 2010; Grande and Taylor 2010; Kuusela and Simpanen 2002). These results underscore the importance of adding mobile-only individuals to landline sampling frame. The validity of mobile phone survey results is still questionable due to higher non-response and measurement bias than in landline telephone surveys (Blumberg and Luke 2007b; Vicente and Reis 2009). So to eliminate low quality of data due to the use of mixed mode (landline telephone and mobile telephone), the mobile-only population should be interviewed in a manner that will not lessen data quality. That is, generating a combined frame of landline phone and mobile-only phone will facilitate elimination of coverage bias only if the mobile-only

individuals can be reached by mobile and agree to be interviewed in a different way, such as a face-to-face interview.

To test whether there is a significant difference between those covered by mobile phone and those without mobile phone, chi-squared test was used for different characteristics, such as demographic characteristics. Table (4.5) summarizes the results of chi-squared test.

**Table (4.5) chi-squared test of association between having a mobile phone and some demographic characteristics**

| Variable                              | Chi-square value | df | P-value   |
|---------------------------------------|------------------|----|-----------|
| Gender                                | 205.73           | 1  | 0.000 *** |
| Age categories                        | 900.308          | 6  | 0.000 *** |
| Marital status                        | 286.591          | 2  | 0.000 *** |
| Locality Type                         | 2.617            | 2  | 0.270     |
| Employment Status                     | 136.153          | 3  | 0.000 *** |
| Industry group                        | 260.665          | 5  | 0.000 *** |
| Currently attending school            | 699.83           | 3  | 0.000 *** |
| Labor Force Status                    | 4.636            | 1  | 0.031 *   |
| Refugee Status                        | 2.678            | 1  | 0.262     |
| Educational achievement               | 569.403          | 5  | 0.000 *** |
| Work Place                            | 9.193            | 3  | 0.027 *   |
| Occupation                            | 517.085          | 6  | 0.000 *** |
| Years of Schooling                    | 545.814          | 3  | 0.000 *** |
| Relationship to the Head of Household | 299.228          | 3  | 0.000 *** |

\* significance at  $\alpha=0.05$  ( $p<0.05$ ), \*\* significant at  $\alpha=0.01$  ( $p<0.01$ ), \*\*\*significant at  $\alpha=0.001$  ( $p<0.001$ )

Table (4.5) shows that a significant difference was found for gender

$\chi^2_{(1)} = 205.73$ ,  $p < 0.001$ , age group  $\chi^2_{(6)} = 900.308$ ,  $p < 0.001$ , marital status

$\chi^2_{(2)} = 286.591$ ,  $p < 0.001$ , employment status  $\chi^2_{(3)} = 136.153$ ,  $p < 0.001$ ,  
 industry group  $\chi^2_{(5)} = 260.665$ ,  $p < 0.001$  currently attending school  
 $\chi^2_{(3)} = 699.83$ ,  $p < 0.001$ , labor force status  $\chi^2_{(1)} = 4.636$ ,  $p < 0.05$ ,  
 educational level  $\chi^2_{(5)} = 569.43$ ,  $p < 0.001$ , work place  $\chi^2_{(3)} = 9.193$ ,  
 $p < 0.05$ , occupation  $\chi^2_{(6)} = 299.22$ ,  $p < 0.001$ , years of schooling  
 $\chi^2_{(3)} = 545.814$ ,  $p < 0.001$ , and relationship to the head of household  
 $\chi^2_{(3)} = 299.228$ ,  $p < 0.05$ . It is clear from the table that there no significant  
 difference found between those with mobile phone and those without mobile  
 phone for locality type, P-value =  $0.270 > 0.05$ , and there is no significant  
 difference found for refugee status, P-value =  $0.262 > 0.05$ .

Estimation of coverage properties of a mobile phone sampling frame in  
 Palestine are presented in table (4.6). The sample included 31.6% individuals who  
 had no mobile phone and 68.4% of individuals who had one. The percent  
 distribution of the sample computed by gender, age, marital status, locality type,  
 employment status, industry group, attending school, labor force status, refugee  
 status, educational achievement, work place, occupation, years of schooling, and  
 relationship to the head of household. In column 1 and 2, these distributions are  
 computed for the sub-samples of individuals with and without mobile phone.  
 Coverage error estimate is computed as the difference between the percent  
 distribution of column (2) with mobile phone and column(3) total sample.

**Table (4.6) Descriptive statistics for sub-samples of person with and without mobile phone and estimated coverage error based on mobile phone list.**

|                          | <b>Without mobile phone (1)</b> | <b>With mobile phone (2)</b> | <b>Total sample (3)</b> | <b>Coverage error (4)</b> |
|--------------------------|---------------------------------|------------------------------|-------------------------|---------------------------|
| <b>Sample size %</b>     | 1206<br>31.6%                   | 2608<br>68.4%                | 3814                    |                           |
| <b>Gender</b>            |                                 |                              |                         |                           |
| Male                     | 31.6%                           | 56.6%                        | 48.7%                   | 7.90% ***                 |
| Female                   | 68.4%                           | 43.4%                        | 51.3%                   | -7.90% ***                |
| <b>Age categories</b>    |                                 |                              |                         |                           |
| Less than 15             | 36.5%                           | 5.30%                        | 15.10%                  | -9.80% ***                |
| 15-25                    | 14.9%                           | 22.50%                       | 20.10%                  | 2.40%                     |
| 26-35                    | 9.5%                            | 30.90%                       | 24.10%                  | 6.80% **                  |
| 36-45                    | 12.0%                           | 23.20%                       | 19.70%                  | 3.50%                     |
| 46-55                    | 3.7%                            | 5.00%                        | 2.90%                   | 2.10%                     |
| 56-65                    | 7.1%                            | 10.70%                       | 9.60%                   | 1.10%                     |
| More than 65             | 16.2%                           | 2.50%                        | 8.50%                   | -6.00% **                 |
| <b>Marital status</b>    |                                 |                              |                         |                           |
| Never Married            | 42.9%                           | 23.7%                        | 29.2%                   | -5.50% *                  |
| Ever Married             | 43.3%                           | 72.0%                        | 63.7%                   | 8.30% **                  |
| Others                   | 13.9%                           | 4.3%                         | 7.1%                    | -2.80%                    |
| <b>Locality Type</b>     |                                 |                              |                         |                           |
| Urban                    | 61.9%                           | 64.0%                        | 63.3%                   | 0.70%                     |
| Rural                    | 24.0%                           | 21.7%                        | 22.5%                   | -0.70%                    |
| camp                     | 14.0%                           | 14.3%                        | 14.2%                   | 0.10%                     |
| <b>Employment Status</b> |                                 |                              |                         |                           |
| Employer                 | 0.8%                            | 5.9%                         | 5.4%                    | 0.50%                     |
| Self employed            | 21.8%                           | 18.6%                        | 18.8%                   | -0.20%                    |
| Wage employed            | 42.1%                           | 69.3%                        | 66.9%                   | 2.40%                     |
| Unpaid family members    | 35.3%                           | 6.3%                         | 8.8%                    | -2.50%                    |
| <b>Industry group</b>    |                                 |                              |                         |                           |
| Agriculture              | 5.3%                            | 6.1%                         | 5.8%                    | 0.30%                     |
| Manufacturing            | 1.6%                            | 6.0%                         | 4.6%                    | 1.40%                     |
| Construction             | 0.9%                            | 7.4%                         | 5.4                     | 2.00%                     |
| Commerce-Hotels          | 1.2%                            | 8.9%                         | 6.5%                    | 2.40%                     |
| Transport-Storage        | 0.4%                            | 3.4%                         | 2.5%                    | 0.90%                     |
| Services                 | 90.5%                           | 68.2%                        | 75.3%                   | -7.10% **                 |

Follow table (4.6)

|  | Without mobile phone (1) | With mobile phone (2) | Total sample (3) | Coverage error (4) |
|--|--------------------------|-----------------------|------------------|--------------------|
| <b>Currently attending school</b>              |                          |                       |                  |                    |
| Currently attending                            | 44.0%                    | 15.7%                 | 24.7%            | -9.00% ***         |
| Attending and left                             | 23.7%                    | 35.4%                 | 31.7%            | 3.70%              |
| Attended and graduate                          | 16.5%                    | 46.1%                 | 36.7%            | 9.40% **           |
| Never attended                                 | 15.8%                    | 2.8%                  | 6.9%             | -4.10% *           |
| <b>Labor Force Status</b>                      |                          |                       |                  |                    |
| Employment                                     | 74.6%                    | 82.3%                 | 81.7%            | 0.60%              |
| Unemployed                                     | 25.4%                    | 17.7%                 | 18.3%            | -0.60%             |
| <b>Refugee Status</b>                          |                          |                       |                  |                    |
| Registered                                     | 41.5%                    | 39.1%                 | 39.8%            | -0.70%             |
| Not Registered                                 | 0.2%                     | 0.4%                  | 0.4%             | 0.00%              |
| Not Refugee                                    | 58.2%                    | 60.5%                 | 59.8%            | 0.70%              |
| <b>Educational achievement</b>                 |                          |                       |                  |                    |
| Elementary and less                            | 64.0%                    | 27.40%                | 39.00%           | -11.60% ***        |
| Preparatory                                    | 26.5%                    | 31.30%                | 29.70%           | 1.60%              |
| Secondary                                      | 7.1%                     | 19.40%                | 15.50%           | 3.90%              |
| Associate Diploma                              | 0.5%                     | 6.50%                 | 4.60%            | 1.90%              |
| BA \ BSc                                       | 1.7%                     | 13.30%                | 9.60%            | 3.70%              |
| Higher Education                               | 0.2%                     | 2.10%                 | 1.50%            | 0.60%              |
| <b>Work Place</b>                              |                          |                       |                  |                    |
| West Bank                                      | 73.7%                    | 61.8%                 | 62.8%            | -1.00%             |
| Gaza Strip                                     | 20.3%                    | 27.2%                 | 26.6%            | 0.60%              |
| Israel and Settlements                         | 5.3%                     | 10.7%                 | 10.2%            | 0.50%              |
| Other  | 0.8%                     | 0.3%                  | 0.3%             | 0.00%              |
| <b>Occupation</b>                              |                          |                       |                  |                    |
| Legislators, Senior official and Managers      | 0.0%                     | 2.5%                  | 1.7%             | 0.80%              |
| Professionals, Technical, Associate and Clerks | 0.4%                     | 13.4%                 | 9.3%             | 4.10%              |
| Service, Shop and Market Workers               | 1.3%                     | 9.9%                  | 7.2              | 2.70%              |
| Skilled Agricultural and Fishing Workers       | 4.3%                     | 4.2%                  | 4.2%             | 0.00%              |
| Craft and Related Trade Workers                | 1.3%                     | 8.4%                  | 6.1%             | 2.30%              |
| Plant and Machine Operators and Assemblers     | .3%                      | 4.2%                  | 3.0%             | 1.20%              |
| Elementary occupations                         | 92.3%                    | 57.5%                 | 68.5%            | -11.00% ***        |
| <b>Years of Schooling</b>                      |                          |                       |                  |                    |
| Less than 6 years                              | 47.1%                    | 17.2%                 | 26.6%            | -9.40% ***         |
| 6 – 12 years                                   | 49.7%                    | 53.6%                 | 52.4%            | 1.20%              |
| 13 – 16 years                                  | 3.0%                     | 24.8%                 | 17.9%            | 6.90% **           |
| More than 16 years                             | .2%                      | 4.4%                  | 3.1%             | 1.30%              |
| <b>Relationship to the Head of Household</b>   |                          |                       |                  |                    |
| Head   | 19.4%                    | 43.8%                 | 36.1%            | 7.70% ***          |
| Spouse   | 27.1%                    | 29.1%                 | 28.5%            | 0.60%              |
| Son\Daughter                                   | 49.1%                    | 24.7%                 | 32.4%            | -7.70% ***         |
| Others   | 4.4%                     | 2.5%                  | 3.1%             | -0.60%             |

\* significance at  $\alpha=0.05$  ( $p<0.05$ ), \*\*significant at  $\alpha=0.01$  ( $p<0.01$ ), \*\*\* significant at  $\alpha=0.001$  ( $p<0.001$ )

From the results in table (4.6), it is clear, for example, that among the individuals with mobile phone, 13.3% have educational achievement BA\BSc, 24.8% have schooling years between 6 – 12 years, 56.6% of the individuals with mobile phone are male, 61.8% of individuals with mobile phone work in the West Bank, 43.8% of the individuals who have a mobile phone are heads of households. By looking at age categories, the table shows that the proportion of young individuals who own a mobile phone is more than the proportion of the old who own mobile, where it is found that nearly 31% of the individuals having a mobile phone are aged 26 – 35, while it is found that nearly 3% of the individuals having a mobile phone aged more than 65 years, which means that young individuals are interest of having a mobile phone more than adults, this is similar to the results of other countries (Vehavor et al., 2004, Keeter, 2006, Currivan et al., 2008, Ehlen and Ehlen, 2007). It is found from the table that about 64% of the individuals own a mobile phone are urban. In table (4.5) we specify the significant variables related to the association between having a mobile phone and some demographic characteristics, while table(4.6) specify in which category of each variable the significant differences are evident. For example, in regard to educational achievement significant differences are evident in group educated elementary and less with coverage error -11.6% ,  $p < 0.001$ . Looking to the results of educational achievement one can conclude that on average the individuals owning a mobile phone are more educated, this similar to the results of other countries (Vicente et al., 2009, Vehavor et al., 2004), where it is clear from the table for this variable that there are an over-estimation cases for



educational level higher than elementary and less (all coverage error are positive), while in elementary and less appear under estimation case (-11.6% coverage error). Also, the significant differences for years of schooling are evident in 13-16 years with coverage error 6.9%,  $p < 0.01$ . For attending to school, the significant differences are evident in group currently attending with coverage error -9%,  $p < 0.001$ , attended and graduate group with coverage 9.4%,  $p < 0.01$ , and never attended with coverage error -4.1%,  $p < 0.05$ . Also, from the result of this variable it is clear that the majority of mobile phone ownership are individuals attended to school and graduate. The significant differences for marital status are evident in never married group with coverage error -5.5%,  $p < 0.05$ , and in ever married group with coverage error 8.3%,  $p < 0.01$ . The table shows that the proportion of married individuals is higher to own a mobile phone. Significant differences for age group are evident in age less than 15 years with coverage -9.8%,  $p < 0.001$ , age group 26- 35 with coverage 6.8% ,  $p < 0.01$  and in age group more than 65 years with coverage -6%,  $p < 0.01$ , which means that the proportion of young's to own a mobile phone is higher. For gender, the significant differences are evident in male with coverage error 7.9%,  $p < 0.001$ , and female with coverage error -7.9%,  $p < 0.001$ , this is give an indication that male have a higher proportion to own a mobile phone. The significant differences was found for industry group in the individuals who practice activity related to services with coverage error -7.1%,  $p < 0.05$ . The significant differences for occupation are evident in elementary occupation group

with coverage error -11%,  $p < 0.001$ . For years of schooling variable the significant differences are evident in group schooling years less than 6 years with coverage error -9.4% ,  $p < 0.0001$ , and the significant differences for this variable are evident in group of schooling years are 13-16 years with coverage error 6.9% ,  $p < 0.01$ . Finally, the significant differences are evident for relation to the head of household in head category with coverage error 7.7%,  $p < 0.001$ , and son\daughter category with coverage error -7.7%,  $p < 0.001$ , this means that the proportion of head of households is higher to own a mobile phone. The table shows that for locality type, employment status, refugee status, and work place no significant differences appearing in different categories for those characteristics. Also, it is clear from the table that the implications of coverage error were under-estimation for some characteristics such as, for age categories, age more than 65 years coverage error -6% and over-estimation for other characteristics such as, for currently attending school, attended and graduate with coverage 9.4%. In general, a comprehensive overview at the table for column 4 finds some characteristics which have over-estimation and others which have under-estimation.

The observed differences indicate the extent that coverage error might affect telephone survey results in Palestine. For example, the non-coverage rate 31.6% and the difference of 29.6% (16.5% - 46.1%) between the two samples in the rate of individuals who attended school and graduate will result in a 9.4% coverage error in the corresponding estimate from a hypothetical survey based on mobile phone sampling frame.

The difference between the individuals who own a mobile phone and those who do not in demographic characteristics indicate the possibility of bias in telephone surveys, which are based on mobile phone lists, related to gender, age, marital status, employment status, industry group, attending to school, labor force status, educational achievement, work place, occupation, years of schooling, relation to the head of household. Therefore, the implication of using sampling frames of mobile phone owners may be systematic under-representation of the females, individuals who are less than 15 years, or more than 65 years, their marital status never married, practice services as industrial activity, currently attending to school or never attended, educational level elementary and less, and having less than six years of schooling. While the implication of using sampling frames of mobile phone owners may be systematic over-representation of males, individuals in age group 26-35 years, married, attended school and graduate, and schooling years 13-16. The results of this study point out that the highest proportion of mobile phone was among males, individuals aged 26-35 years, married, individuals who attended to school and graduate, individuals having 13-16 years of schooling and head of the household. This result give an indication that young and educated individuals having a mobile phone. This result like to results in other countries ( Grande and Taylor 2010; Strauts 2010; Vicente et al. 2009).

Estimation from the multivariate analysis for predicting the probability of mobile phone ownership are presented in table (4.7). The probability of mobile phone ownership is affected by several factors.

**Table (4.7) Binary logistic regression for mobile phone status**

| <b>Predictors</b>   | <b>Coefficient</b> | <b>S.E</b> | <b>EXP(B)</b> |
|---|--------------------|------------|---------------|
| <b>Gender</b> (reference: male)                             | -1.564 ***         | 0.254      | 0.209         |
| <b>Age</b> (reference: 36 - 45)                             |                    |            |               |
| Less than 15  | -2.133 **          | 0.743      | 0.119         |
| 15-25   | 0.000              | 0.350      | 1.000         |
| 26 – 35   | 0.321              | 0.289      | 1.379         |
| 46 - 55   | -1.296 *           | 0.506      | 0.274         |
| 56 – 65   | -0.500             | 0.316      | 0.607         |
| More than 65  | -0.900             | 0.531      | 0.407         |
| <b>Place of Work</b> (reference :West Bank)                 |                    |            |               |
| Gaza Strip  | -0.494             | 0.271      | 0.610         |
| Israel and Settlement                                       | 0.277              | 0.452      | 1.319         |
| Others  | -2.567 *           | 1.182      | 0.077         |
| <b>Attending to School</b> (reference: Currently attending) |                    |            |               |
| Attending and left  | -0.340             | 0.574      | 0.712         |
| Attended and graduate                                       | 0.469              | 0.586      | 1.599         |
| Never attended  | -1.017             | 0.758      | 0.362         |
| <b>Industry</b> (reference :Agriculture)                    |                    |            |               |
| Manufacturing   | 0.723 *            | 0.317      | 2.060         |
| Construction  | 0.815 *            | 0.392      | 2.260         |
| Commerce-Hotels   | 1.437***           | 0.348      | 4.207         |
| Transport-Storage   | 1.101 *            | 0.512      | 3.006         |
| Services  | 1.931***           | 0.317      | 6.897         |
| <b>constant</b>   | 2.123              | 0.630      | 8.356         |

\* significance at  $\alpha=0.05$  ( $p<0.05$ ), \*\* significant at  $\alpha=0.01$  ( $p<0.01$ ), \*\*\*significant at  $\alpha=0.001$  ( $p<0.001$ )

Table (4.7) shows that the probability of mobile phone ownership is affected by gender, age, place of work, currently attending school, and industry. All those factors are significant.

From table (4.7) it is clear that individuals aged less than 15 years are less likely to own a mobile phone than those aged 36-45, which means that individuals aged 36-45 are eight times likely to own a mobile phone than aged less than 15. The results also showed that individuals aged 46-55 are less likely to own a mobile phone than individuals aged 36-45. This result is consistent with the results of other countries (Vicente et al., 2009, Vicente and Rice 2009, Ehlen and Ehlen, Peytchev et al. 2008, Grande and Taylor 2010). Also, this study points out that males have a higher chance to own a mobile phone than females. This result is similar to results in other countries (Gordoni 2010). This study indicates that individuals who work in the West Bank have a higher chance to own a mobile phone than individuals who work outside Palestine. For industrial activity, the results point out that individuals who practice manufacturing, construction, commerce-hotels, transport-storage and services have a higher chance to own a mobile phone than individuals who practice agriculture as industrial activity.

#### **4.4: Comparison of landline and mobile-only telephone populations:**

The structure of at least landline phone or mobile phone coverage in Palestine displayed in the following figure.

**Figure (4.4) Structure of at least one phone coverage in Palestine, 2011**

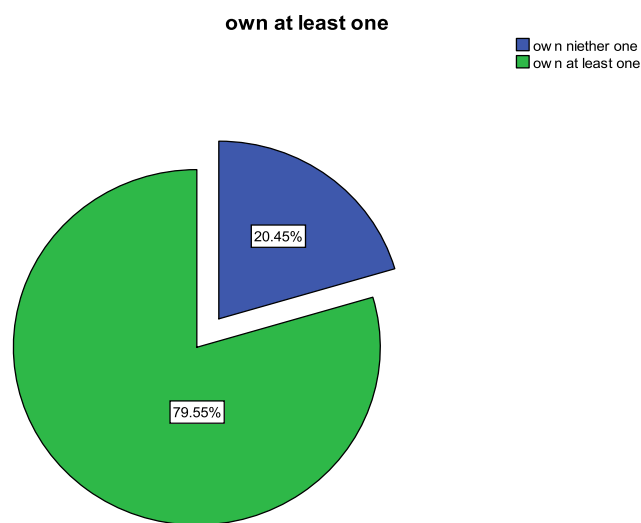


Figure (4.4) explain that 79.55% of individuals having at least one type of phone, while 20.45% of individuals having none.

To test whether there is a significant difference between those covered with mobile phone or landline phone, chi-squared test was used for different characteristics, such as demographic characteristics. Table (4.8) summarizes the results of chi-squared test.

**Table (4.8) chi-squared test for the model of having at least landline phone and those mobile phone-only**

| Variable                              | Chi-square value | df | P-value   |
|---------------------------------------|------------------|----|-----------|
| Gender                                | 106.283          | 1  | 0.000 *** |
| Age categories                        | 457.363          | 6  | 0.000 *** |
| Marital status                        | 157.716          | 2  | 0.000 *** |
| Locality Type                         | 0.181            | 2  | 0.913     |
| Status in Employee                    | 46.675           | 3  | 0.000 *** |
| Industry group                        | 156.754          | 5  | 0.000 *** |
| Currently attending school            | 297.412          | 3  | 0.000 *** |
| Labor Force status                    | 12.7             | 1  | 0.000 *** |
| Refugee Status                        | 5.355            | 2  | 0.069     |
| Educational achievement               | 102.475          | 5  | 0.000 *** |
| Work Place                            | 3.522            | 3  | 0.318     |
| Occupation                            | 166.473          | 6  | 0.000 *** |
| Years of Schooling                    | 102.57           | 3  | 0.000 *** |
| Relationship to the Head of Household | 187.455          | 3  | 0.000 *** |

\* significance at  $\alpha=0.05$  ( $p<0.05$ ), \*\* significant at  $\alpha=0.01$  ( $p<0.01$ ), \*\*\* significant at  $\alpha=0.001$  ( $p<0.001$ )

The population that could be contacted by telephone communication was 1820 individuals: 1394 mobile-only and 426 with landline phone. Significant differences in percentage points between estimates from these two samples was found for gender  $\chi^2_{(1)} = 106.283$ ,  $p < 0.001$ , age group  $\chi^2_{(6)} = 457.363$ ,  $p < 0.001$ , marital status  $\chi^2_{(2)} = 157.716$ ,  $p < 0.001$ , employment status  $\chi^2_{(3)} = 46.675$ ,  $p < 0.001$ , industry group  $\chi^2_{(5)} = 156.754$ ,  $p < 0.001$ , currently attending school  $\chi^2_{(3)} = 297.412$ ,  $p < 0.001$ , labor force status  $\chi^2_{(1)} = 12.7$ ,  $p < 0.01$ , educational

level  $\chi^2_{(5)} = 102.475$ ,  $p < 0.001$ , occupation  $\chi^2_{(6)} = 166.473$ ,  $p < 0.001$ , years of schooling  $\chi^2_{(3)} = 102.57$ ,  $p < 0.001$ , and relationship to the head of household  $\chi^2_{(3)} = 187.455$ ,  $p < 0.05$ .

It is clear from the table that there is no significant difference was found between those with mobile phone and those with landline phone for locality type, P-value =  $0.913 > 0.05$ , there is no significant difference found for refugee status, P-value =  $0.069 > 0.05$ , and there is no significant differences found between those who have a mobile phone and landline phone in Work place characteristics P-value =  $0.318 > 0.05$ .

Differences between the landline and mobile only population are shown in table (4.9). Here refer to the individuals who have either a landline or mobile phone, and test whether sampling from the landline list can result in coverage bias. As before the researcher computed the percent distributions of gender, age, marital status, locality type, employment status, industry, attending school, labor force status, refugee status, educational achievement, work place, occupations, years of schooling, and relationship to the head of household, for people with mobile phone only (Table 4.9, column 1), with landline phone (column 2), and with either kind of phone (column 3).



**Table (4.9) Descriptive statistics for sub-samples of persons from households with at least a landline phone and those with mobile phone only**

|                            | Mobile only<br>(1) | Landline phone<br>(2) | Mobile or landline<br>phone(3) | Coverage error<br>(4) |
|----------------------------|--------------------|-----------------------|--------------------------------|-----------------------|
| <b>Sample size %</b>       | 1394<br>76.6%      | 426<br>23.4%          | 1820                           |                       |
| <b>Gender</b>              |                    |                       |                                |                       |
| Male                       | 57.2%              | 28.60%                | 50.5%                          | -21.90% ***           |
| Female                     | 42.8%              | 71.40%                | 49.5%                          | 21.90% ***            |
| <b>Age categories</b>      |                    |                       |                                |                       |
| Less than 15               | 4.6%               | 37.10%                | 12.20%                         | 24.90% ***            |
| 15-25                      | 22.6%              | 14.30%                | 20.70%                         | -6.40%                |
| 26-35                      | 36.1%              | 6.60%                 | 29.20%                         | -22.60% ***           |
| 36-45                      | 21.6%              | 13.40%                | 19.70%                         | -6.30%                |
| 46-55                      | 2.1%               | 4.00%                 | 2.50%                          | 1.50%                 |
| 56-65                      | 8.7%               | 10.10%                | 9.00%                          | 1.10%                 |
| More than 65               | 4.4%               | 14.60%                | 6.80%                          | 7.80%                 |
| <b>Marital status</b>      |                    |                       |                                |                       |
| Never Married              | 19.9%              | 42.20%                | 24.6%                          | 17.60% ***            |
| Ever Married               | 75.6%              | 42.20%                | 68.6%                          | -26.40% ***           |
| Others                     | 4.5%               | 15.60%                | 6.8%                           | 8.80%                 |
| <b>Locality Type</b>       |                    |                       |                                |                       |
| Urban                      | 60.5%              | 61.30%                | 60.7%                          | 0.60%                 |
| Rural                      | 24.2%              | 23.20%                | 24.0%                          | -0.80%                |
| camp                       | 15.3%              | 15.50%                | 15.3%                          | 0.20%                 |
| <b>Employment status</b>   |                    |                       |                                |                       |
| Employer                   | 3.9%               | 0.00%                 | 3.7%                           | -3.70%                |
| Self employed              | 19.2%              | 11.80%                | 18.8%                          | -7.00%                |
| Wage employed              | 69.6%              | 47.10%                | 68.6%                          | -21.50%               |
| Unpaid family members      | 7.4%               | 41.20%                | 8.8%                           | 32.40% *              |
| <b>Industry group</b>      |                    |                       |                                |                       |
| Agriculture                | 8.4%               | 2.80%                 | 7.1%                           | -4.30%                |
| Manufacturing              | 6.5%               | 1.40%                 | 5.3%                           | -3.90%                |
| Construction               | 9.8%               | 0.00%                 | 7.5%                           | -7.50%                |
| Commerce-Hotels            | 8.5%               | 1.40%                 | 6.8%                           | -5.40%                |
| Transport-Storage          | 4.0%               | 0.20%                 | 3.1%                           | -2.90%                |
| Services                   | 62.8%              | 94.10%                | 70.1%                          | 24.00% ***            |
| <b>Attending to school</b> |                    |                       |                                |                       |
| Currently attending        | 12.7%              | 46.50%                | 20.6%                          | 25.90% ***            |
| Attending and left         | 42.7%              | 21.60%                | 37.7%                          | -16.10% ***           |
| Attended and graduate      | 40.5%              | 19.50%                | 35.6%                          | -16.10% ***           |
| Never attended             | 4.1%               | 12.40%                | 6.0%                           | 6.40%                 |
| <b>Labor Force status</b>  |                    |                       |                                |                       |
| Employment                 | 79.2%              | 69.7%                 | 78.8%                          | -9.1%                 |
| Unemployed                 | 20.8%              | 30.3%                 | 21.2%                          | 9.1%                  |
| <b>Refugee Status</b>      |                    |                       |                                |                       |
| Registered                 | 37.7%              | 43.00%                | 39.0%                          | 4.00%                 |
| Not Registered             | 0.4%               | 0.00%                 | 0.3%                           | -0.30%                |
| Not Refugee                | 61.8%              | 57.00%                | 60.7%                          | -3.70%                |

Follow table (4.9)

|  | Without mobile phone (1) | With mobile phone (2) | Total sample (3) | Coverage error (4) |
|--|--------------------------|-----------------------|------------------|--------------------|
| <b>Educational achievement</b>                 |                          |                       |                  |                    |
| Elementary and less                            | 33.8%                    | 59.20%                | 39.7%            | 19.50 ***          |
| Preparatory                                    | 35.2%                    | 28.40%                | 33.6%            | -5.20%             |
| Secondary                                      | 17.5%                    | 8.50%                 | 15.4%            | -6.90%             |
| Associate Diploma                              | 4.7%                     | 0.90%                 | 3.8%             | -2.90%             |
| BA \ BSC                                       | 8.0%                     | 2.30%                 | 6.6%             | 1.50%              |
| Higher Education                               | 0.8%                     | 0.70%                 | 0.8%             | -5.90%             |
| <b>Work Place</b>                              |                          |                       |                  |                    |
| West Bank                                      | 58.0%                    | 73.50%                | 58.7%            | 14.80%             |
| Gaza Strip                                     | 28.2%                    | 20.60%                | 27.8%            | -7.20%             |
| Israel and Settlements                         | 13.7%                    | 5.90%                 | 13.3%            | -7.40%             |
| Other  | 0.1%                     | 0.00%                 | 0.1%             | -0.10%             |
| <b>Occupation</b>                              |                          |                       |                  |                    |
| Legislators, Senior official and Managers      | 1.1%                     | 0.0%                  | 0.8%             | -0.80%             |
| Professionals, Technical, Associate and Clerks | 7.4%                     | 0.9%                  | 5.9%             | -5.00%             |
| Service, Shop and Market Workers               | 10.1%                    | 1.6%                  | 8.1%             | -6.50%             |
| Skilled Agricultural and Fishing Workers       | 5.5%                     | 2.8%                  | 4.9%             | -2.10%             |
| Craft and Related Trade Workers                | 10.1%                    | 0.9%                  | 8.0%             | -7.10%             |
| Plant and Machine Operators and Assemblers     | 5.1%                     | 0.2%                  | 4.0%             | -3.80% ***         |
| Elementary occupations                         | 60.7%                    | 93.4%                 | 68.4%            | 25.00%             |
| <b>Years of Schooling</b>                      |                          |                       |                  |                    |
| Less than 6 years                              | 21.7%                    | 42.7%                 | 42.70%           | 16.10% ***         |
| 6 – 12 years                                   | 58.5%                    | 52.6%                 | 26.6%            | -4.50%             |
| 13 – 16 years                                  | 18.1%                    | 4.0%                  | 57.1%            | -10.80% *          |
| More than 16 years                             | 1.6%                     | 0.7%                  | 14.8%            | -0.70%             |
| <b>Relationship to the Head of Household</b>   |                          |                       |                  |                    |
| Head   | 47.1%                    | 16.40%                | 39.9%            | -23.50% ***        |
| Spouse   | 29.8%                    | 28.40%                | 29.5%            | -1.10%             |
| Son\Daughter                                   | 20.7%                    | 50.50%                | 27.7%            | 22.80% ***         |
| Others   | 2.4%                     | 4.70%                 | 2.9%             | 1.80%              |

\* significance at  $\alpha=0.05$  ( $p<0.05$ ),\*\* significant at  $\alpha=0.01$  ( $p<0.01$ ),\*\*\* significant at  $\alpha=0.001$  ( $p<0.001$ )

Table (4.9), shows the differences between the landline and mobile only population, and estimation of coverage properties of a landline phone only, or mobile phone sampling frame in Palestine. 76.6% of the sample have a mobile phone only, while 23.4% of the sample have a landline phone only.

From the results in table (4.9), it was found that 50.5% of individuals having a mobile phone or landline phone are male, while 49.5% of individuals having mobile phone or landline phone are females. This result give an indication that chance of owning mobile phone or landline phone nearly equal for males and females. By looking at age categories, the table shows that the proportion of young individuals (individuals aged 45 and less) who own a mobile phone or landline phone is more than the proportion of older (individuals aged more than 45) who own a mobile or landline phone. The results shows that nearly 29% of the individuals having a mobile phone or landline phone are in age group 26-35 years, while for the same group it is clear from the results that nearly 36% of individuals in this age own a mobile phone and 6.6% of those individuals own a landline phone. This result emphasized the conclusion taken from the results of owning a mobile phone in table (4.6), that younger individuals have large chance to own a mobile phone. By looking to marital status the result shows that 68.6% of individuals having a mobile phone or landline phone are married, while 42.2% of married individuals own a landline phone only and 75.6% of them own a mobile phone only. For industry group, the highest percentage of owning a mobile phone or landline phone appear with individuals practice services as an industrial activity, the percentage reach about 70%.

Table (4.9) explains that the significant differences for gender are evident in male group with coverage error -21.9%,  $p < 0.001$ , and in female group with coverage error 29.9%,  $p < 0.001$ . The significant differences found in age group are evident in age category less than 15 years with coverage error 24.9%,

$p < 0.001$  and age category 26-35 with coverage error -22.6,  $p < 0.001$ . For marital status the significant differences are evident in individuals group never married with coverage error 17.6%,  $p < 0.001$ , and married individuals with coverage error -26.4%,  $p < 0.001$ . Significant differences was found in employment status in category of unpaid family members with coverage error 32.4%,  $p < 0.05$ . In industry group, significant differences are evident in individuals practice activity related to services. For attending to school, the significant differences appear in all category of this property except for the category which represents the individuals never attended, the results shows that there is no significant difference appear in this category. For educational achievement, the significant differences are evident in group educated elementary and less with coverage error 19.5% ,  $p < 0.001$ . The significant differences for occupation are evident between individuals whose their occupations are plant, machine operators, and assembler with coverage error -3.8%,  $p < 0.001$ . Also the significant differences for years of schooling are evident in group of individuals having less than 16 years of schooling with coverage error 16.1%,  $p < 0.001$ , and for individuals having 13-16 years of schooling with coverage error -10.8% ,  $p < 0.05$ . Finally, the significant difference for relation to the head of household are evident between head individuals with coverage error -23.5%,  $p < 0.001$ , and son\daughter with coverage errors 22.8%,  $p < 0.001$ . The table shows that for locality type, refugee status, labor force status and work place there are no significant differences in coverage error that appear in different categories for those characteristics.

The implications of coverage error were under-estimation for some characteristics such as, for gender, under-estimation of -21.9% for men, also under estimation of -22.6% appear for age category categories 26-35, while an over-estimation for other characteristics such as, over-estimation of 12.2% for age less than 15, over-estimation 21.9% for gender for female, over-estimation 17.6% for marital status for never married. In general, a comprehensive overview at the table for column 4, finds some characteristics which have over-estimation and other have under-estimation.

Estimation of multivariate model predicting the log odds of at least landline phone or mobile phone are shown in table (4.10)

**Table (4.10) Binary logistic regression for owning landline or mobile phone**

| Predictors   | Coefficient | S.E   | EXP(B) |
|--|-------------|-------|--------|
| <b>Age</b> (reference: 36-45)                                  |             |       |        |
| Less than 15   | -0.062      | 0.497 | 0.940  |
| 15-25  | 0.551 *     | 0.227 | 1.735  |
| 26 – 35  | 0.623 ***   | 0.145 | 1.864  |
| 46 - 55  | -0.873 *    | 0.380 | 0.418  |
| 56 – 65  | -0.326      | 0.186 | 0.722  |
| More than 65   | -0.857 *    | 0.396 | 0.425  |
| <b>Locality Type</b> (reference :Urban)                        |             |       |        |
| Rural  | 0.261       | 0.136 | 1.298  |
| Camp   | 0.432 *     | 0.170 | 1.540  |
| <b>Employment Status</b> (reference :Employer )                |             |       |        |
| Self Employed(On Own Account)                                  | 0.644 *     | 0.280 | 1.903  |
| Wage Employed  | 0.940 **    | 0.261 | 2.561  |
| Unpaid family members  | 1.169 *     | 0.342 | 3.218  |
| <b>Relationship to the Head of Household</b> (reference :Head) |             |       |        |
| Spouse   | -0.814 ***  | 0.184 | 0.443  |
| Son\Daughter   | -0.986 ***  | 0.201 | 0.373  |
| Others   | -1.707 *    | 0.552 | 0.181  |

Follow table (4.10)

| Predictors   | Coefficient | S.E   | EXP(B) |
|--|-------------|-------|--------|
| <b>Educational achievement</b> (reference : Elementary and less) |             |       |        |
| Preparatory  | -0.154      | 0.154 | 0.857  |
| Secondary  | -0.796 ***  | 0.182 | 0.451  |
| Associate Diploma  | -0.947 ***  | 0.233 | 0.388  |
| BA \ BSC   | -1.527 ***  | 0.190 | 0.217  |
| Higher Education   | -2.068 ***  | 0.386 | 0.126  |
| <b>Labor Force Status</b> (reference : employment)               |             |       |        |
| Unemployed   | 0.451 *     | 0.185 | 1.570  |
| Out of labor force   | 0.150       | 0.238 | 1.162  |
| <b>constant</b>  | -0.277      | 0.284 | 0.758  |

\* significance at  $\alpha=0.05$  ( $p<0.05$ ), \*\* significant at  $\alpha=0.01$  ( $p<0.01$ ), \*\*\* significant at  $\alpha=0.001$  ( $p<0.001$ )

Table (4.10) shows that the probability of mobile phone or landline phone ownership is affected by age, locality type, employment status, relationship to the head of household, educational achievement, labor force status. All those factors are significant.

From the table, it can be noticed that the odds of having a mobile phone or landline phone for individuals aged 15-35 years are higher than for individuals aged 36-45, this means that individuals in age group 15-35 have nearly double chance to own mobile phone or landline phone than individuals in age group 36 – 45. The odds ratio for mobile phone or landline phone for the age group 15-25 equal 1.74, while the odds ratio for age group 26-35 equal 1.877. The results indicate that people in age group 46-55 are less likely to own at least landline phone or mobile phone than people in age 36-45, and individuals more aged 36-45 have a higher chance to own at least landline or mobile phone than individuals aged more than 65 years. This results give an indication that young individuals have a higher chance to own at least landline or mobile phone. The

results of this study shown that the individuals who reside in refugee camps have a higher chance to own at least a landline or mobile phone than those who reside in urban areas. For relationship to the head of the household, spouse, son\daughter, and others are less likely to have a landline or mobile phone than head of the household. Looking at educational achievement factor, it was found that the individuals with preparatory, secondary, associate diploma, BA\BSc, and higher education are less likely to have at least a mobile phone or landline phone than individuals have elementary and less educational achievement. Finally, for labor force status, unemployed individuals are more likely to own at least mobile or landline phone than employment individuals.

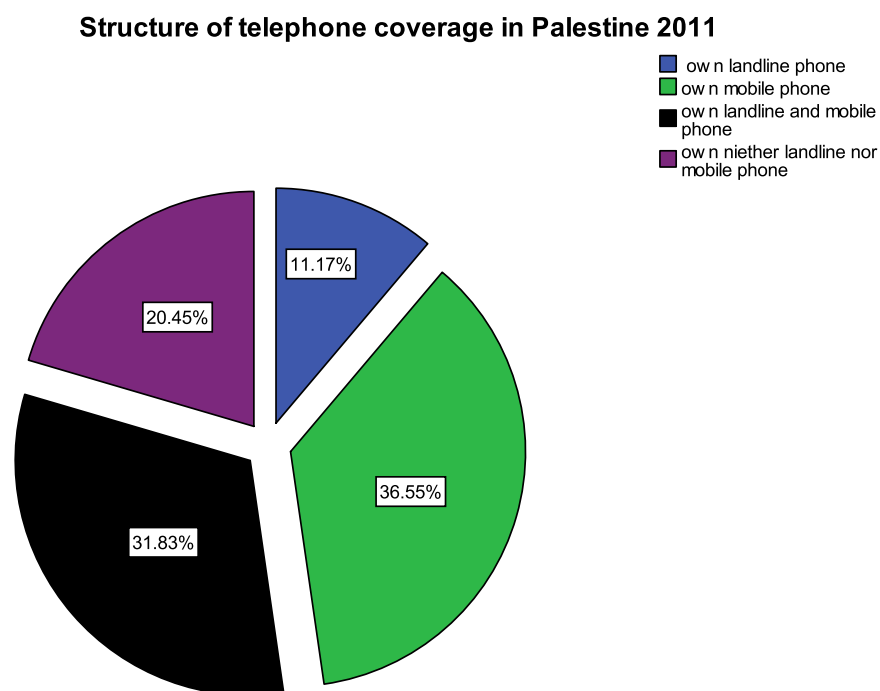
#### **4.5: Multinomial logistic regression analysis:**

Having a landline phone and/ or a mobile phone depends on several factors. Multinomial logistic regression is conducted in order to determine how the ownership of phones differs between groups of individuals. The dependent variable represents the ownership of landline or mobile phones, with the following categories, first category own a landline phone, second category own a mobile phone, third category own landline and mobile phones, and fourth category own neither landline nor mobile phone. The multinomial logistic regression model constructed with all factors stated in as independent variables stated in chapter three. In addition the variables stated in chapter three interactions are added. This approach allows for the identification of how different individuals forecast the likelihood of ownership. Using forward stepwise approach, the final model contains the following variables: Age, relation to the head of households,

attending to school, gender, locality type, region, educational achievement, occupation.

The structure of telephone coverage in Palestine displayed in the following figure.

**Figure (4.5) Structure of Telephone Coverage in Palestine, 2011**



The final multinomial logistic regression model is adequate and presents good prediction for the ownership of phones groups. It was statistically significant  $\chi^2_{(75)} = 2043.63$ ,  $p = 0.000$ , which give an indication that the full model fits the data better than intercept-only null model. The final model includes only significant variables at 0.05.



Table (4.11) provides factor likelihood ratios for each variable in the significant model, with significance level for each chi-square of each variable.

**Table(4.11) Likelihood Ratio Test of the Multinomial Logistic Regression Model**

| <b>Effect</b>                     | <b>-2loglikelihood or reduced model</b> | <b>Chi-square</b> | <b>Df</b> | <b>Significant level</b> |
|-----------------------------------|---|-------------------|-----------|--------------------------|
| Intercept                         | 4400.944                                | 0.000             | 0         |                          |
| Age                               | 4712.049                                | 311.105           | 18        | 0.000                    |
| Relation to the head of household | 4484.199                                | 83.255            | 6         | 0.000                    |
| Attending to school               | 4454.844                                | 53.900            | 9         | 0.000                    |
| Gender                            | 4466.318                                | 65.374            | 3         | 0.000                    |
| Locality type                     | 4418.159                                | 17.215            | 6         | 0.009                    |
| Region                            | 4490.191                                | 89.247            | 3         | 0.000                    |
| Educational Achievement           | 4594.278                                | 193.334           | 12        | 0.000                    |
| Industry                          | 4451.449                                | 50.505            | 12        | 0.000                    |
| Place of work                     | 4428.776                                | 27.832            | 6         | 0.000                    |

From the results in table (4.11) which represent the multinomial logistic regression model, ownership of either both phones or landline phone only or mobile phone only rather than not having any phone services are affected by age, relation to the head of household, attending to school, gender, locality type, region, educational achievement, industry, and place of work.

Table (4.11) provides factor likelihood ratios for each variable in the significant model, with the significant level of chi-square of each variable, based on a zero factor model. As explained in table (4.11), significant contributors to

the model are age, relation to the head of household, attending to school, gender, locality type, region, educational achievement, industry and place of work.

The larger chi-square values, the greater the loss of model fit when dropping the corresponding term. Significant chi-square tests for the independent variables indicate that if the variable removed from the model, the model would be fit significantly worse. For example, if gender is removed from the regression model, the log-likelihood value would change by 65.374. Also, if industry removed from the regression model the log-likelihood value would be change by 50.505. The odds ratio and the corresponding confidence intervals are estimated for all significant factors. Table (4.12) illustrate the odds ratio and confidence intervals.

**Table (4.12) Significant odds Ratio and 95% confidence Intervals**

| Factors  | Both phones |                | Landline phone only |                | Mobile phone only |                |
|--|-------------|----------------|---------------------|----------------|-------------------|----------------|
|  | Odds Ratio  | 95% CI         | Odds Ratio          | 95% CI         | Odds Ratio        | 95% CI         |
| <b>Age (36-45)</b>                             |             |                |                     |                |                   |                |
| Less than 15                                   | 0.138       | (0.071, 0.268) | NS                  |                | 0.301             | (0.157, 0.575) |
| 15 - 25  | 0.504       | (0.306, 0.830) | NS                  |                | NS                |                |
| 26 - 35  | NS          |                | NS                  |                | 1.586             | (1.071, 2.347) |
| 46 - 55  | NS          |                | 2.493               | (1.324, 4.696) | NS                |                |
| 56 -65   | NS          |                | 2.951               | (1.556, 0.596) | 0.382             | (0.227, 0.644) |
| 65+  | 0.441       | (0.246, 0.789) | 2.208               | (1.106, 4.407) | 0.166             | (0.095, 0.290) |
| <b>Relation to the head of household(Head)</b> |             |                |                     |                |                   |                |
| Spouse   | NS          |                | NS                  |                | 0.481             | (0.325, 0.711) |
| Others   | NS          |                | 1.99                | (1.140, 3.49)  | 0.253             | (0.161, 0.398) |

- NS: Not significant

Follow table(4.12)

| Factors  | Both phones |                 | Landline phone only |                | Mobile phone only |                |
|--|-------------|-----------------|---------------------|----------------|-------------------|----------------|
|  | Odds Ratio  | 95% CI          | Odds Ratio          | 95% CI         | Odds Ratio        | 95% CI         |
| <b>Attending to school (currently attending )</b>      |             |                 |                     |                |                   |                |
| Attended and left                                      | NS          |                 | NS                  |                | NS                |                |
| Attended and graduate                                  | NS          |                 | NS                  |                | NS                |                |
| Never attended   | 0.151       | (0.069, 0.329)  | 0.305               | (0.139, 0.67)  | NS                |                |
| <b>Gender (male)</b>                                   |             |                 |                     |                |                   |                |
| Female   | 0.369       | (0.273, 0.5)    | NS                  |                | 0.417             | (0.31, 0.56)   |
| <b>Locality Type (urban)</b>                           |             |                 |                     |                |                   |                |
| Rural  | 0.656       | (0.498, 0.864)  | NS                  |                | NS                |                |
| Camps  | NS          |                 | NS                  |                | NS                |                |
| <b>Region (West Bank)</b>                              |             |                 |                     |                |                   |                |
| Gaza Strip   | 0.314       | (0.239, 0.413)  | 0.57                | (0.433, 0.750) | 0.338             | (0.261, 0.44)  |
| <b>Place of work(West Bank)</b>                        |             |                 |                     |                |                   |                |
| Gaza Strip   | NS          |                 | NS                  |                | 2.051             | (1.095, 3.844) |
| Israel , Settlement and others                         | 0.501       | (0.296, 0.848)  | NS                  |                | NS                |                |
| <b>Educational Achievement (Elementary and less)</b>   |             |                 |                     |                |                   |                |
| Preparatory  | 2.198       | (1.638, 2.949)  | 1.469               | (1.06, 2.04)   | 1.527             | (1.158, 2.01)  |
| Secondary  | 7.462       | (4.775, 11.662) | NS                  |                | 3.379             | (2.187, 5.22)  |
| Associate Diploma                                      | 40.69       | (9.54, 173.69)  | NS                  |                | 13.258            | (3.10, 56.71)  |
| BA\BSc and higher education                            | 21.71       | (10.24, 46.01)  | 3.673               | (1.367, 9.87)  | 4.412             | (2.08, 9.37)   |
| <b>Industry(Agriculture)</b>                           |             |                 |                     |                |                   |                |
| Manufacturing  | 3.975       | (1.82, 8.66)    | NS                  |                | NS                |                |
| Construction, and Transport, Storage and communication | 3.061       | (1.43, 6.54)    | NS                  |                | NS                |                |
| Commerce, Hotels and restaurant                        | 8.675       | (3.74, 20.13)   | NS                  |                | 3.273             | (1.47, 7.28)   |
| Services   | 4.492       | (2.36, 8.56)    | NS                  |                | 1.849             | (1.03, 3.31)   |

- NS: Not significant

The odds ratio and the corresponding confidence intervals are estimated for all significant factors as illustrated in table (4.12). Only the significant results

included in the table. This table compares the odds ratio of belonging to each one of the three groups; both phones, landline phone only, mobile phone only to the reference group of no phones.

The table shows that, the most significant influences in both phones status are age (age categories less than 15, 15-25, and more than 65 years), attending to school (never attended), gender, region, locality type (rural), place of work (Israel, Settlement and others), educational achievement and industry.

In case of only mobile phone status, the significant factors are age (less than 15, 16-25, 26-35, 36-45, 46-55, 56-65, and more than 65), relation to the head of household, gender, region, place of work (Gaza Strip), educational achievement, and industry (commerce, hotels and restaurant, and services).

However the most significant influences on only landline phone status are age (46-55, 56-65, more than 65), relation to the head of household (others), attending to school (never attended), region, and educational achievement (preparatory, BA\BSc and higher education).

From the results of table (4.12) we can conclude that relative to having no phones, both phones individuals are more likely to have educational achievement preparatory or secondary or diploma or BA\BSc or higher education and his industrial activity is manufacturing or construction, and transport, storage and communication or commerce, hotels and restaurant, or services. On the other hand, individuals with only landline are more likely to be in age group 46-55 or 56-65 or more than 65 and not spouse as a relation to the head of household and his educational achievement preparatory or BA\BSc or higher education. But only

mobile phone individuals are more likely to be in age group 26-35, work in the Gaza Strip and his educational achievement preparatory or secondary or diploma or BA\BSC or higher education and his industrial activity related to commerce, hotels and restaurants or services, and less likely to be female in age group 55-65 or more than 65 from Gaza Strip and his relation to household spouse or others.

Moreover, from the results of multinomial logistic regression model, ownership of landline phone are negatively affected by age (less than 15, 15-25, and 26-35), locality type (rural), attending to school, region and industry (Construction, and Transport, Storage and communication). For a mobile phone only, the result of multinomial logistic regression model shows that the ownership are negatively affected by relationship to the head of household, gender, locality type (rural), age (less than 15, 46-55, 56-65, and more than 65), place of work (Israel, Settlement and others), region and attending to school(never attended). Finally, the results shows that for both phones ownership are negatively affected by relation to the head of household, locality type, gender, age for all category except age group 46-55, place of work (Israel, settlement and others, region, and attending to school.

It is known that odds ratio that is greater than 1 reflected higher odds of belonging to a given group, compared to the reference group. A confidence interval with lower limit greater than 1 give an indication that the variable is significantly associated with ownership of phones.

From table (4.12), for example, an odds ratio of 0.314 for region, indicates that individuals reside in the Gaza Strip were less likely than individuals reside

in the West Bank to be both phones than the neither phones group. While the odds ratio 0.382 for age, indicates that individuals aged 56-65 were less likely than individuals aged 36-45 to be in only mobile phone group than the neither phones group. Also, the odds ratio 0.57 for region, indicates that individuals reside in the Gaza Strip were less likely than individuals reside in the West Bank to be in only landline phone group than the neither phones group.

On the other hand, an odds ratio of 2.493 means that individuals in age groups 46-55 were more likely than individuals aged 36-45 to be in only landline phone than the neither phone group. Also, odd ratio 1.586 means that, individuals in age group 26-35 were more likely than individuals aged 36-45 to be in only mobile phone group than neither phone group. Odds ratio of 7.462 means that individual their educational achievement secondary were more likely than individuals his educational achievement both phones than individual their educational achievement elementary and less to be in both phone than neither phone.

The final multinomial logistic regression model gives a good prediction for the ownership of phones groups. It was statistically significant as it indicates that the full model fits the data better than an intercept only model. From the results of multinomial logistic regression model, ownership of either both phones or a landline phone only or a mobile phone only rather than not having any phone services are positively affected by educational achievement for the individuals whose educational level is preparatory and the individuals with educational level BA\BSc or higher, while ownership of both phones or a landline phone is affected by the educational achievement for individuals having preparatory education and

individuals having a BA\BSc or higher. On the other hand, ownership of both phones or mobile phone only is positively affected by educational achievement and by industrial activity for the individuals who practice commerce, hotels, and restaurant and for the individuals who practice services as an industrial activity. Moreover, ownership of both phones or landline phone or mobile phone is negatively affected by region for the individuals who reside in the Gaza Strip. Meanwhile, ownership of both phones or landline phones is negatively affected by region for the individuals reside in the Gaza Strip and by attending to school for never attended individuals. Multinomial logistic regression model provided sufficient evidence that ownerships of phones were affected by certain characteristics. The logistic regression analysis revealed that regarding individuals with no phones, individuals with both phones had significantly greater odds of having higher educational levels, and practice an industrial activities. This means that the individuals who have both phones are more educated, and employed. But individuals with a landline phone only had significantly greater odds of higher educational level and age 46 and more. Finally, individuals with mobile phones only had significantly greater odds of age 26 – 35, work in the Gaza Strip, high educational level and practice commerce and services as an industrial activity. In general, one can conclude that, there was also significantly greater odds of educated individuals to own either both a landline and mobile phones, or only landline phone or only mobile phone rather than owning no phone services at all.

**Chapter Five**

**Statistical Methods for Reducing**

**Coverage Bias in Telephone Surveys**



## **Statistical methods for reducing coverage bias in telephone surveys**

The aim of this chapter is to view methods used to reduce coverage bias in telephone surveys in Palestine, which depends on relative weights. These methods used ICT, 2011, in Palestine, to calculate relative weights that can be used to reduce coverage bias in telephone surveys in Palestine.

Several studies have attempted to identify the factors associated with the ownership of landline phone, which vary from State to State. For example, in U.S, studies have shown that the factors which are most relevant to landline phone ownership are region, socio-economic status, ethnic\race, in addition to these factors in some State, household size, head employment status, age, educational level, and social status. In Egypt studies shown that the factors that most relevant are region, socio-economic status, education level for head of household.

In order to apply Simple Post-Stratification method to reduce coverage bias, it is necessary to have a previous studies related to coverage bias in telephone surveys in Palestine. Within researcher knowledge, there is no such studies available in Palestine. So, in order to specify the factors that affected in landline phone ownership, the researcher use the data for the Household Culture Survey, 2009, conducted by PCBS with random sample of 6150 households.

The researcher used binary logistic regression to specify the factors related to ownership of landline phone. From these factors researcher select educational achievement with five categories (elementary and less, preparatory, secondary, diploma, and BA\BSc or higher, region with two categories (West Bank, and

Gaza Strip), and locality type (urban, rural, and camps), to calculate the relative weights for estimated population from the ICT, 2011, survey for the 30 classes ( $5*2*3=30$ ).

The following table represent the proportion of owning landline phone according to ICT, 2011, surveys and relative weights calculated by simple post-stratification.

**Table(5.1) Proportion of owning landline phone according to ICT, 2011, surveys and relative weights calculated by simple post stratification.**

| classes             |            |               | Proportion of owning landline phone | Relative weights | Total numbers in group |
|---------------------|------------|---------------|-------------------------------------|------------------|------------------------|
| Education           | Region     | Locality type |                                     |                  |                        |
| Elementary and less | West Bank  | Urban         | 59.3                                | 1.67             | 291                    |
|                     |            | Rural         | 30.2                                | 3.31             | 202                    |
|                     |            | Camp          | 10.6                                | 9.43             | 65                     |
|                     | Gaza Strip | Urban         | 84.5                                | 1.18             | 159                    |
|                     |            | Rural         | 1.7                                 | 58.82            | 12                     |
|                     |            | Camp          | 13.8                                | 7.25             | 25                     |
| Preparatory         | West Bank  | Urban         | 62.3                                | 1.61             | 245                    |
|                     |            | Rural         | 24.1                                | 4.15             | 115                    |
|                     |            | Camp          | 13.6                                | 7.35             | 52                     |
|                     | Gaza Strip | Urban         | 71.9                                | 1.39             | 117                    |
|                     |            | Rural         | 5.3                                 | 18.87            | 9                      |
|                     |            | Camp          | 22.8                                | 4.39             | 31                     |
| Secondary           | West Bank  | Urban         | 61.4                                | 1.63             | 111                    |
|                     |            | Rural         | 31.8                                | 3.14             | 46                     |
|                     |            | Camp          | 6.8                                 | 14.71            | 18                     |
|                     | Gaza Strip | Urban         | 79.7                                | 1.25             | 79                     |
|                     |            | Rural         | 5.1                                 | 19.61            | 5                      |
|                     |            | Camp          | 15.3                                | 6.54             | 19                     |

Follow table (5.1)

| classes          |            |               | Proportion of owning landline phone | Relative weights | Total numbers in group |
|------------------|------------|---------------|-------------------------------------|------------------|------------------------|
| Education        | Region     | Locality type |                                     |                  |                        |
| Diploma          | West Bank  | Urban         | 62.5                                | 1.6              | 36                     |
|                  |            | Rural         | 20.0                                | 5                | 13                     |
|                  |            | Camp          | 17.5                                | 5.71             | 14                     |
|                  | Gaza Strip | Urban         | 68.8                                | 1.45             | 18                     |
|                  |            | Rural         | 6.3                                 | 15.87            | 3                      |
|                  |            | Camp          | 25.0                                | 4                | 8                      |
| BA\BSC or higher | West Bank  | Urban         | 65.1                                | 1.54             | 89                     |
|                  |            | Rural         | 28.3                                | 3.53             | 40                     |
|                  |            | Camp          | 6.6                                 | 15.15            | 11                     |
|                  | Gaza Strip | Urban         | 80.9                                | 1.24             | 53                     |
|                  |            | Rural         | 2.1                                 | 47.62            | 2                      |
|                  |            | Camp          | 17.0                                | 5.88             | 18                     |

By looking to table (5.1) it is clear from the table that there are 13 classes having a small total number ( less than 25 ). To solve this problem the researcher Aggregate classes with small numbers. The following table represent the adjusted proportion of owning landline phone and relative weights calculated by simple post stratification.

**Table(5.2) Adjusted proportion of owning landline phone according to ICT, 2011, and relative weights calculated by simple post stratification.**

| Education           | Classes    |               | Proportion of owning landline phone | Relative weights | Total numbers in group |
|---------------------|------------|---------------|-------------------------------------|------------------|------------------------|
|                     | Region     | Locality type |                                     |                  |                        |
| Elementary and less | West Bank  | Urban         | 59.3                                | 1.67             | 291                    |
|                     |            | Rural         | 30.2                                | 3.31             | 202                    |
|                     |            | Camp          | 10.6                                | 9.43             | 65                     |
|                     | Gaza Strip | Urban         | 84.5                                | 1.18             | 159                    |
|                     |            | Rural         | 7.75                                | 12.9             | 37                     |
|                     |            | Camp          |                                     |                  |                        |
| Preparatory         | West Bank  | Urban         | 62.3                                | 1.61             | 245                    |
|                     |            | Rural         | 24.1                                | 4.15             | 115                    |
|                     |            | Camp          | 13.6                                | 7.35             | 52                     |
|                     | Gaza Strip | Urban         | 71.9                                | 1.39             | 117                    |
|                     |            | Rural         | 14.05                               | 7.11             | 40                     |
|                     |            | Camp          |                                     |                  |                        |
| Secondary           | West Bank  | Urban         | 61.4                                | 1.63             | 111                    |
|                     |            | Rural         | 19.3                                | 5.18             | 64                     |
|                     |            | Camp          |                                     |                  |                        |
|                     | Gaza Strip | Urban         | 79.7                                | 1.25             | 79                     |
|                     |            | Rural         | 10.2                                | 9.8              | 24                     |
|                     |            | Camp          |                                     |                  |                        |
| Diploma             | West Bank  | Urban         | 62.5                                | 1.6              | 36                     |
|                     |            | Rural         | 18.75                               | 5.33             | 27                     |
|                     |            | Camp          |                                     |                  |                        |
|                     | Gaza Strip | Urban         | 33.37                               | 2.99             | 29                     |
|                     |            | Rural         |                                     |                  |                        |
|                     |            | Camp          |                                     |                  |                        |
| BA\BSC or higher    | West Bank  | Urban         | 65.1                                | 1.54             | 89                     |
|                     |            | Rural         | 17.45                               | 5.7              | 51                     |
|                     |            | Camp          |                                     |                  |                        |
|                     | Gaza Strip | Urban         | 80.9                                | 1.24             | 53                     |
|                     |            | Rural         | 9.55                                | 10.47            | 20                     |
|                     |            | Camp          |                                     |                  |                        |

The following table represent the treated and untreated indicators for variables that indicate that there are significant differences in appear bias coverage of dealers with a landline phone from the ICT, 2011, survey in Palestine.

**Table( 5.3) Treated and untreated indicators for selected variables( from ICT, 2011 survey in Palestine)**

| Indicator                                 | Indicator for household |               | Total | Treated indicator by SPS | Treated indicator by MPS |
|---|-------------------------|---------------|-------|--------------------------|--------------------------|
|   | Without landline        | With landline |       |                          |                          |
| <b>Marital status</b>                     |                         |               |       |                          |                          |
| Others                                    | 0.076                   | 0.056         | 0.067 | 0.093                    | 0.093                    |
| <b>Currently attending to school</b>      |                         |               |       |                          |                          |
| Attended and left                         | 0.38                    | 0.252         | 0.324 | 0.29                     | 0.292                    |
| Attended and graduate                     | 0.297                   | 0.44          | 0.359 | 0.368                    | 0.4                      |
| <b>Educational achievement</b>            |                         |               |       |                          |                          |
| Elementary and less                       | 0.463                   | 0.309         | 0.396 | 0.379                    | 0.365                    |
| BA\BSC                                    | 0.055                   | 0.15          | 0.097 | 0.086                    | 0.102                    |
| <b>Occupation</b>                         |                         |               |       |                          |                          |
| Legislators, Senior official and Managers | 0.006                   | 0.025         | 0.014 | 0.026                    | 0.019                    |
| Elementary occupation                     | 0.722                   | 0.637         | 0.685 | 0.703                    | 0.68                     |
| <b>Years of schooling</b>                 |                         |               |       |                          |                          |
| Less than 6 years                         | 0.321                   | 0.199         | 0.268 | 0.263                    | 0.267                    |
| 13 – 16 years                             | 0.127                   | 0.259         | 0.184 | 0.166                    | 0.177                    |

Table (5.3) explain differences between indicator variables which is calculated depending on the data of household with and without landline phone relative to the household sample in applied population from the ICT, 2011 survey in Palestine. For example, the proportion of individuals attended to school and left in household with landline phone differ from individuals attended to school and left in household without landline phone. Proportion of individuals having educational achievement BA\BSc in household with landline more than

proportion of individuals having educational achievement BA\BSc in household without landline phone. While proportion of individuals having educational achievement elementary and less in household with landline less than proportion of individuals having educational achievement elementary and less in household without landline phone. Also, table (5.3) contains the values of indicators calculated from data that are limited to households with landline phone, that have been treated by simple post-stratification (SPS), and modified post-stratification (MPS). By looking to these values, we find that the values of some treated indicators approaching to calculated indicators from data of all households (with and without landline phone), compared to untreated indicators that are calculated limited on the data of households with landline phone.

The following table represent the percent of absolute bias for treated and untreated indicator for selected variable ( from ICT,2011, Palestine), where percent of absolute bias calculated from the following formula

$$\text{Percent Absolute Bias} = \frac{|\text{Bias of a Target Measure}|}{\text{Overall Population Actual Measure}} \times 100$$

**Table (5.4) Percent of absolute bias for treated and untreated indicator for selected variable ( from ICT, 2011, Palestine)**

| Indicators                                | Percent absolute bias for     |                           |                           |
|---|-------------------------------|---------------------------|---------------------------|
|   | Household with landline phone | Indicators treated by SPS | Indicators treated by MPS |
| <b>Marital status</b>                     |                               |                           |                           |
| Others                                    | 16.42                         | 38.81                     | 38.81                     |
| <b>Currently attending to school</b>      |                               |                           |                           |
| Attended and left                         | 22.22                         | 10.49                     | 9.88                      |
| Attended and graduate                     | 22.56                         | 2.51                      | 11.42                     |
| <b>Educational achievement</b>            |                               |                           |                           |
| Elementary and less                       | 21.97                         | 4.293                     | 7.83                      |
| BA\BSC                                    | 54.64                         | 11.34                     | 5.15                      |
| <b>Occupation</b>                         |                               |                           |                           |
| Legislators, Senior official and Managers | 78.57                         | 85.71                     | 35.71                     |
| Elementary occupation                     | 7.01                          | 2.63                      | 0.73                      |
| <b>Years of schooling</b>                 |                               |                           |                           |
| Less than 6 years                         | 25.75                         | 1.87                      | 0.37                      |
| 13 – 16 years                             | 40.76                         | 9.78                      | 3.80                      |

Table (5.4) contains the value for percent of absolute bias. These values explains that the most indicators calculated on data limited on households with landline phone, and treated by method of modified post-stratification (MPS) is better than indicators are not treated or treated by simple post-stratification method(SPS), which means that, it approaches the indicator values calculated from the total population household data, whether own or do not own landline phone.

In order to get a clear picture of the impact of the methods used to reduce coverage bias, table below shows the average and median of percent absolute bias for indicators.

**Table (5.5) Mean and median for percent absolute bias related to indicators**

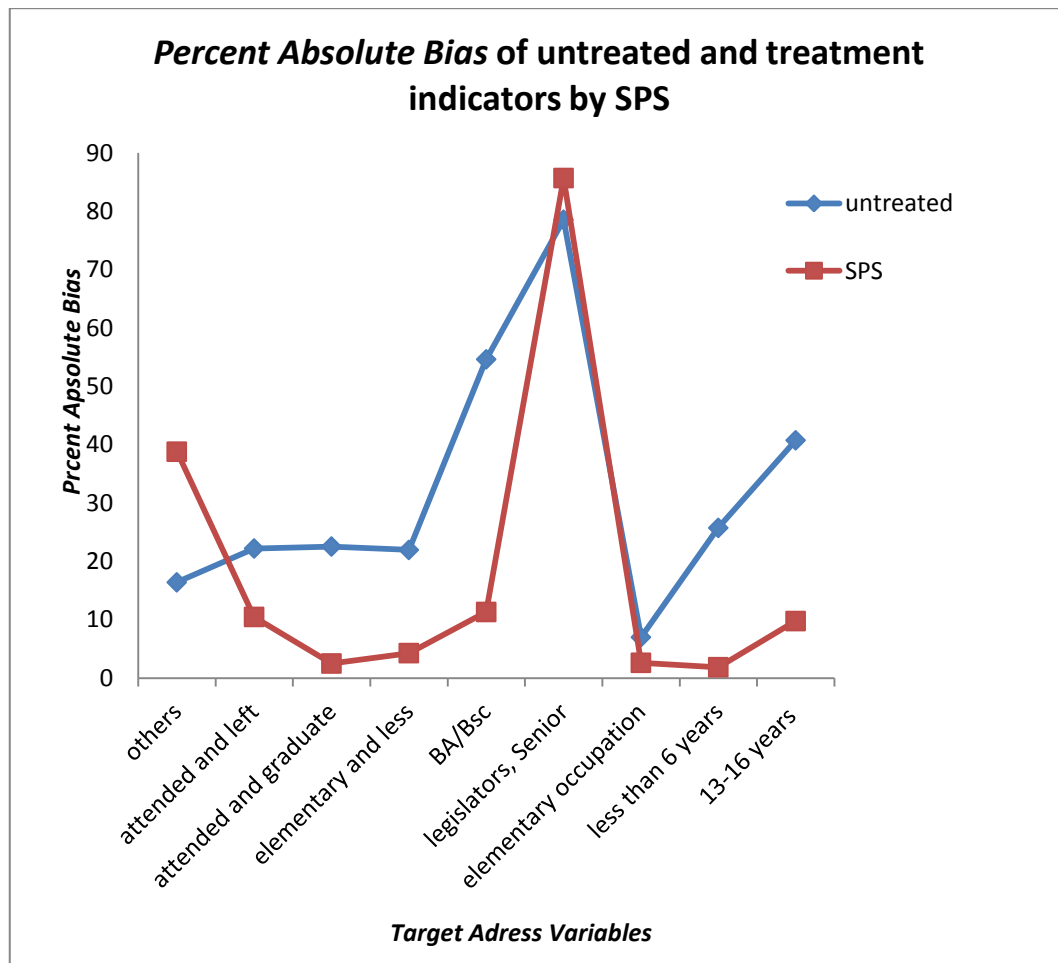
|               | Percent a absolute bias for indicators |                             |                             |
|---------------|--|-----------------------------|-----------------------------|
|               | With landline phone                    | Treatment indicators by SPS | Treatment indicators by MPS |
| <b>Mean</b>   | 32.21                                  | 18.60                       | 12.63                       |
| <b>Median</b> | 22.56                                  | 9.78                        | 7.83                        |

The results of table (5.5) indicates that mean and the median for value of percent absolute bias reduced nearly about 50% when we applied the two methods of weighting. Also, figure (5.3) explain the impact of the two methods of weighting.

The researcher graph the bias for untreated and treatment indicators by Simple Post-Stratification method, and graph untreated and treatment indicators by Modified Post-Stratification method separately, figures (5.1) and (5.2) represent the cases.

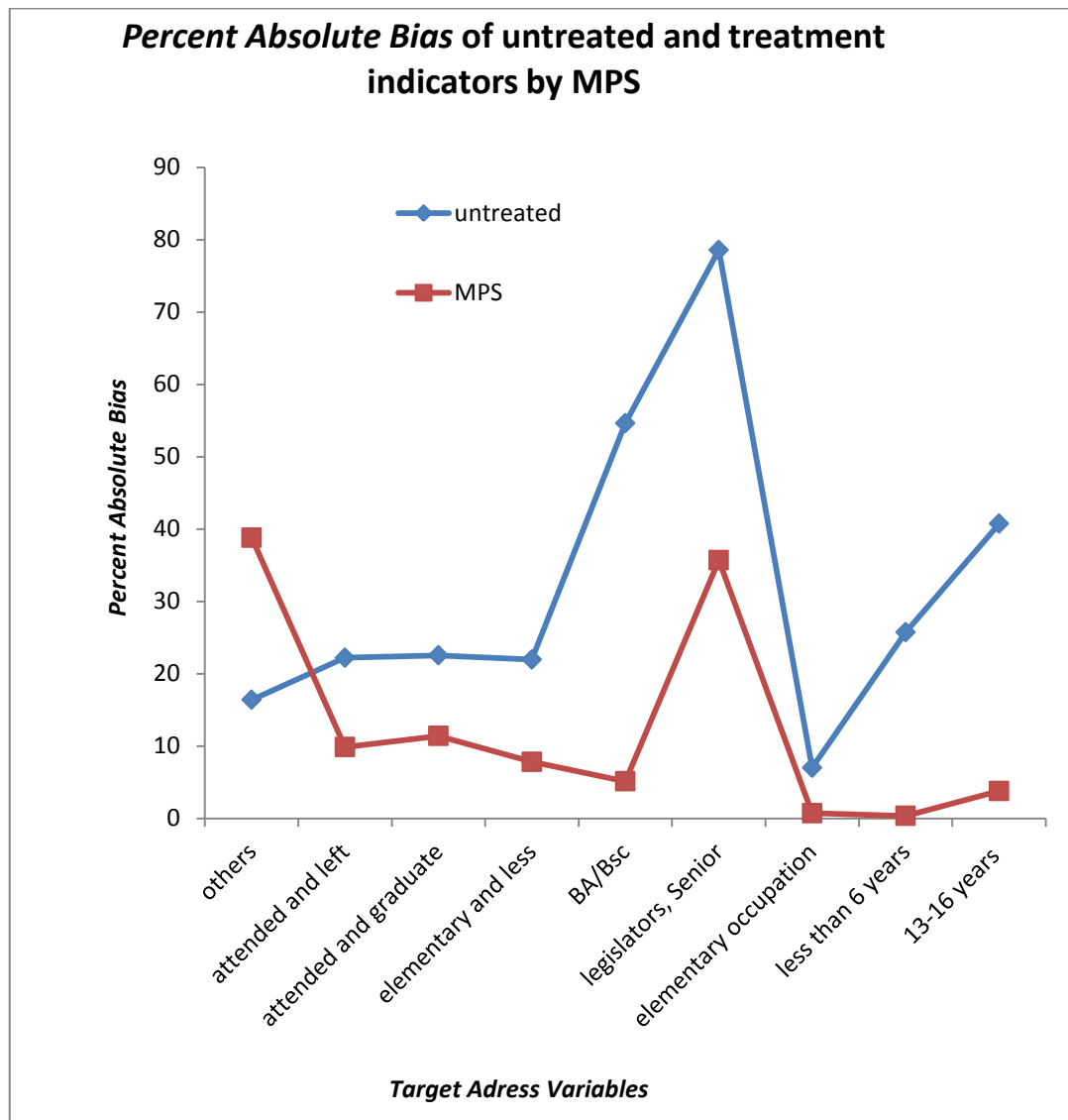


**Figure (5.1) Percent Absolute Bias of untreated and treatment indicators by SPS method**



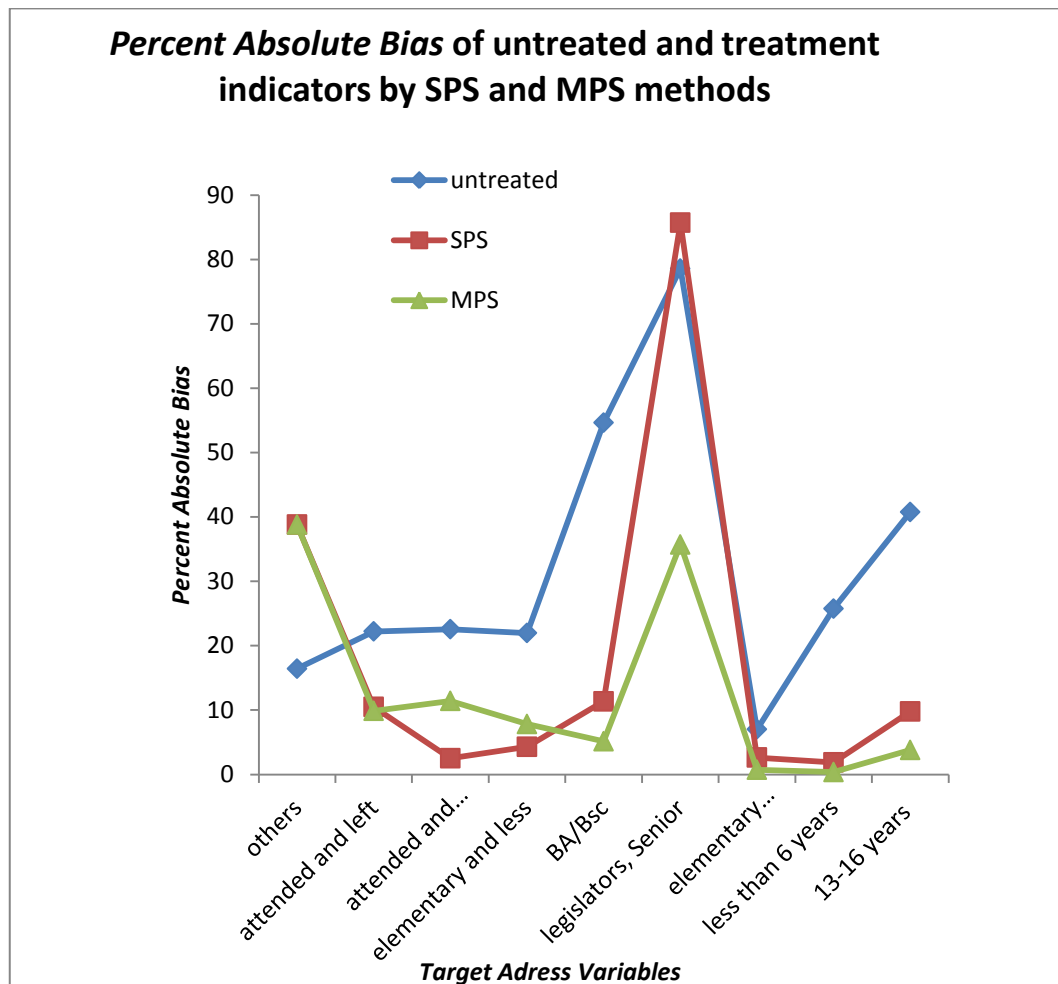
It is clear from figure (5.1) that indicators treated by simple post-stratification method give better results than untreated indicators if the indicator shows a significant amount of bias as a result of a non-coverage error in telephone survey.

**Figure (5.2) Percent Absolute Bias of untreated and treatment indicators by MPS method**



It is clear from figure (5.2) that treatment indicators by Modified Post-Stratification method give better results than untreated indicators.

**Figure (5.3) Percent Absolute Bias of untreated and treatment indicators by SPS and MPS methods**



By making a comparison between untreated and treatment indicators by the two methods, figure (5.3) give an indication that results of treatment indicators by Modified Post-Stratification method in general better than the results for treatment indicators by Simple Post-Stratification method.

In order to reduce coverage bias, two methods of weighting were used. Weighting by *Modified Post-Stratification* method give better results than weighting by using *Simple Post-Stratification* method. Looking at the values of

the treated indicators, we find that most of the values of the treated indicators by MPS method approaches the values of these indicators calculated from the total population (with and without landline phone), compared to these values with untreated indicators for households with landline. Also, the results showed that *Percent Absolute Bias* for most of treated indicators by MPS method for individuals with landline are better than those untreated or treated indicators by SPS. The results of this study indicate that the mean and the median for Percent Absolute Bias decrease about 60 % when applying Modified Post-Stratification method, while the two values decreased nearly 50% by applying Simple Post-Stratification method. All of these results give an indication that in general weighting reduces non-coverage bias in telephone surveys. And the results of the two methods, used in this study, explain that MPS method is better than SPS method for some indicators. The result of weighting in this study is similar to the results of other countries (القصابي وآخرون, 2007, Hogglin and Battaglia, 1996).

In order to apply methods of weighting to treat telephone survey data, there are some points to be considered, among these points is when applying MPS as a method of weighting, in this method the data which will be collected must be compatible with the data which are used to calculate weights. This means that in order to apply *Modified Post-Stratification* method, the data are collected for the following variables: occupation, labor force status, years of schooling, age, and relation to the head of household.

The results of this study make it possible to identify the sub-population that is under-represented in landline phone sampling, and generally in phone sampling. Inclusion of new variables in future studies such as income, renter\home ownership, variables related to health, and economic indicator, may help more to explain the association found between the predictors and coverage bias.

### **Recommendations:**

Based on the results of this study, the researcher recommends the following:

- 1- For future studies in this field the researcher suggests to add new variables related to the health and economic status to test whether those variables affect the ownerships of landline or mobile phone similar to other countries.
- 2- In order to collect data for public opinions, it is useful to use telephone surveys to achieve this purpose. This is needed to establish a Public Opinion Poll Center of the Information and Decision Support Center similar to other countries.
- 3- Using a mixed mode sampling frame without substitution of mobile phone instead of landline phone.
- 4- Using new methods of weighting to reduce non-coverage errors in telephone surveys in Palestine and make a comparison between these methods.

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## **Appendices**



BIRZEIT UNIVERSITY ص.ب 14 بيرزيت - فلسطين. تلفون (02)2982040 فاكس (02) 2982986

## كلية الدراسات العليا - برنامج ماجستير الإحصاء التطبيقي

البريد الإلكتروني: tsadeq@birzeit.edu

22 تشرين الأول 2012

من: مدير برنامج ماجستير الإحصاء التطبيقي

إلى: الجهاز المركزي للإحصاء الفلسطيني

الموضوع: تزويد بالبيانات الخام

تحية طيبة وبعد،

يقوم الطالب نصوح الصوص من برنامج ماجستير الإحصاء التطبيقي بعمل بحث عن معالجة التحيز الناتج عن المسح باستخدام الهاتف، نرجو من حضرتكم تزويد الطالب بالبيانات الخام لمسوح تكنولوجيا المعلومات والمسوح الصحية للأعوام 2004 - 2006.

وتفضلوا بقبول فائق الاحترام.

مدير برنامج ماجستير الإحصاء التطبيقي

د. طارق صادق



كلية الدراسات العليا - برنامج ماجستير الإحصاء التطبيقي

24 تشرين ثاني ٢٠١٢

البريد الإلكتروني: tsadeq@birzeit.edu

من : مدير برنامج ماجستير الإحصاء التطبيقي

إلى : الجهاز المركزي للإحصاء الفلسطيني

الموضوع : تزويد بالبيانات الخام

تحية طيبة وبعد،

يقوم الطالب نصوح الصوص من برنامج ماجستير الإحصاء التطبيقي بعمل بحث عن التحيز الناتج عن المسح باستخدام الهاتف ، نرجو من حضرتكم تزويد الطالب بالبيانات الخام المتعلقة بمسح القوى العاملة الدورة 62 الربع الثالث 2011 بالإضافة إلى الاستمارة المستخدمة في المسح .

وتفضلوا بقبول فائق الاحترام

مدير برنامج ماجستير الإحصاء التطبيقي

