



تكايفؤ طرق قياس وتعريف الفقر. دراسة مقارنة بين الطرق  
التقليدية وطريقة الفزي: تطبيقات على الأراضى الفلسطينية

*The Equivalence of Totally Fuzzy and Relative  
Approaches of Poverty Index Definitions:  
A Comparative Analysis of Palestinian Data*

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*Submitted in partial fulfillment of the requirements for the “  
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”Graduate Studies at Birzeit University-Palestine*

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BIRZEIT UNIVERSITY

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## ملخص تنفيذي

هدف هذا البحث لعرض أسلوب ومنهجية جديدة لدراسة الفقر في الأراضي الفلسطينية، مستخدمة أسلوب (Totally Fuzzy and Relative Approach)، ومقارنة هذه المنهجية مع المنهجيات الأخرى في قياس الفقر (خاصة الفقر المادي). حيث تم عرض العديد من المنهجيات المستخدمة في قياس الفقر، وأهم الطرق/ المنهجيات التي تم عرضها:

(Totally Fuzzy and Relative Approach (TFR (موضوع البحث)

الفقر المادي (فقر الدخل): الفقر المدقع، الفقر النسبي، والفقر الاجتهادي

مؤشرات التنمية البشرية، حيث تم استعراض كل من:

(Human Development Index (HDI ○

(Human Poverty Index (HPI-1 ○

تم عرض النتائج باستخدام البيانات المتوفرة من المسح الوطني لإنفاق واستهلاك الأسرة الذي نفذه الجهاز المركزي للإحصاء الفلسطيني خلال الفترة 15/01/2004 ولغاية 14/02/2005.

لقد تم استخدام الطرق التالية في عمليات التحليل والمقارنة:

Descriptive Analysis

Comprehensive Analysis: Latent Class Analysis and Logit regression

أهم ما توصلت إليه الدراسة:

اختلاف المنهجيات وطرق حساب الفقر يؤدي إلى اختلاف نسب الفقر. كما أن هدف كل

دراسة يحدد الطريقة الواجب استخدامها

كل طريقة لها إيجابيات وسلبيات. حيث أن طريقة الفقر المادي تبسط مشكلة الفقر من خلال

تقسيم السكان لمجموعتين (فقير، وغير فقير) بالاعتماد على مؤشر واحد فقط (الدخل/ أو

الاستهلاك)، في حين أن أسلوب TFR يواجه مشكلة آلية تحديد المؤشرات الواجب استخدامها

لقياس مؤشر الفقر باستخدام هذه الطريقة، وبالتالي صعوبة تفسير المؤشر.

بشكل عام، هنالك أفضلية في استخدام TFR لقياس مؤشرات الفقر في الأراضي الفلسطينية

مقارنة بالمنهجيات الأخرى، خاصة إذا تم النظر لقضية الفقر في الأراضي الفلسطينية من وجهة

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من المؤشرات التنموية (ديموغرافية، اجتماعية، واقتصادية) وعدم الاكتفاء بمؤشر واحد فقط،

(الدخل/ أو الاستهلاك).

## **Abstract**

The objective of this thesis is to test a new application of poverty measurement to Palestinian data. This approach, Totally Fuzzy Relative method (TFR), has been applied to other countries and is said to provide a more comprehensive measurement of poverty. Other approaches used in the literature are also applied, primarily for comparison purposes.

In this thesis, two approaches are used to estimate the determinants of poverty in the Occupied Palestinian Territory; the first approach is the monetary approach and the second is the Totally Fuzzy Relative method. To compare the results of the two approaches and analyze their differences many statistical techniques were used, especially the descriptive analysis covering the percentages and the overlapping between these results. In addition, a logit regression and a cluster analysis using Latent class analysis approach were used.

The analysis is based on the available data of the Household Expenditure and Consumption Survey (HECS). This survey was conducted by the Palestinian Central Bureau of Statistics (PCBS), starting on January 15<sup>th</sup> 2004 and ending on January 14<sup>th</sup> 2005.

Results show that various definitions and approaches give different results. For example, using absolute definition of poverty, about 26.0% of the Palestinian households are classified as poor in 2004; if the national poverty

line is used, 25.0% of households are poor; compared with 39.0%<sup>1</sup> if US\$2 poverty line is used, (using income data), and 51.0% if the original specification of TFR is used.

There are advantages and disadvantages for each method and that the TFR method covers a wider array of attributes for the measurement of poverty. There is a need to use different poverty indices and make the comparisons between them, to have a comprehensive picture of poverty and to see what poverty measure will be used and accepted by policy makers for poverty reduction plans.

Each poverty index has its drawbacks. For example, the monetary index is easily identified, but it is too summarized and leads to loss of information and may lead to irrelevant comparisons. The TFR set suffers from explanation and the possibilities of comparing indices.

With all its drawbacks, the TFR seems to give more robust picture about poverty in the Occupied Palestinian Territory, compared with the monetary approach. However, there is a need to identify acceptable poverty variables for the Occupied Palestinian Territory to be accepted by officials and the public at large. For policy purposes, there is a need to look at and use the two approaches if poverty has to be looked at as a development issue not only as emergency issue.

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<sup>1</sup> These figures were estimated using income data, but if consumption data is used about 13.9% of households will be classified as poor.



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## Chapter One

### Introduction

#### ***1.1 Background***

Poverty measurement in the Occupied Palestinian Territory (West Bank and Gaza Strip) started in mid 1990s. Various definitions and methods relating to various poverty lines were used. Shaban and Al-Botmeh (1995)<sup>2</sup> estimate of poverty rate was 19.1% of the population. The Palestinian National Commission for poverty alleviation (1997) estimate of poverty rate reached 22.5% of the Palestinian households. The Palestinian Central Bureau of Statistics (PCBS) estimate of poverty was 20.3% of the Palestinian households in 1998<sup>3</sup>.

Since the outbreak of the Palestinian Uprising “*Al-Aqsa Intifada*” in September 2000, poverty rates have more than doubled. According to the output of the impact survey rounds, which were conducted by PCBS during 2001 and 2004, the proportion of households below poverty line was in the range of 61% and 64% of the Palestinian households living in West Bank and Gaza Strip<sup>4</sup>. The World Bank and PCBS estimated poverty rate at 16% in the end of 2003<sup>5</sup>. The University of Geneva, after conducting various budget and living conditions surveys, estimated poverty at 58% in July 2003<sup>6</sup>. PCBS estimate of poverty in 2004, after conducting the household expenditure and consumption survey,

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<sup>2</sup> Palestine Economic Policy Research Institute (MAS), November 1995. Poverty in the West Bank and Gaza Strip.

<sup>3</sup> <http://www.pcbs.gov.ps>. Poverty in the Palestinian Territory, 1998. Main Finding Report.

<sup>4</sup> <http://www.pcbs.gov.ps>: The Impact Survey of the Israeli measures on the Economic Conditions of the Palestinian Households.

<sup>5</sup> PCBS & World Bank, October 2004. Deep Palestinian Poverty in the Midst of Economic Crisis.

<sup>6</sup> <http://www.dartmonitoring.org>

stood at 30.6% of population (when consumption data is used) and rose to 57.8% of population (when income data is used)<sup>7</sup>. According to the World Bank projections, the poverty rate stood at 60% in 2004<sup>8</sup>.

The divergence of these estimates shows that various definitions and approaches were used. Shaban and Al-Botmeh (1995) used absolute definition for poverty line, which is based on the cost of nutritional requirements used by FAO (Food Agriculture Organization) and WHO (World Health Organization) plus a multiplier to allow consumption of other essential items “non-food component”. The National Commission for Poverty Alleviation in 1997 derived a poverty line (the official poverty line) from a relative concept of poverty and used it as absolute measure. The definition of the official poverty line combines two bounds (deep “absolute” and “relative” poverty lines) and is based on a budget of basic needs for a reference household (6 persons: 2 adults and 4 children). World Bank and PCBS 2003 used absolute poverty definition (called a Subsistence poverty line), which was taken from Shaban and Al-Botmeh (1995) definition.

Within this context, one can see that, various definitions and methods relating to various poverty lines were used in the Occupied Palestinian Territory. These definitions of poverty lines correspond to various aims, objectives and agendas. From the definition, it can be noticed that these methods used the monetary definition (one-dimension) of poverty namely income or consumption and classified individuals and\ or household into poor or non-poor accordingly. For example, PCBS and World Bank poverty report (2004),

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<sup>7</sup> PCBS, 2005. Poverty in Palestine, 2004. Main Finding Report.

<sup>8</sup> World Bank 2004a. Disengagement, the Palestinian Economy and the settlements)

and Geneva reports were oriented to the donor community to determine the role of the assistances provided to the Palestinians. The report of the National Commission of Poverty Alleviation 1998, and 2004 basically, was oriented to the Palestinian Authority to redesign its plans to cope with ongoing deteriorating situation, conducting the Med-Term Development Plans (MTDP) and to monitor poverty alleviation programs.

### ***1.2 Research Problem***

The literature on monetary poverty measures is in theory straightforward. It classifies individuals or households to be poor or not by using a specific value, “the poverty line according to their income\ consumption”, but it is difficult in practice. The difficulty rises from the issue that poverty is a complex phenomenon having monetary and non-monetary dimensions and using specific value “monetary” measure of poverty “income\ consumption” to classify person to be poor or not simplifies the problem.

Using monetary dimension of poverty is unsatisfactory for several reasons: what determines the poverty line, a person considered as poor according to one measure may not be poor in terms of another (Sen, 1985). On the other hand, using the monetary dimension and classifying people as poor and non-poor by a poverty line causes a loss of information and removes the difference that exists between the two extremes around the poverty line (Cheli and Lemmi, 1995). Another issue is typically raised that the definition deals with poverty as a matter of hunger not as a matter of lack of welfare and lack of accessibility to resources.

Recent years have witnessed a lot of trials of poverty definitions and approaches. These trials attempted to present poverty not only as lack of income, but more generally as deprivation in various life domains, which include financial difficulties, basic needs, housing conditions, durables, health, social contacts, participation, and life satisfaction, (Cheli and Lemmi 1995).

This thesis tries to address poverty from different angles, as it questions a classification system; the analytical framework and the relevance of policy-oriented interventions.

It is also important for the national statistical offices, which intends to provide poverty alleviation plans to decision-makers who acquire information to make rational decisions with a meaningful and accurate measurement of poverty indicators.

### ***1.3 Importance of the Research***

The importance appears from the fact that it provides an opportunity of understanding the multi-dimensional aspects of poverty and deprivation among people by considering poverty as a matter of degree “deprivation” rather than dealing with it as a monetary dimension by classifying people as poor and non-poor. Also, it upgrades the understanding of poverty under special condition mainly in developing countries, especially in the case of the Occupied Palestinian Territory. While monetary poverty measure is useful for estimating poverty in the Occupied Palestinian Territory, but it deals with poverty as a problem of hunger, not as a problem of lack of welfare and lack of resources. Families with the same amount of money may have different needs and

different priorities. For example, having a dwelling is more important for a newly wedded couple compared to others, even if they have the same amount of money.

#### ***1.4 Goals of the Study***

The study aims to achieve the following:

- To conduct a comprehensive study of poverty in the Palestinian Territory using new approach and technique, (Totally Fuzzy and Relative method).
- To compare the results of the new technique with existing ones “the official definition of poverty” and analyze their differences.
- To identify the determinants of poverty.

#### ***1.5 Research Methodology***

The hypothesis that usage of several indicators of poverty not only helps in giving a more complete picture of the living conditions, but also gives an image of poverty that is closer to what is perceived by just observing reality. This hypothesis will be examined for the Occupied Palestine Territory by applying Totally Fuzzy and Relative method (TFR approach). Also, the results of this approach will be compared basically with the results achieved by the National Commission of Poverty Alleviation (official methodology adopted). In order to compare between these methods, two types of analysis will be conducted, descriptive and advanced analysis. The descriptive analysis in this thesis will cover the degree of overlapping between the various approaches. Cluster analysis, using Latent class analysis approach, and *logit* regression will be used for advanced analysis.

The analysis will be based on the available data of the Palestinian household expenditure and consumption survey. All variables or elements used by standard definition of poverty will be used in order to test the proposed poverty index across the said definition, (available variables used to distinguish between poor and non-poor individuals will be included).

This analysis will help to reach one of these conclusions: Shall we continue using the official methodology, or TFR to draw a complete picture of poverty in the Occupied Palestinian Territory?. Do all these approaches fit measuring poverty?. Are they comparable?.

### ***1.6 Research Plan***

The outline of this thesis covers five chapters. The first one is an introduction. The second is a review of related literature covering the theoretical models explaining poverty. The third chapter covers poverty profile in the Palestinian Territory. Chapter four presents poverty estimations in the Palestinian Territory according to the different approaches. Chapter five presents comprehensive analysis, and chapter six concludes with main findings and recommendations.



## Chapter Two

### **Literature Review: “Theoretical Models Explaining Poverty”**

In this chapter the different views on poverty, covering the concept, the approaches, the indexes, limitations, and problems facing these approaches, will be discussed. The first section will focus on the monetary measure of poverty, “definition and models”, while the second section will review some common multi-dimensional approaches and will focus on the Totally Fuzzy and Relative approach.

#### ***2.1 Monetary Measurement: (Unidimensional Approach)***

During the past few decades several attempts have been made to find a suitable way of measuring poverty. The most common measurement of poverty is the monetary approach which basically depends on income\ or expenditure equivalence. This measurement dichotomizes the individuals into one of two categories, poor or non-poor. An individual is classified as poor if his\her income\expenditure drops below a certain monetary value, called the poverty line.

The monetary approach can be defined as follows:

given  $X = \{x_1, x_2, \dots, x_n\}$  be a population of  $n$  individuals,

$Y = \{y_1, y_2, \dots, y_n\}$  be the income of  $n$  individuals

$z$  be “the monetary poverty line”.

$Q$  be a sub-set of  $X$ , where  $Q = \{x_i, f_Q(x)\}$ , and represents the poor where  $f_Q(x)$  is the membership function to  $Q$ , which takes only two values.

$$f_Q(x_i) = \begin{cases} 1 \rightarrow x_i \in Q & \text{If } y_i < z \text{ "poor"} \\ & \text{If } y_i \geq z \text{ "non-poor"} \\ 0 \rightarrow x_i \notin Q & \end{cases} \quad (1)$$

There are three common concepts to define the monetary poverty line ( $z$ ). They are the relative, absolute, and subjective concepts, (Foster and Thorbecke, 1984).

**The relative concept** takes into account the overall distribution of consumption or income and the poverty line is set to a cut-off point in the welfare distribution, such as income or expenditure level below one half the median income. This poverty line has the following characteristics:

1. It varies with the level of income.
2. It is not concrete to monitor poverty over time or space, since there is always a bottom 50 percent of the population, even if the living standards for the population have risen over time.
3. It is not comparable across regions or countries.
4. It is not clear why should it be defined in terms of one cut-off point instead of another.

Many European Union countries set poverty lines based on relative standards. In the United Kingdom, for example, the poverty line is 60 percent of the median income, (Ravallion, 1992). The official Israeli poverty line is strictly relative and changes with the evolution of the income in the country, it is set

each year at 50% of the net median income per adult equivalent, (PCBS and World Bank, 2004<sup>9</sup>)

***The absolute poverty concept*** identifies an individual as a poor if s/he does not have an income sufficient to meet basic needs, (such as food, clothes, housing, transportation, health, and education, etc, (Foster, Greer, Thorbecke, 1984). Two common methods are used in setting the absolute poverty line; the cost-of-basic needs methods, which estimates the cost of a basket of essential products and commodities (consists of two components: food, and non-food component), and the other one is the food energy intake which defines the income level at which the individual food energy intake is just enough to meet the food energy requirements (the major advantage of this method is that there is no need to calculate two components, food and non-food parts of the poverty line, (Foster, Greer, Thorbecke, 1984).

Many developing countries set poverty line based on absolute standards. UNDP (2005), for example, adopted basic needs to construct poverty line in Syria<sup>10</sup>. The World Bank (2004b) adopted calorie requirements to construct absolute poverty line in Jordan<sup>11</sup>

In 1990, the World Bank used an alternative absolute poverty approach in the World Bank poverty assessment studies around the world, (Gisele, 2004<sup>12</sup>).

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<sup>9</sup> Palestinian Central Bureau of Statistics & the World Bank. October 2004. Deep Palestinian Poverty in the Midst of Economic Crisis.

<sup>10</sup> UNDP, 2005. Poverty In Syria 1996-2004. Diagnosis and pro-poor Policy Considerations.

<sup>11</sup> World Bank, 2004b. The Hashemite Kingdom of Jordan: Poverty Assessment. Report No, 27658-JO. June 2004.

<sup>12</sup> Gisele Kanmanou. *Challenges of poverty statistics in the UN Statistical Commission framework and in the present context of follow up of the UN Millennium Development Goals*. Fourth Regional Workshop on Poverty Statistics. Amman, Jordan. November 2004

The World Bank used the US\$1 per capita per day as a standard definition to compare between countries. This definition reflects what is known as purchasing power parities “PPPs”. In other words, it means the equivalent of what a person could buy with one dollar in the United States but it still not clear in practice since the exchange of the US\$ 1 at the local currency is used instead of PPPs. Lipton (1996) maintained that “*It is important to note, that the US\$1/ day definition does not reflect how far a dollar could go in the local currency, but rather is an indication of what a dollar could purchase in the United States adjusted for difference in domestic price levels by what is known as the World Penn Tables*”.

Reddy (2002) suggested that “*There is no clearness about the explanation of the Bank’s definition, with many believing that US\$1/ day is measured in nominal exchange rate terms*”.

***The subjective concept*** is based on “*the individual’s response to the question that elicit the minimum income needed to make ends meets*” (Van Praag et. al., 1982; Hagenaaars, 1986; Kapteyn et. al., 1998<sup>13</sup>). All individuals with income less than their reported minimum income are classified as poor<sup>14</sup>. One of the major disadvantages of this approach is that people with the same level of welfare may give different answers or levels for their minimum income requirement, and may be treated differently, in terms of classification into poor and non-poor.

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<sup>13</sup> Palestinian National Commission for Poverty Alleviation. Poverty in Palestine 1998.

<sup>14</sup> A survey response to a question like the following is used: “What income level do you personally consider to be absolutely minimal?” (Ravallion 1992:33). This subjective definition is no where adopted as an official measure, however.

### ***Setting the Poverty Line***

Identifying the poor requires a measure of poverty, which captures the level and trends of economic well-being of the households and\ or individuals, and be acceptable by officials and the public at large. There is no accepted consensus definition of poverty line. Poverty means different things to different persons. Sen (1985) defined poverty as “*the absence of the capability to lead a full life, which included many things not merely an adequate consumption*”. A person regarded as poor according to one measure may not be poor in terms of another.

In this context, it is noteworthy to hint that there are critical steps to be done when using monetary approach:

1. The first step is to determine what type of poverty concept to be used. In other words, identifying the poor requires a definition and a measure of the standard of living in order to classify households and individuals according to the resources they have, and the minimal needs, marking the cut-off that classify households into poor and non poor. In most developed countries income is used for defining poverty line, while in most developing countries consumption is used to define the poverty line. This is mainly due to the fact that consumption is better in reflecting needs in the developing countries than income, ( Moon 1977).
2. The second critical step is to decide which equivalence scale to use, to reflect the differences in the household size and composition (age group) within and between households. Households differ in composition and size, and there is a need to define a type of an equivalence scale to reflect the difference in the composition and size

within and between the household. Atkinson (1991) suggests that *“There are many scales available, but there is no one scale that is generally accepted. Most scales focus on differences in household size, but some consider variations in household composition including the ages of children”*.

One of the most widely used scales is the OECD scale which gives 1 for the first adult, 0.7 for each additional adult and 0.5 for each additional child (OECD, 1982). While this scale was developed for use in the European context, it is occasionally applied to Third World countries. Another “reasonable” scale that became popular in the North American context is the square root of family size, originally proposed by Ruggles (1990). Such scales are arbitrary because they do not take actual consumption behavior into consideration, and may not, therefore, be appropriate for all countries.

3. The third step is to decide about the type of reference unit (household, individual) that will be used as a unit of analysis. If the household is used, there is a need to define the reference household (*typical household*) to be used.

4. The fourth step is to decide what level should the poverty line be defined. Is it at the national level or at the sub-regional level within the country. If the poverty line is defined at the national level, there is a need for a kind of adjustment to reflect regional differences in standard of living, (income distribution and\ or consumer baskets and prices).

Having defined the poverty line, two indices can be obtained: the *incidence* and the *depth* of poverty. The Head-count Index reflects the incidence of poverty (the proportion of the poor population). Although it is widely used, this index does not capture the depth of poverty. the depth of poverty has two components (poverty gap index and squared poverty gap index “the severity of poverty”, (Ravallion, 1992). The Poverty Gap Index captures the average of the gaps between the standard of living of the poor and the poverty line. This index is useful for telling the amount of savings that can be made from transfers to the poor to reach the poverty line. The Squared Poverty Gap Index “the Severity of poverty” gives the mean of the squared consumption deficits.

Both of these indices can be derived as special cases of the  $P_a$  index proposed by Foster, Greer and Thorbecke (1984), defined as follows:

$$P_a = \frac{1}{N} \sum_{i=1}^q \left( \frac{z - y_i}{z} \right)^\alpha, \quad (2)$$

where:

N: is the population size,

$y_i$ : is the  $i^{\text{th}}$  income\consumption of n individuals ordered from the smallest to the largest  $\{y_1 \leq y_2 \leq \dots \leq y_n\}$ ,

$q$ : is the number of poor

$z$ : is the poverty line that classifies individuals (the poor) at the lower end,

$$\{y_1 \leq y_2 \leq \dots \leq y_q < z \leq y_{1+q} \dots \leq y_n\}$$

$\alpha$ : is a parameter reflecting the weight placed on the welfare levels of the poorest among the poor, which takes three values (0,1,2).

If  $\alpha = 0$ , the Head-count Index ( $P_0$ ) is derived ( $P_0 = q/N$ ); if  $\alpha = 1$ , the Poverty Gap Index ( $P_1$ ) is derived; and if  $\alpha = 2$ , the Squared Poverty Gap Index “ the Severity of poverty” ( $P_2$ ) is derived.

As noted, the monetary approach faces many limitations:

1. It simplifies the problem of poverty, since it refers to one proxy-indicator, basically income, but it is difficult in practice. It depends on defining the standard of living (by definition), which is a complex issue, consisting of both direct consumption as well as non-consumption services, largely provided by the public sector (Sen, 1985; van de Walle, 1995).
2. The second major limitation refers to practice, such as which type of unit of analysis has to be used, (household or individual). Which type of equivalence scale have to be used to adjust the differences in the composition and household size, and the distribution of income\consumption within the household. How to adjust over time and region. The adjustment depends on the poverty approach and the availability of regional differences in consumer baskets and prices. For example, the relative poverty line is not useful for monitoring poverty over time or space, since there is always a lowest percent of the population, either the living of standards decreased or increases (richer regions always have higher poverty lines). In the absolute poverty line approach, the regional differences in the basket items and prices will be



raised. If the World Bank absolute poverty line is used, there is always a significant confusion about the definition, with many believing that US\$1/day or US\$2/day is measured in nominal exchange rate terms, (Nye and Reddy, 2002) .

## ***2.2 Multi-Dimensional Approach(s)***

Given the limitation related to the one-proxy measurement of poverty “monetary approach”, the recent years witnessed many techniques and aspects of poverty reflecting dimensions including more than just the monetary one. These approaches analyzed poverty not only as lack of income, but as deprivation in various life domains. These domains include financial difficulties, basic needs, housing conditions, durables, health, social contacts, participation, and life satisfaction. According to this approach two attempts will be discussed in this literature review: the human poverty index and Totally Relative and Fuzzy approach.

### ***2.2.1 Human Poverty Index***

The United Nations Development Programme (UNDP) created two basic indexes to be used in their Human Development Reports (HDRs); the human development index and the human poverty index (HPI). The HDI is a composite index that measures the average achievements in a country in three basic dimensions of human development: a long and healthy life, as measured by life expectancy at birth; knowledge, as measured by the adult literacy rate and the combined gross enrolment ratio for primary, secondary and tertiary schools; and a decent standard of living, as measured by GDP per capita in

purchasing power parity (PPP) US dollars. While the HPI measures deprivation in the three basic dimension of human development captures in the HDI. The HPI has two components; HPI-2 for the developed countries and HPI-1 for the developing countries, (UNDP, 1997<sup>15</sup>).

The Palestinian Human Development Report (1998/1999), estimate of the Palestinian HDI value reached 0.70. According to its HDI, Palestine is placed in the medium development level, ranking 100 out of 175 countries, (the average HDI value for the group of countries considered as medium development is 0.662)<sup>16</sup>.

For year 2004, the Palestinian HDI, (using the available data from the Palestinian Human development Report 2004)<sup>17</sup>, the HDI stood at 0.693 in 2004, while the human poverty index (HPI-1) stood at 7.13, (*see Appendix IV*).

### ***2.2.2 Totally Fuzzy Relative Approach***

The basic concept in the fuzzy set theory is the idea of a set without sharp boundaries, and fuzzy relations represent the correspondences. According to mathematical definition, it can be interpreted as the probability of a certain element to belong to a certain set. The fuzzy set theory provides suitable mathematical instruments for developing an approach to poverty measurement that is closer to reality (Zadeh, 1965 and 1975).

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<sup>15</sup> UNDP 1997. *Human Development Report*. New York. UNDP

<sup>16</sup> Birzeit University 2002. Development Studies Programme. Palestine, *Human Development Report 1998-1999*.

<sup>17</sup> Birzeit University 2005. Development Studies Programme. Palestine, *Human Development Report 2004*.

Cerioli and Zani (1990), proposed to use the fuzzy sets method for poverty analysis and various other authors then continued in the same direction. Cheli and Lemmi (1995) proposed a totally fuzzy and relative technique (TFR) for multidimensional cross-sectional poverty analysis, and (Cheli, 1999) proposed improvements on the technique to be applied for longitudinal data as well, and (Cheli, 2001) addressed the interpretation and aggregation problems in TFR measures.

### ***Theory***

The Totally Fuzzy Relative (TFR) approach can be defined as follows: given a set  $X$  of elements  $x \in X$ , and

Let  $A$  be any fuzzy subset of  $X$ , where:

$$A = \{x, f_A(x)\}, \text{ and}$$

$$f_A(x) : X \rightarrow [0,1] \text{ is the membership function to the fuzzy subset } A.$$

The value  $f_A(x)$  indicates the degree of membership of  $x$  to  $A$ .

thus:

$$f_A(x) = 0 \text{ signifies that } x \text{ does not belong to } A, \text{ and}$$

$$f_A(x) = 1 \text{ indicates that } x \text{ belongs completely to } A.$$

However, when  $0 < f_A(x) < 1$ , then  $x$  only partially belongs to  $A$ , with a degree of membership that increases in relation to the proximity of  $f_A(x)$  to 1. Thus  $X$  can be considered as a population of  $n$  households and  $A$  the subset of poor households. The degree of membership of each household to the subset of poor can be estimated on the basis of the observation of a number of different variables that are chosen as poverty indicators.

If we suppose that for each household we observe  $k$  poverty indicators  $X_1, X_2, \dots, X_k$ , the membership function of the  $i^{\text{th}}$  household in the fuzzy sub-set can be defined in the following manner (Cerioli and Zani, 1990):

$$f(x_{i.}) = \frac{\sum_{j=1}^k g(x_{ij})w_j}{\sum_{j=1}^k w_j}, j = 1, 2, \dots, k \quad (3)$$

where,

$f(x_{i.})$ : is an individual index of poverty ( $P_j$ , where  $P_j = \frac{1}{n} \sum_{i=1}^n g(x_{ij})$ )

$g(x_{ij})$ : is the deprivation measure to the  $j^{\text{th}}$  indicator of poverty,

$w_j$ : represents an adequate weighting system to aggregate the measures of deprivation relative to any single item.

### ***The Deprivation Measure***

The TFR approach adopts two specifications of the deprivation measure according to a generic poverty indicator  $X$ , the original and alternative specifications.

Cheli and Lemmi (1995), developed a model for TFR as follows:

1. Define the original specification of the deprivation measure of the indicator  $j$  as follows:

$$g(x_{ij}) = \begin{cases} H(x_{ij}), & \text{If the degree of poverty grows as } X \text{ increases} \\ 1 - H(x_{ij}) & \text{otherwise} \end{cases} \quad (4)$$

where,  $H(\cdot)$  represents the observed distribution function of  $X$  and subscript  $i$  refer to the  $i^{\text{th}}$  individual.

3. According to fuzzy set theory,  $g(x_i)$  can be interpreted as membership function in the fuzzy subset of the poor calculated for the  $i^{\text{th}}$  individual.

4. When the  $X$  variable is ordinal, adapted normalized version of  $g(x_j)$  can be written as follows:

$$g(x_i) = \left\{ \begin{array}{ll} 0 & x_i = x_{(1)} \\ g(x_{(k-1)}) + \frac{H(x_{(k)}) - H(x_{(k-1)})}{1 - H(x_{(1)})} & x_i = x_{(k)}, k = 1, 2, \dots, m \end{array} \right\} \quad (5)$$

Where  $x_{(1)}, \dots, x_{(m)}$  represent the categories of  $X$  sorted increasingly with respect to the risk of poverty.

5. The above formula can also be written as follows (by manipulations)<sup>18</sup>:

$$g(x_i) = \frac{H(x_{(k)}) - h(x_{(1)})}{1 - h(x_{(1)})}, x_i = x_{(k)}, k = 1, 2, \dots, m, \quad (6)$$

where the function  $h(\cdot)$  associates any category of  $X$  to the corresponding relative frequency (density function). In this way  $g(\cdot)$  always takes the value 0 in correspondence to the lowest category of  $X$ , (lowest risk of poverty), and 1 in correspondence to the highest one (highest risk of poverty).

6. The global poverty index of  $X$  could be given by:

$$P = \frac{1}{n} \sum_{i=1}^n g(x_i) = \sum_{k=1}^m h(x_{(k)}) \cdot g(x_{(k)}) \quad (7)$$

<sup>18</sup> For details see the original contribution by Cheli and Lemmi (1995).

which represents the average of deprivation measure over population for the specific X with k categories.

Cheli (2001) proposed an alternative specification by transformation of the sample distribution function  $H(\cdot)$  as follows:

$$\ddot{H}(x_i) = \left\{ \begin{array}{ll} \frac{1}{2} h(xk_{(1)}) & x_i = x_{(1)} \\ H(x_{(k-1)}) + \frac{1}{2} h(xk_{(k)}) & x_i = x_{(k)}, (k > 1) \end{array} \right\} \quad (8)$$

Hence, the deprivation measure could be specified as follows:

$$g(x_i) = \begin{cases} \ddot{H}(x_i) & \text{If membership deprivation increases as X grows} \\ 1 - \ddot{H}(x_i) & \text{If membership deprivation decreases as X grows} \end{cases} \quad (9)$$

and the deprivation index is still the same as in formula (6).

The main difference between the alternative and the original specifications is that in the original specification of membership function (*equation 4*) all units shared the same category (value) of X as the  $i^{\text{th}}$  one were implicitly considered as less deprived. While in the alternative specification (*equation 7*), half of the units are considered to be better off and the remaining half are considered worse off than the  $i^{\text{th}}$  one.

***The adequate weighting system***

The weight  $w_j$  is specified as a decreasing function of  $P_j$  to be more representative of lifestyle prevailing in society. The original weights used in the TFR method were given by  $w_j = \ln\left(\frac{1}{P_j}\right)$ , and according to this function, the  $w_j$  is minimum and equal to zero when  $P_j = 1$ , and tends to grow to infinity as  $P_j$  approaches 0.

Cheli (2001) proposed an alternatives to the weighting function, he used  $w_j = e^{-P_j}$  and  $w_j = e^{-4P_j} + e^{-2}$  and discussed their characteristics, and concluded that both arbitrary choice of weight function and preference for the original or alternative membership function are not crucial problems, since they do not condition the results of the analysis.

For the purpose of this research we will use  $w_j = \ln\left(\frac{1}{P_j}\right)$  (and examine  $w_j = e^{-P_j}$  for comparison purposes), as they satisfy the decreasing property in relation to  $P_j$ , but the natural logarithm function is more sensitive to small changes more that the alternative weighting function defined by  $w_j = e^{-P_j}$

***The TFR Index***

The TFR index is derived from a multidimensional approach of measurement, where different aspects can be studied either one by one or fused together and measured by a single index. Once the (k) membership functions are calculated  $g_{(X_{i1})}, \dots, g_{(X_{ik})}$  relative to (k) corresponding indicators for  $i^{th}$  household, we aggregate them to get a new membership function which takes into account all

information jointly provided by (k) items. Cheli and Lemmi (1995) defined this global membership function as a weighted mean of specific membership functions as follows:

$$f(x_i) = f(x_{(i1)}, \dots, x_{(ik)}) = \frac{\sum_{j=1}^k w_j \cdot g_j(x_{ij})}{\sum_{j=1}^k w_j}, w_j = w(p_j) = w\left(\frac{1}{n} \sum_{i=1}^n g_j(x_{ij})\right) \quad (10)$$

Which represents an household measure of global membership, by averaging this measure over population under consideration, and proposed a collective index given by:

$$P = \frac{1}{n} \sum_{i=1}^n f(x_i) = \frac{1}{n} \sum_{i=1}^n \left( \frac{\sum_{j=1}^k w_j \cdot g_j(x_{ij})}{\sum_{j=1}^k w_j} \right) = \frac{\sum_{j=1}^k w_j \cdot \left( \frac{1}{n} \sum_{i=1}^n g_j(x_{ij}) \right)}{\sum_{j=1}^k w_j} = \frac{\sum_{j=1}^k w_j P_j}{\sum_{j=1}^k w_j} \quad (11)$$

For example, Cheli 2001 and others used this index to conduct an empirical analysis of Poverty in Britain using the British Household Panel Survey (BHPS) data from 1991 to 1997, to compare some different weight specifications to one another by applying the original versus the alternative specification using three different weight functions; (They noticed that results do not seem to be substantially influenced by the weighting system used)<sup>19</sup>. In their paper prepared for the Demographic Society of South Africa conference

<sup>19</sup> Andrea Filippone, Bruno Cheli, Antonella D'Agostino. Addressing the Interpretation and the Aggregation Problems in Totally Fuzzy and Relative Poverty.



2003, Naidoo, et., al., used the TFR approach as effective tool to overcome the limitations of the traditional methods of measuring poverty<sup>20</sup>.

### ***Drawbacks of the TFR Indices***

1. The membership function of the original TFR indices are based on ordinal measures, (all units shared the same category of X as the  $i^{\text{th}}$  one were implicitly considered as less deprived). While the alternative specification of membership function of the TFR makes the aggregation of measures relative to different aspects of poverty less controversial, (half of the units is considered to be better off and the remaining half is considered worse off the  $i^{\text{th}}$  one).
2. The values of TFR indices have no intrinsic meaning, which limits the possibility of comparing the indices that refer to different items as well as the possibility of aggregating them in order to produce global poverty index.
3. Although, the particular specification of the weights usually adopted in the TFR reflects the fact that it reflects the importance of an item for the measurement of poverty, but it might be seen as arbitrary. This argument refers to the fact that there are many alternative forms that can be suggested, for example, the original weight  $w_j = \ln\left(\frac{1}{P_j}\right)$ , is minimum and equal to 0 if  $P_j = 1$  (that is when item  $j$  is deprived by everybody), and grows to infinity as  $P_j$  approaches 0 (that is when item  $j$  is possessed by everybody). While the exponential weight  $w_j = e^{-P_j}$  gives very little

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<sup>20</sup> Naidoo, AGV; Yadavalli, VSS; Crowther NAS; Molefe, S. *A Multidimensional Measure of Poverty using the Totally Fuzzy and Relative Approach*. Demographic Society of South Africa conference 2003.

importance to small differences in  $P_j$ 's values. This means that weighting the various poverty indicators by this weight is not very different from not weighting at all.

## Chapter Three

### **Poverty Profile in the Palestinian Territory**

This chapter presents two sections. Section one covers the major efforts made to define the dimensions of poverty in the Occupied Palestinian Territory. Section two is a poverty profile (a descriptive study) of the Palestinian households in the Occupied Palestinian Territory using the official poverty definition.

#### ***3.1 National Efforts on Poverty Analysis***

As mentioned before, many efforts had been done to estimate poverty in the Palestinian Territory. All these studies used the monetary “one-proxy” definition of poverty.

##### ***3.1.1 Shaban and Al-Botmeh (1995): Poverty in the West Bank and Gaza Strip<sup>21</sup>***

Shaban and Al-Botmeh (1995) used the absolute definition using the Jordanian food basket, assuming the similarity in consumption habits between Jordanian and Palestinian households. After specifying the food items of the basic basket, they used the local Palestinian prices, (retail prices of food items in Bethlehem area in June 1995 were used), to estimate the cost of nutritional requirements. After estimating the food poverty line, they estimated the non-food part of poverty line assuming that the poor Palestinians spend the same fraction of their expenditure on food items as poor Jordanians. Shaban and Al-Botmeh

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<sup>21</sup> Shaban utilizes data on household expenditure obtained from the Palestinian Expenditure and Consumption Survey, covering the 3 months of October-December 1995. The relatively small sample of only 1149 observations may reduce the robustness of the obtained results

annual absolute poverty line equals US\$ 490 (about US\$ 41 per month), and the poverty rate stood at 19.1% of the population<sup>22</sup>.

### ***3.1.2 Official Statistics of Poverty***

The official poverty line was defined by the National Commission for Poverty Alleviation in 1997. It was derived from a relative concept and used as absolute poverty line with two boundaries. It is based on a budget of basic needs for a family of 6 persons (2 adults and 4 children<sup>23</sup>). The two boundaries (two poverty lines) have been constructed according to actual spending patterns of Palestinian households. The lower boundary is called “deep poverty line,” which includes a budget for food, clothing and housing. The second line “higher boundary which is called poverty line” includes other necessities including health care, education, transportation, personal care, and housekeeping supplies. The two lines have been adjusted using an equivalence scale to reflect the different consumption needs within and between families (household size and the household composition\ number of children).

### ***3.1.3 Palestinian Central Bureau of Statistics and World Bank Study 2004:***

Absolute definition (called subsistence poverty line) of poverty was used. This poverty line was taken from the definition which was derived by Shaban and Al-Botmeh (1995). It is based on the cost of satisfying the minimum calorie intake as established by FAO\WHO plus value amount for non-food items. The non-food value was estimated by using an economic regression between the logarithm of individual food consumption and the logarithm of individual

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<sup>22</sup> Palestine Economic Policy Research Institute (MAS), November 1995. Poverty in the West Bank and Gaza Strip.

<sup>23</sup> child is any person less than 18 years old. Adult is any person 18 years old or more.

consumption. This poverty line tried to estimate the percentage of the poorest of the poor, during the political crisis (from 2001 to 2003) between the Palestinians and Israelis<sup>24</sup>.

### ***3.2 Poverty in the Palestinian Territory***<sup>25</sup>

The analysis is based on the available data of the Household Expenditure and Consumption survey (HECS). HECS is a nationally representative survey conducted during January 15<sup>th</sup> 2004 and January 14<sup>th</sup> 2005, with a sample of 3,098 households. The instruments were designed following the UN/ILO recommendations for atypical Household Budget Surveys. These recommendations follow the concept of the system of National Accounts (SNA 1993). The main concepts are summarized as follows:

- A self-weighted sample consisting of twelve sub-samples, one for each month.
- A survey period of twelve months, accounting for seasonal differences in correct way.
- A recording period of one month for each household. Longer participation period for each household gives less variance.
- Data capture by record keeping with the help of the interviewer support, if needed.
- The HECS questionnaire consists of two main sections:
  - **First section:** Certain articles / provisions of the form filled at the beginning of the month, and the remainder filled out at the end of the month. The questionnaire includes the following provisions:

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<sup>24</sup> PCBS and World Bank. October 2004. Deep Palestinian Poverty in the Midst of the Economic Crisis.

<sup>25</sup> All statistics in this chapter were done by the student himself.

Statement of the family members: Contains social, economic and demographic particulars of the selected family.

Statement of the long-lasting commodities and income generation activities: Includes a number of basic and indispensable items (i.e, Livestock, or agricultural land).

Housing Characteristics: Includes information and data pertaining to the housing conditions, including type of shelter, number of rooms, ownership, rent, water, electricity supply, connection to the sewer system, source of cooking and heating fuel, and remoteness/proximity of the house to education and health facilities.

Monthly and Annual Income: Data pertaining to the income of the family is collected from different sources at the end of the registration / recording period.

o **Second section:** The second section of the questionnaire includes a list of 50 consumption and expenditure groups itemized and serially numbered according to its importance to the family. Each of these groups contains important commodities. The number of commodities items in each for all groups stood at 667 commodities and services items.

Table 3.2.1 presents the summary statistics of the main indicators collected by the survey and used in the analysis.

**Table 3.2.1: Sample Distribution (Frequencies) of HECS by Main Indicators**

Variable	(Sample size (frequencies	
	Households	individuals
<b>Palestinian Territory</b>	<b>3,098</b>	<b>20,576</b>
<b>West Bank<sup>26</sup></b>	<b>2,060</b>	<b>12,951</b>
West Bank-North	844	4,997
West Bank-Middle	652	4,060
West Bank-South	564	3,894
<b>Gaza Strip</b>	<b>1,038</b>	<b>7,625</b>
<b>Locality Type</b>		
Urban	1,650	11,012
Rural	957	6,170
Refugee camp	491	3,394
<b>Household size</b>		
1	80	80
2-3	427	1,078
4-5	646	2,942
6-7	841	5,442
8-9	615	5,152
10+	489	5,882
<b>Number of children</b>		
0	516	1,488
1-2	660	3,310
3-4	905	5,977
5-6	653	5,546
7-8	270	2,911
9+	94	1,344
<b>Sex of head of household</b>		
Male	2,837	19,571
Female	261	1,005
<b>Educational level of head of household</b>		
Less than elementary	301	4,598
Elementary	213	5,002
Preparatory	466	4,598
Secondary	668	3,119
College	726	1,362
University or more	724	1,897
<b>employment status of household head</b>		
<b>In labor</b>	<b>2,602</b>	<b>17,875</b>
Employed (1-14 hrs per week)	175	1,148
Employed 15 hrs+ per week)	1,907	12,884
Unemployed	520	3,843

<sup>26</sup> West Bank-North includes: Jenin, Tubas, Tulkarm, Qalqilya, Salfit, Nablus. West Bank-Middle includes: Ramallah, Jerusalem, Jericho. West Bank-South includes: Hebron, Bethlehem

<b>Out-labor</b>	496	2,701
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Poverty statistics calculated here are based on the official definition of poverty which was developed in 1997 by the Palestinian National Commission of Poverty Alleviation. Using this definition, the monthly poverty line was estimated to be US\$ 433 (NIS 1,934).

According to this approach, the proportion of households below poverty stood at 25.6% in 2004, (about 30.6% of population), of which 19.8% in the West Bank (about 23.6% of population) and 37.2% of households in Gaza Strip (about 42.5% of population), (*Table 3.2.2*).

Poverty is concentrated in the southern governorates; about 37.2% of the households living in Gaza Strip were suffering from poverty compared to 31.2% in the Southern governorates of the West Bank, 22.2% in the Northern Governorates of the West Bank and 6.7% in the Central Governorates of the West Bank. (*Table 3.2.2*).

**Table 3.2.2: Household likelihood of being poor by region, 2004**

Region	Poverty Status		
	Non-poor	Poor	Total
<b>Palestinian Territory</b>	<b>74.4</b>	<b>25.6</b>	<b>100</b>
<b>West Bank</b>	<b>80.2</b>	<b>19.8</b>	<b>100</b>
West Bank-North	77.8	22.2	100
West Bank-Middle	93.3	6.7	100
West Bank-South	68.8	31.2	100
<b>Gaza Strip</b>	<b>62.8</b>	<b>37.2</b>	<b>100</b>

More significant is the fact that the contribution of the West Bank to national poverty is 51.4% compared with 48.6% to Gaza Strip, this indicates that there are almost as many poor households in the West Bank as in Gaza Strip. More important perhaps from a policy point of view is the fact that the contribution



of Gaza to national poverty increases to 52.4% when the poverty gap index is used, (Table 3.2.3). The poverty gap index shows that per-poor household was needed to be paid a 6.6% of the poverty line value per month (about NIS 148) to be at the poverty line.

**Table 3.2.3: Poverty and Poverty Gap indices by region, 2004**

Region	Poverty		Poverty Gap	
	Value	Contribution	Value	Contribution
<b>Palestinian Territory</b>	<b>25.6</b>	<b>100.0</b>	<b>6.6</b>	<b>100.0</b>
<b>West Bank</b>	<b>19.8</b>	<b>51.4</b>	<b>4.8</b>	<b>47.6</b>
West Bank-North	22.2	23.7	4.9	20.0
West Bank-Middle	6.7	5.5	1.3	4.2
West Bank-South	31.2	22.2	8.6	23.4
<b>Gaza Strip</b>	<b>37.2</b>	<b>48.6</b>	<b>10.4</b>	<b>52.4</b>

Refugee camps have higher incidence of poverty; About 31.6% of households in refugee camps were poor in 2004, and this is higher than the rate of poverty in urban (24.4%) and rural areas (24.6%). Higher incidence of poverty in the refugee camps may be explained by the fact that the households living in the refugee camps have larger families, and higher dependency ratios, (Table 3.2.4).

**Table 3.2.4: Household likelihood of being poor by locality type, 2004**

Locality Type	Poverty Status		
	Non-poor	Poor	Total
Urban	75.6	24.4	100
Rural	75.4	24.6	100
Refugee camp	68.5	31.5	100

Poverty correlates strongly with the household size, poverty rates increase as the household size increases. This may be due to the fact that as the household size increases the number of children, elderly (most vulnerable) increase

compared with working-aged adults, which means high dependency ratios, (Table 3.2.5).

**Table 3.2.5: Household likelihood of being poor by household size, 2004**

Household Size	Poverty Status		
	Non-poor	Poor	Total
1	86.3	13.7	100
2-3	85.5	14.5	100
4-5	83.0	17.0	100
6-7	78.5	21.5	100
8-9	65.4	34.6	100
10+	55.6	44.4	100

More children, means higher incidence of poverty. Households with the least incidence of poverty (18.7%) are those with 1-2 children, but poverty increases to 33.9% for households with 5-6 children, 43.6% for households with 7-8 children, and 56.4% for those with at least 9 children, (Table 3.2.6).

**Table 3.2.6: Household likelihood of being poor by number of children, 2004**

Number of children	Poverty Status		
	Non-poor	Poor	Total
0	83.3	16.7	100
1-2	81.3	18.7	100
3-4	78.8	21.2	100
5-6	66.1	33.9	100
7-8	56.4	43.6	100
9+	43.6	56.4	100

In the Palestinian Territory in 2004, female headed-households represented only 8.4% of total households. They have lower poverty rates (21.0%) than male-headed households (26.0%). This result is may be surprising, but it may be explained by the fact that this group is one of the highest recipient of public

support and assistance payments, the majority (73.8% compared with less than one percent for male-headed households) of them were either widows, having small household size (4 persons compared with 7 persons for male-headed households), and number of dependents (1 dependent per female-headed household compared to 3 dependents per male-headed in average), (*Table 3.2.7*).

**Table 3.2.7: Household likelihood of being poor by sex of household head, 2004**

Sex of Head of household	Poverty Status		
	Non-poor	Poor	Total
Males	74.0	26.0	100
Females	79.0	21.0	100

Poverty variations appeared clearly with the educational level of head of household. The poverty rate between household heads with less than elementary education (35.0%) was almost two and half times higher than those with a two-year college degree (13.8%), and almost four times higher than those with university degree and above (8.8%), (*Table 3.2.8*).

**Table 3.2.8: Household likelihood of being poor by educational level, 2004**

Educational Level of head of household	Poverty Status		
	Non-poor	Poor	Total
Less than elementary	65.0	35.0	100
Elementary	70.1	29.9	100
Preparatory	76.9	23.1	100
Secondary	75.8	24.2	100
College	86.2	13.8	100
University degree or more	91.2	8.8	100

In 2004, about 84.0% of household heads were classified as labor force participants “in labor” compared with 16.0% as non-participants “out of labor”. The poverty rate among households whose their heads are non-

participants is 28.7% compared with 25.0% among those households whose heads are labor force participants, (Table 3.2.9).

**Table 3.2.9: Household likelihood of being poor by labor force participation of head of household, 2004**

Labor force participation of head of household	Poverty Status		
	Non-poor	Poor	Total
In labor	75.0	25.0	100
Out labor	71.3	28.7	100

On the other hand, labor force participants consisting of employed and unemployed, and as expected the households with unemployed heads (36.3%) have higher incidence of poverty than those who are employed. In addition to that, about 32.5% of households whose head worked for up 14 hours last week were poor compared with 21.2% among those employed 15 hours and more last week. On the other hand, one can say that there is not a significant difference between those who worked less than 15 hours last week (32.5%) and those who are classified as unemployment (36.3%) last week, (the difference percent does not exceed 4%), (Table 3.2.10).

**Table 3.2.10: Household likelihood of being poor by employment status of head of household, 2004**

Employment status of head of household	Poverty Status		
	Non-poor	Poor	Total
Employed (1-14 hrs)	67.5	32.5	100
Employed (15 hrs +)	78.8	21.2	100
Unemployed	63.7	36.3	100

### ***Poverty and Inequality in the Palestinian Territory, 2004***

In 2004, the poorest 10% of households (ranked by equivalence consumption) were consuming 4.1% of the total monthly household consumption (of which 4.1% in the West Bank and 4.3% in Gaza Strip), while the richest 10% were

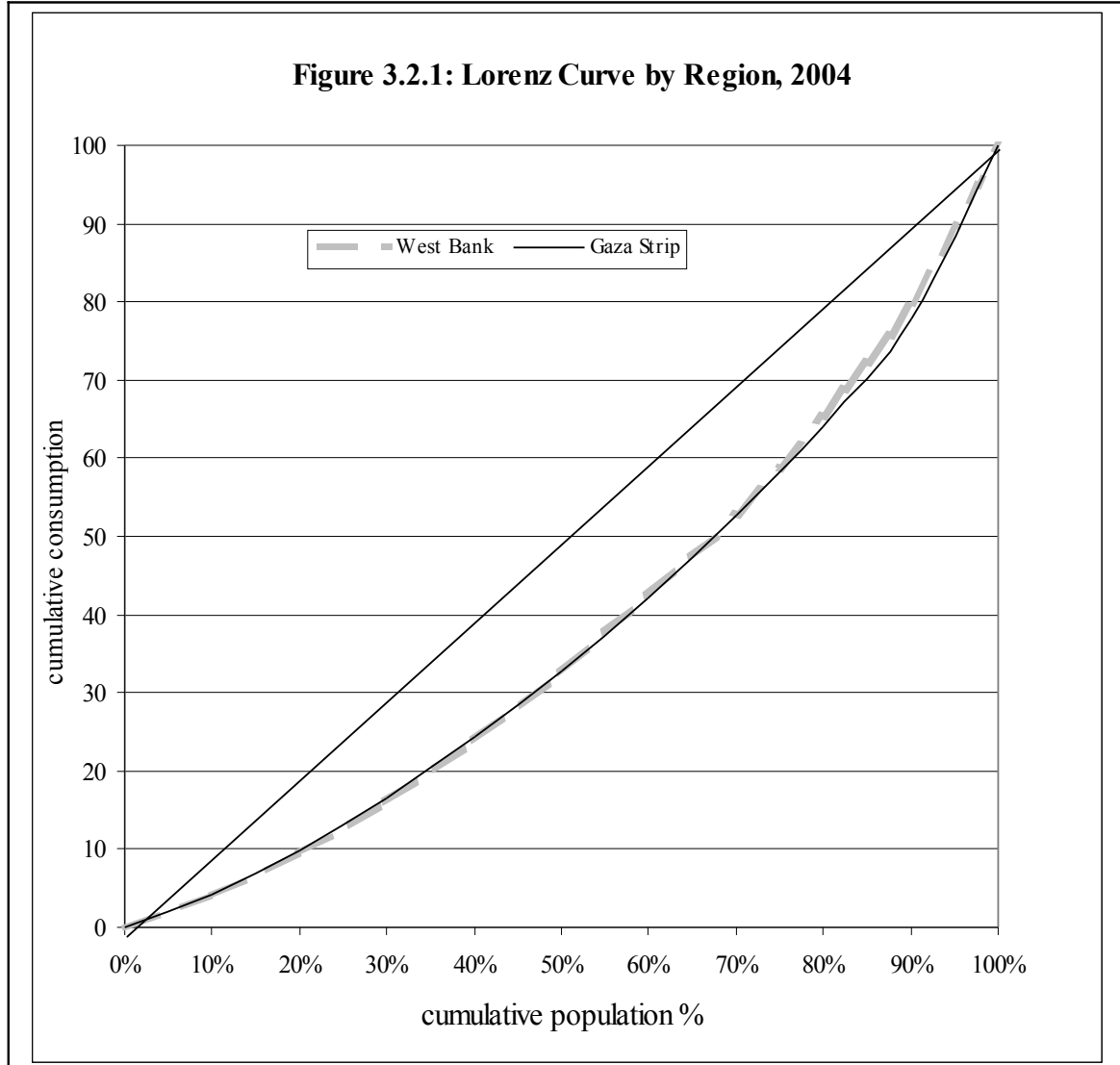
consuming 20.8%, (of which 22.2% in the West Bank and 20.1% in Gaza Strip). In addition to that, the results indicated that the ratio of the consumption of the richest 10% to the consumption of the poorest 10% was 5.1, (of which 5.2 in the West Bank and 4.9 percent in Gaza Strip), (Table 3.2.11).

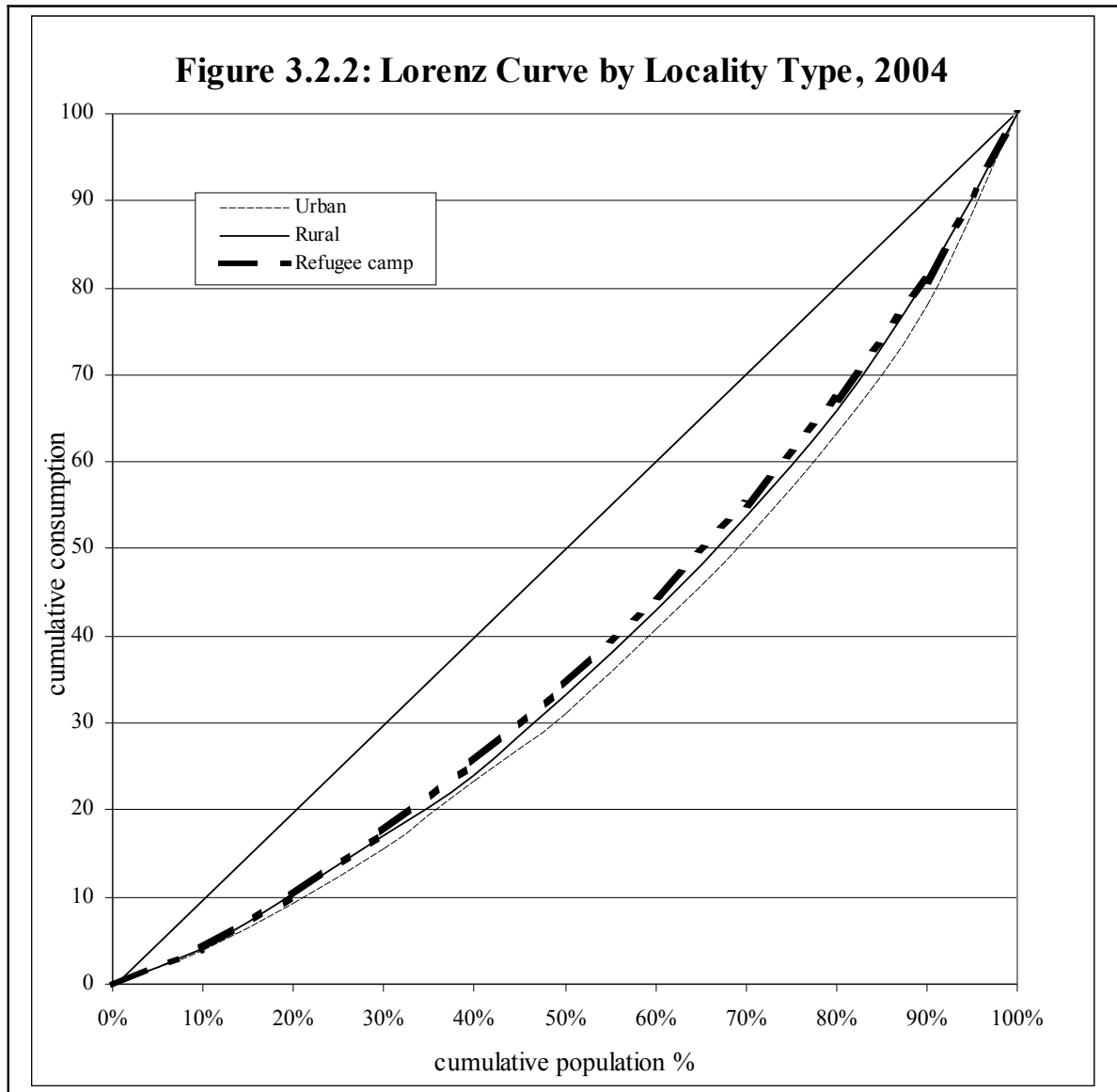
**Table 3.2.11: Household Total Monthly Consumption Distribution Patterns, 2004 (Lorenz Curve)**

	Deciles									Gini Index
	10%	20%	30%	40%	50%	60%	70%	80%	90%	
<b>Region</b>										
West Bank	4.1	9.7	16.1	23.9	32.5	42.3	52.6	65.3	79.9	31.3
Gaza Strip	4.3	9.9	16.6	24.5	32.8	42.1	52.6	64.1	77.8	30.0
<b>Locality Type</b>										
Urban	3.9	9.3	15.6	23.4	31.0	40.9	51.1	63.3	77.9	34.4
Rural	4.1	10.4	17.1	24.0	33.3	43.0	53.7	65.8	81.2	30.9
Refugee camp	4.2	10.2	17.5	25.5	34.3	44.4	55.1	67.1	80.8	27.9

Consumption inequality (Gini Index) between the West Bank households (31.3%) is higher than Gaza Strip households (30.0%), while the consumption inequality between urban households (34.4%) is higher. While Figure (3.2.1) and Figure (3.2.2) show that inequality is the almost same between West Bank and Gaza Strip (no significant difference), while there is a significant difference if locality type is taken in consideration.

Figure 3.2.1: Lorenz Curve by Region, 2004





## Chapter Four

## Poverty Estimation in the Palestinian Territory Using the Different Approaches

### 4.1 Monetary Approaches: (Absolute, Relative, Subjective)

The analysis is based on the HECS. Consumption data was used in the analysis, instead of income data. Three Poverty indices were used to calculate poverty indicators: Head Count Index, Poverty Gap Index; and Severity Poverty Index

$$\text{Head Count Index; } [H = q/N], \quad (12)$$

where,  $q$  represents the poor,  $N$  represents the population.

$$\text{Poverty Gap Index; } [PG = \frac{1}{N} \sum_{i=1}^q \left( \frac{Z - y_i}{Z} \right) \times 100], \quad (13)$$

$$\text{Severity Poverty Index; } [PS = \frac{1}{N} \sum_{i=1}^q \left( \frac{Z - y_i}{Z} \right)^2 \times 100], \quad (14)$$

where,  $Z$  represents the poverty line, and  $y_i$  represents household consumption.

The head count index measures the proportion of households below poverty line, while the poverty gap index measures the mean distance below poverty line as a percentage of the poverty line which represents what money is needed to lift every body out of poverty.



Basically, The official statistics equivalence scale is used to solve the differences of household size, household composition, and the distribution of income\ or consumption within the household, (National Commission 1997<sup>27</sup>):

$$E = (A + P \cdot C)^F = Eq_{os} = (A + 0.46 * C)^{0.89}$$

(15)

where, A is the # of adults, C is the # of children expressed as a proportion, P, of an adult, and F =0.89 is a scale economy factor, (*F was estimated directly from the HECS 1996 and 1997 data*), (National Commission 1997<sup>28</sup>):.

#### ***4.1.1 Absolute Poverty Line (Nutritional Needs, and US\$ 1 per-day per-person)***

##### ***4.1.1.1 Nutritional Needs***

There are two common methods in setting the absolute poverty line, (cost-of-basic needs, and energy intake, (Sen 1985). For the purpose of public policy, the cost-of-basic needs is the most commonly used method for calculation of absolute poverty. Cost-of basic needs method is derived by calculating two components, (which are food poverty line and the non-food allowance which is added to food poverty line to allow for essential non-food part of the poverty line).

##### ***Setting the Food Poverty Line***

The most commonly used method in measuring the food poverty line is the energy requirements by calorie intake, (Sen 1985). This method depends on calorie requirements of individuals taking into consideration sex, age, body

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<sup>27</sup> National Commission for Poverty Alleviation . Poverty in Palestine, 1998.

<sup>28</sup> National Commission for Poverty Alleviation . Poverty in Palestine, 1998.

weight and activity. This approach is not followed in this thesis, because there is no national food basket adopted for the Palestinians until now, and all calculation will be dependent on adopting similar food basket used in the region, and to be able to do a robust analysis according to this approach, there is a need to conduct a national nutritional survey and estimate food basket which reflects the calorie intake required by the Palestinians. Given the consideration above, and after revising the available alternatives, the definition followed in this part is taken from Shaban and Al-Botmeh (1995) which was used by PCBS & World Bank in 2004<sup>29</sup>. Using this approach, the cost of satisfying nutritional requirements (food poverty line) for average Palestinian person is thus calculated to be NIS 217 per month in 2004, (*Table 4.1.1*).

**Table 4.1.1: Monthly cost of nutritional needs for a person in Palestinian Territory, 2004.**

Basic Food Items	Basic daily needs for average person (gm) <sup>30</sup>	Monthly Cost Estimate <sup>31</sup>	
		NIS	US\$
<b>Animal &amp; vegetables protein</b>			
Eggs	31.81	6.2	1.4
Meat	25.31	13.6	3.0
Beans	42.59	6.9	1.5
<b>Calcium</b>			
Dairy products	337.92	113.8	25.4
<b>Carbohydrate</b>			
Rice	30.66	6.0	1.3
Flour	121.94	6.6	1.5
Bread	188.40	14.0	3.1
Oils	32.83	12.7	2.8
Sugars\Sweets	37.36	2.2	0.5
<b>Vitamins\ Minerals</b>			
Tomatoes\Citrus	113.36	11.9	2.7

<sup>29</sup> PCBS and World Bank, October 2004. Deep Palestinian Poverty in the Midst of Crisis. The poverty line is based on the cost of satisfying nutritional requirements (as established by FAO/WHO) plus a multiplier to allow consumption of other essential items. The food items satisfying the nutritional requirement was taken from a study of nutrition in Jordan. This conclusion based on assumption that there is a similarity in the consumption habits between the two populations.

<sup>30</sup> Basic daily needs for average person (gm) is taken from Shaban and Al-Botmeh study (1995).

<sup>31</sup> The cost of the food basket was estimated by using the average prices available from the consumer prices survey which was conducted by PCBS during 2004.

Green vegetables	79.38	18.6	4.1
Fruit & Other Vegetables	44.94	4.3	1.0
<b>Total</b>	<b>1,086.5</b>	217	48.4

### ***Setting the Non- Food Value of the Absolute Poverty Line***

To estimate the non-food part of the poverty line, an economic regression between the logarithm of food consumption per person (using the full sample) on the logarithm of consumption, (PCBS & World Bank 2004), is used.

$$LPFC = \alpha + \beta(LPTC), \quad (16)$$

where, LPFC : logarithm of per capita monthly food consumption

LPTC : logarithm of per capita total monthly consumption

By using this econometric method, a person with total monthly consumption of NIS 217 (those their total consumption equal the food poverty line) , will spend NIS 86 for food consumption [ $86 = \exp(-0.014 + 0.83 * \ln(217))$ ], and the rest will be spent (NIS 131) on the non-food consumption, (Table 4.1.2). This implies that the person needs NIS 131 per month to be able to cover the non-food consumption. Based on this method, the per capita monthly absolute poverty line, using consumption data, was set at NIS 348, [*food poverty line + non-food consumption part:  $217 + 131 = 348$* <sup>32</sup>], in 2004.

<sup>32</sup> This figures were estimated without using any equivalence scale.

**Table 4.1.2: Economic regression between the logarithm of food consumption per person**

source	ss	df	ms			
	844.52485			Number of observations=	3098	
Model	7	1	844.524857	F( 1, 3096) =	9250.82	
Residual	282.63976	3096	.091291914	Prob > F =	0.0000	
Total	1127.1646	3097	.363953705	R-squared =	0.7492	
	2			Adj R-squared =	0.7492	
				Root MSE =	0.7492	
LPFC	Coef	Std. Err	t	P> t	95% Conf. Interval	
LPTC	.8296742	.0086262	96.18	0.000	8127607.	8465878.
cons	-.0141067	.0531427	-0.27	0.791	1183052.-	0900918.
LPFC : logarithm of per capita food consumption						
LPTC : logarithm of per capita total consumption						

Using this definition, about 26.0% of the Palestinian households dropped below the absolute poverty line in 2004 (represents 33.3% of the population), assuming that any person belongs to a poor household is poor. (Table 4.1.3).

**Table 4.1.3: Absolute Poverty Indicators, 2004**

Indicator	Value	Standard <sup>33</sup> Error	95% confidence interval	
			Lower	Upper
<b>Head count Index (% of households)</b>	<b>0.260</b>	<b>0.008</b>	<b>0.245</b>	<b>0.276</b>
Poverty Gap Index (%)	0.072	0.003	0.066	0.077
Poverty Severity Index (%)	0.029	0.001	0.026	0.032

The poverty gap index shows that per-poor household was needed to be paid a 7.2% of the poverty line value per month to be at the poverty line, while the poverty severity index shows that per-poor household was needed to be paid a 2.9% of the poverty line value per month to eradicate the gap between poor households.

<sup>33</sup> The standard error was calculated the same way as for any population proportion. The head-count index has a binomial distribution, approaching a normal distribution as sample size increases. The normal distribution will be accurate as long as the absolute value of  $\sqrt{[(1-H)/H]} - \sqrt{[H/(1-H)]}$  does not exceed  $0.3\sqrt{n}$  (Box et al. 1978).

#### 4.1.1.2 US\$1/ per capita per day as Absolute Poverty Approach

This approach is used by the World Bank for international comparisons. The US\$1/day definition reflects what is known as Purchasing Power Parities “PPPs. Since, there is no estimate available for the Palestinian Territory, and the complexity of calculating this value, and after looking at different resource and publications of the World Bank, which adopted 2.08 as the highest PPPs for the developing countries, the developing countries started to use two lines. The two lines are US\$1 per capita per day and US\$2 per capita per day. If the US\$1 per capita per day poverty line is used, about 1.6% of the Palestinian households dropped below the absolute poverty line in 2004 (about 2.4% of the population)<sup>34</sup>, (Table 4.1.4).

**Table 4.1.4: US\$1/ per capita per day Poverty Indicators, 2004.**

Indicator	value	Standard Error	95% confidence interval	
			Lower	Upper
Head count Index (% of households)	0.0163	0.0023	0.0118	0.0207
Poverty Gap Index (%)	0.0033	0.0006	0.0021	0.0045
Poverty Severity Index (%)	0.0011	0.0003	0.0005	0.0017

If the US\$2 per capita per day poverty line is used, about 13.9% of the Palestinian households dropped below the absolute poverty line in 2004<sup>35</sup>, (Table 4.1.5).

**Table 4.1.5: US\$2 / per capita per day Poverty Indicators, 2004.**

Indicator	value	Standard Error	95% confidence interval	
			Lower	Upper
Head count Index (% of households)	0.139	0.006	0.126	0.151
Poverty Gap Index (%)	0.034	0.002	0.030	0.038
Poverty Severity Index (%)	0.013	0.001	0.011	0.015

<sup>34</sup> These figures were estimated using the consumption data, but if income data is used, about 14.3% of Palestinian households will be classified as poor, (about 17.1% of the population)

<sup>35</sup> These figures were estimated using the consumption data, but if income data is used, about 39.0% of Palestinian households will be classified as poor, (about 45.5% of the population)

### 4.1.2 Relative Poverty Line Approach

A relative measure of poverty sets the poverty standard at a fixed proportion, usually 50%, of some measure of well-being such as median *adjusted* family income or expenditure. The 50% cut-off is the norm used in the European countries, but some use different cut-off such as 40% or 60%. Others use the bottom 30<sup>th</sup> percentile of per capita income (Glewwe, 1990; Kanbur, 1987).

The definition used is derived according to the 60% of the median of monthly consumption of the reference household in the Palestinian Territory (two adults and four children). The relative poverty of the reference household was set at (NIS 1,795 per month). The official equivalence scale (equation # 13) was used to adjust the differences in the household composition, size, and the distribution of consumption within the household, (Table 4.1.6).

**Table 4.1.6: Relative Poverty Indicators, 2004. (using official equivalence scale)**

Indicator	value	Standard Error	95% confidence interval	
			Lower	Upper
Head count Index (% of households)	0.216	0.007	0.201	0.230
Poverty Gap Index (%)	0.053	0.002	0.049	0.058
Poverty Severity Index (%)	0.020	0.001	0.018	0.022

### 4.1.3 Subjective Poverty Line Approach

The concept based on the opinions of people about their standing with respect to the minimum required for making ends meet, (Ravallion, 1992). HECS 2004 responses to a question like the following is used: “What income level do you personally consider to be absolutely minimal?”. The results of this question was used as a subjective poverty line the results showed that about 25.0% of

the Palestinian households dropped below the subjective poverty line in 2004, (Table 4.1.7).

**Table 4.1.7: Subjective Poverty Indicators, 2004.**

Indicator	value	Standard Error	95% confidence interval	
			Lower	Upper
<b>Head count Index (% of households)</b>	<b>0.250</b>	<b>0.008</b>	<b>0.249</b>	<b>0.280</b>
Poverty Gap Index (%)	0.052	0.002	0.048	0.057
Poverty Severity Index (%)	0.017	0.001	0.015	0.019

#### 4.1.4 Official Poverty Line

The official definition of poverty was developed in 1997<sup>36</sup>. The definition combines absolute and relative features and is based on a budget of basic needs for a family of 6 persons (2 adults and 4 children). Two poverty lines have been developed. Using this definition, the two poverty lines stood at NIS (New Israeli Shekels) 1,934 and NIS 1,622 per-month for the reference household of six-members.

**Table 4.1.8: Official Poverty Indicators, 2004.**

Indicator	value	Standard Error	95% confidence interval	
			Lower	Upper
<b>Poverty</b>				
<b>Head count Index (% of households)</b>	<b>0.256</b>	<b>0.008</b>	<b>0.241</b>	<b>0.271</b>
Poverty Gap Index (%)	0.066	0.003	0.061	0.072
Poverty Severity Index (%)	0.025	0.001	0.023	0.028
<b>Deep Poverty</b>				
<b>Head count Index (% of households)</b>	<b>0.164</b>	<b>0.007</b>	<b>0.151</b>	<b>0.177</b>
Poverty Gap Index (%)	0.039	0.002	0.035	0.043
Poverty Severity Index (%)	0.014	0.001	0.012	0.016

<sup>36</sup> (Poverty in Palestine. Poverty Report, 1998. Methodology)

#### **4.1.5 Main Results and Recommendation**

This section employs two techniques, (descriptive and regression analysis) to test whether there are differences among the various approaches to poverty lines. It is also the intention to check whether the various approaches would identify the same household as poor.

Table 4.1.9 shows that there are some apparent differences in the results for monetary poverty lines used, since there is no intersection between the confidence intervals of some of these lines, (there is significant difference). The two monetary approaches that differ are US\$2 and Relative Poverty Line. This may be due to their definitions or that they do not reflect the living standards in the Palestinian Territory, especially if we take into consideration that, in the developing countries, families differ in needs and have different levels of well being even when they have the same amount of money (income). Also, one can say that this may be due to the type of data used for analysis even if the same definition of the poverty line is used. For example, the percentage of households suffering of poverty if the US\$2 poverty line is used stood at 13.9% if the consumption data is used while it stood at 39.0% if the income data is used, (*since there is a general tendency for respondents in household surveys to underreport their income everywhere, underreporting is especially serious in situations like ours*).



**Table 4.1.9: Confidence Interval of Poverty Index among the Palestinian Households by Type of Monetary Poverty Line**

Indicator	Value (poverty rate)	Standard Error of mean	95% confidence interval	
			Lower	Upper
National Poverty Line	25.6	0.8	24.1	27.1
Absolute Poverty Line	26.0	0.8	24.5	27.6
US\$2 per day	13.9	0.6	12.6	15.1
Relative Poverty Line	21.6	0.7	20.1	23.0
Subjective Poverty Line	25.0	0.8	24.9	28.0

Two poverty lines would be considered approximate measures of poverty if the majority of households are captured by both. The proportion of households captured by all poverty lines reflects the attributes which are common to all measures of poverty. Tables (4.1.10a and 4.1.10b) show the degree of household overlapping among various poverty lines. For example, 22.1% of the households classified as poor by the national poverty line are classified as such by the absolute poverty line, (86.4% out of the 25.6%). 13.9% of the households classified as poor by the national poverty line are classified as such by the US\$2 (54.1% of 25.6%).

The last column and row of the tables show the proportion of households identified as poor by national poverty line which are common to all other poverty lines. This shows that the absolute poverty line has the highest proportion.

The number 6.5% represents all households characterized as poor by all used poverty lines which is very low. This reflects the differences in attributes focused on by the various measures.

**Table 4.1.10a: Degree of Overlapping between the Various Approaches of Monetary Poverty Line (%)**

Poverty Line	National	Absolute	US\$2	Relative	Subjective	Poverty rate
National	100	86.4	54.1	84.2	42.1	25.6
Absolute	84.9	100.0	53.2	75.2	42.1	26.0
US\$2	100.0	100.0	100.0	98.8	47.4	13.9
Relative	100.0	90.9	63.5	100.0	43.2	21.6
Subjective	43.2	43.9	26.3	37.3	100.0	25.0
Poverty rate	25.6	26.0	13.9	21.6	25.0	<b>6.5<sup>37</sup></b>

**Table 4.1.10b: Symmetrical Matrix between the Various Approaches of Monetary Poverty Line (%)**

Poverty Line	National	Absolute	US\$2	Relative	Subjective	Poverty rate
National	<b>100</b>	22.1	13.9	21.5	10.8	25.6
Absolute	22.1	<b>100.0</b>	13.8	19.6	10.9	26.0
US\$2	13.9	13.8	<b>100.0</b>	13.7	6.6	13.9
Relative	21.5	19.6	13.7	<b>100.0</b>	43.2	21.6
Subjective	10.8	10.9	6.6	43.2	<b>100.0</b>	25.0
Poverty rate	25.6	26.0	13.9	21.6	25.0	<b>6.5</b>

In order to estimate the impact of various households characteristics using the different poverty lines, a logit model was used. Poverty rate (*PSTA*: 0 for non-poor; 1 for poor) is used as dependent variable, while the independent variables used in the logit regression were chosen from the World Bank study<sup>38</sup>, since these indicators were classified as poverty indicators in the Palestinian Territory, (*Table 4.1.11*).

<sup>37</sup> It represents the total overlapping between the poverty lines, (households who drop below the five poverty lines).

<sup>38</sup> For detailed results see: *World Bank. 2001b, Poverty in West Bank and Gaza, Report No, 22312-GZ.*

**Table 4.1.11: The poverty parameters in the Palestinian Territory**

Variable	Type of variable
Number of dependents	Continuous
Number of aged-working adults	Continuous
School years of working aged adults	
Number of adult males	Continuous
Type of locality (two dummy variables)	
Living in refugee camp (1: yes, 0: no)	Dummy variable
Living in rural area (1: yes, 0: no)	Dummy variable
Living in urban area (0)	
Place of residence (three dummy variables)	
Living in Gaza Strip (1: yes, 0: no)	Dummy variable
Living in West Bank-North (1: yes, 0: no)	Dummy variable
Living in West Bank-South (1: yes, 0: no)	Dummy variable
Living in West Bank-Middle (0)	
Number of working adults	Continuous
Number of working adults in the Palestinian Authority	Continuous
Number of working adults in the Israeli sectors	Continuous
Household business as main source of income (1: yes, 0: no)	Dummy variable

The probability of being poor can be written as follows:

$$\text{Prob} (PSTA = 1) = \frac{\exp \left( \alpha + \sum_i \beta_i X_i \right)}{1 + \exp \left( \alpha + \sum_i \beta_i X_i \right)} \quad (17)$$

where the dependent variable,  $PSTA$ , takes the value 1 if the household is poor and 0 if the household is non-poor.  $X_i$  are the independent variables, and  $\varepsilon_i$  an error term.

**Table 4.1.12: Results of the Logit Regression using the Alternative Monetary Poverty Lines in the Palestinian Territory, 2004**

Parameter	National	Absolute	US\$2	Relative	Subjective
<b>Likelihood Ratio LRI</b>	<b>0.185</b>	<b>0.266</b>	<b>0.267</b>	<b>0.188</b>	<b>0.030</b>
<b>Constant</b>	<b>4.039-</b>	<b>4.872-</b>	<b>6.113-</b>	<b>4.392-</b>	<b>0.574-</b>
Number of dependents ( $x_1$ )	0.183 (0.019)	0.408 (0.022)	0.394 (0.025)	0.179 (0.019)	0.048 (0.017)
Number of aged-working adults ( $x_2$ )	0.499 (0.064)	0.162 (0.067)	0.172 (0.081)	0.512 (0.066)	*0.047- (0.061)
School years of working aged adults ( $x_3$ )	0.052- (0.005)	0.052- (0.005)	0.055- (0.007)	0.052- (0.005)	0.016- (0.004)
Number of adult males ( $x_4$ )	*0.100- (0.089)	*0.130- (0.098)	*0.071- (0.123)	*0.161- (0.094)	*0.027 (0.088)
Living in refugee camp ( $x_5$ )	*0.250 (0.131)	*0.224 (0.140)	*0.225 (0.167)	*0.264 (0.138)	*0.242- (0.134)
Living in a rural area ( $x_6$ )	0.393 (0.118)	0.519 (0.125)	0.356 (0.159)	0.471 (0.126)	0.220- (0.091)
Living in Gaza Strip ( $x_7$ )	2.563 (0.194)	2.864 (0.212)	3.252 (0.348)	2.716 (0.217)	0.554- (0.131)
Living in northern West Bank ( $x_8$ )	1.757 (0.190)	2.151 (0.207)	2.416 (0.350)	1.785 (0.214)	*0.052 (0.120)
Living in southern West Bank ( $x_9$ )	1.827 (0.196)	2.036 (0.213)	2.463 (0.349)	1.934 (0.218)	*0.086 (0.131)
Number of working adults ( $x_{10}$ )	*0.003- (0.060)	0.270 (0.065)	*0.134 (0.078)	*0.025 (0.062)	*0.069- (0.058)
Number of working adults in PA ( $x_{11}$ )	0.470- (0.109)	0.448- (0.113)	0.387- (0.153)	0.552- (0.120)	*0.069- (0.095)
Number of working adults in Israel ( $x_{12}$ )	*0.087- (0.103)	*0.047- (0.1098)	*0.004- (0.128)	*0.067- (0.107)	*0.135- (0.094)
Household business as main source of income ( $x_{13}$ )	0.581- (0.135)	0.764- (0.144)	0.498- (0.175)	0.599- (0.144)	*0.179- (0.139)
Numbers between brackets represent the Std. Errors.					
*: Insignificant indicators					

Regardless the subjective poverty line<sup>39</sup>, the results in Table 4.1.12 reveal some systematic patterns, they are:

1. Insignificant covariates are insignificant regardless of the line used.
2. The variable that most reduces the probability of poverty in advance is having a household business as a main source of income followed by number of working adults in PA.
3. The incidence of poverty is more probable in Gaza Strip than in the West Bank
4. Schooling is very significant in reducing the probability of being poor.
5. Employment in Israel is not significant despite the higher wage in Israel. The reason is expected to be related to the small sample of employment in Israel and\ or to un sustainable working days and curfews.

To have an idea of the goodness of fit of the logit regressions, a criterion that is similar to the R-square used in linear regression. This idea is to compute the maximal value of the log-likelihood ( $\ln L$ ) and compare it with the log likelihood obtained when only a constant term is used ( $\ln L_0$ ). The likelihood ratio LRI is defined as:

$LRI = 1 - (\ln L / \ln L_0)$ , where the bounds of this measure are 0 and 1, (Green, 1992). The likelihood Ratio (LRI) results show that the best results are

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<sup>39</sup> To have an idea of the fit model of the alternative poverty lines using the significant covariates, the regression was run again using one of the three covariates (number of working adults, number of working adults in PA or Israel) per time, to see if there is a multi-collinearity between these covariates affecting the results of the regression. The results showed that either one of the three covariates or all of them are used, the direction (the sign) of the coefficient of these covariates do not change, especially if the subjective poverty line is used.

obtained for absolute and US\$2 poverty indices, followed by relative and national poverty line.

## ***4.2 Totally Fuzzy Relative Approach***

This section will cover the explanation of the two approaches of the TFR poverty indices (the original and alternative specifications) and the choice of the weighting system, in addition to the criteria of selecting TFR indicators to define the membership function.

### ***4.2.1 Criteria of selecting Poverty indicators (characteristics)***

The frame of variables selected for the purpose of defining the membership function is the common variables included in the standard household expenditure and consumption survey, which was conducted by PCBS in 2004. Since, there is no robust “arithmetic” method, to tell us how to choose the indicators, and the choosing depends on the experience of the researcher in this field. In order to choose the indicators of membership function of the fuzzy set, three steps were taken.

1. First step, we depend on similar studies which were implemented in the European countries, and see what the similar indicators available in the Palestinian household expenditure and consumption survey and used as TFR indicators . The common indicators between these studies are income, dwelling condition and durable goods.
2. The second step, to be more accurate, a stepwise regression model is used. The logarithm individual consumption is regressed against various households characteristics which are believed to affect poverty in the Palestinian Territory. The variables which were

statistically significant to the consumption were selected, (*See Appendix II for detailed results*).

3. Third step, any indicators seemed to be owned by the majority or rarely owned were excluded from the model. In particular, the following variables were selected in the definition of the membership function (*Table 4.2.1*).

**Table 4.2.1: Indicators of the membership function of the TFR approach**

Variable	Type of variable
<b>Individual income</b>	<b>Ordinal</b>
<b>Socio-economic indicators of the household</b>	
Number of children	Ordinal
Income earners (at least one income earner)	Categorical
<b>Socio-economic indicators of head of the household</b>	
Age	Ordinal
Refugee status	Nominal
Educational level	Ordinal
Occupation	Categorical
<b>Dwelling conditions</b>	
<b>Density</b>	
Availability of heating	Categorical
<b>Durable goods</b>	
Private car	Categorical
Electric sweeper	Categorical
Home library	Categorical
Phone line	Categorical
Home computer	Categorical
Satellite (dish)	Categorical

		0
		1-2
		3-4
Number of children	$X_1 =$	5-6
		7-8
		9+

Number of income earners in the household

$$X2 = \begin{cases} 0 & \text{At least one income earner} \\ 1 & \text{No-income earners} \end{cases}$$

Age of head of household

$$X3 = \begin{cases} \text{Up to 24 years} \\ 25-34 \\ 35-44 \\ 45-54 \\ 55-64 \\ 65+ \end{cases}$$

Refugee status of head of household

$$X4 = \begin{cases} 0 & \text{Non-refugee} \\ 1 & \text{refugee} \end{cases}$$

Educational level of head of household

$$X5 = \begin{cases} \text{Bsc+} \\ \text{diploma} \\ \text{secondary} \\ \text{preparatory} \\ \text{elementary} \\ \text{none} \end{cases}$$



Occupation of head of household  $X6 =$  Legislators, senior officials, managers, Professionals, technical and clerks  
 Plant and machine operators and assemblers  
 Service, shop and market workers  
 Craft and related trade workers  
 Elementary occupations  
 Skilled agricultural and fishery workers  
 Unemployment  
 Out of labor

Source of heating  $X7 =$  Electricity  
 Gas  
 Kerosene  
 Wood  
 No-heating

Private car  $X8 = \begin{cases} 0 & \text{yes} \\ 1 & \text{no} \end{cases}$

Electric sweeper  $X9 = \begin{cases} 0 & \text{yes} \\ 1 & \text{no} \end{cases}$

$$\text{Home library} \quad X10 = \begin{cases} 0 & \text{yes} \\ 1 & \text{no} \end{cases}$$

$$\text{Phone line} \quad X11 = \begin{cases} 0 & \text{yes} \\ 1 & \text{no} \end{cases}$$

$$\text{Home computer} \quad X12 = \begin{cases} 0 & \text{yes} \\ 1 & \text{no} \end{cases}$$

$$\text{Satellite (dish)} \quad X13 = \begin{cases} 0 & \text{yes} \\ 1 & \text{no} \end{cases}$$

#### 4.2.2 The Estimation

The TFR method adopts two specifications of the deprivation measure,  $g(x_i)$ , according to a generic poverty index of indicator  $X$ , (equations 5,6,8).

In this context, it is noteworthy to hint that to be able to calculate  $g(x_i)$ , there is a need to sort the categories of TFR indicator in increasing order with respect to the risk of poverty. In this way the measure of  $g(x_i)$  always takes the value 0 in correspondence to the lowest category of poverty variable, (lowest risk of

poverty), and 1 in correspondence to the highest one (highest risk of poverty), (*Appendix III*).

The second step is to calculate the density and distribution functions of the specific variable. Appendix (III) represents the density functions, “ $h(x)$ ”, and the cumulative distribution functions, of the original specification  $H(x)$  and the alternative specification  $\dot{H}(x)$ , of the TFR indicators used in the calculations of the two methods of  $g(x_i)$ . Table 4.2.2 represents the values of  $g(x_i)$  using the two specifications (*equations, 6 and 8*). As mentioned before, Table 4.2.2 shows that  $g(x_i)$ , using the original specification, takes the value 0 in correspondence to the lowest category of X, (lowest risk of poverty) and 1 in correspondence to the highest risk of poverty. For example, if the 1<sup>st</sup> category of number of children (having no children), the results show that this category has the lowest risk of poverty, while if the 3<sup>rd</sup> category (3-4 children), the results show that this category has more higher risk of poverty compared with the 1<sup>st</sup> one, and lower risk of poverty compare with the last category (nine children or more). While using the alternative specification makes the aggregation of measures less controversial. Instead of giving 0 to the lowest risk of poverty and 1 for highest risk of poverty, it divided the units of variables to be better off and the remaining is considered worse off the i<sup>th</sup> one. For example, in the original specification all units in the category of having no children took the value 0, (all units were considered as less poor), while in the alternative specification part of them were considered less to be less poor and the remaining were considered poor.

The third step is to specify what type of adequate weighting system to be used. The TFR suggests different ways of calculating the adequate weighting system, (*the adequate weighting system, page 20*). In this section two types of weights were used:  $w_j = \ln(1 / P_j)$  and  $w_j = e^{-P_j}$ . The two different weight functions were applied to the original specification of the membership function. The results of these weights, for TFR indicators, are presented in Table 4.2.3a and Table 4.2.3b.

After deciding what type of weighting system to be used, the two specifications of membership function were calculated. Table 4.2.3a and Table 4.2.3b represent the results obtained using the original m.f. specification and the two specifications of the weighting system.

**Table 4.2.2: The deprivation measure,  $g(x_i)$ , values using the two specifications (the original and alternative)**

Indicators	West Bank		Gaza Strip		Palestinian Territory	
	Original	alternative	Original	alternative	Original	alternative
<b>Number of children</b>						
0	0.000	0.089	0.000	0.072	0.000	0.083
1-2	0.277	0.292	0.214	0.236	0.256	0.274
3-4	0.657	0.562	0.509	0.454	0.606	0.526
5-6	0.894	0.816	0.898	0.701	0.860	0.783
7-8	0.979	0.948	0.935	0.884	0.964	0.926
9+	1.000	0.992	1.000	0.972	1.000	0.985
<b>Number of income earners</b>						
At least one income earner	0.000	0.291	0.000	0.295	0.000	0.293
No-income earners	1.000	0.792	1.000	0.796	1.000	0.793
<b>Age of head of household</b>						
Up to 24 years	0.000	0.009	0.000	0.015	0.000	0.011
25-34	0.244	0.138	0.229	0.140	0.239	0.139
35-44	0.565	0.416	0.572	0.418	0.567	0.416
45-54	0.763	0.670	0.766	0.679	0.764	0.673
55-64	0.880	0.824	0.889	0.832	0.883	0.827
65+	1.000	0.941	1.000	0.946	1.000	0.943
<b>Refugee status of head of household</b>						
Non-refugee	0.000	0.338	0.000	0.179	0.000	0.285
refugee	1.000	0.838	1.000	0.679	1.000	0.785
<b>Educational level of head of household</b>						
Bsc+	0.000	0.042	0.000	0.063	0.000	0.049
diploma	0.076	0.118	0.076	0.159	0.076	0.132
secondary	0.206	0.213	0.318	0.299	0.244	0.242
preparatory	0.450	0.384	0.547	0.504	0.482	0.425
elementary	0.738	0.628	0.747	0.691	0.741	0.649
none	1.000	0.880	1.000	0.889	1.000	0.883
<b>Occupation of head of household</b>						
Legislators, senior officials, managers, Professionals, technical and clerks	0.000	0.073	0.000	0.099	0.000	0.081
Plant and machine operators and assemblers	0.091	0.185	0.086	0.234	0.090	0.201
Service, shop and market workers	0.219	0.277	0.248	0.333	0.228	0.296
Craft and related trade workers	0.385	0.403	0.397	0.458	0.389	0.422

**Table 4.2.2-cont.: The deprivation measure,  $g(x_i)$ , values using the two specifications (the original and alternative)**

Indicators	West Bank		Gaza Strip		Palestinian Territory	
	Original	alternative	Original	alternative	Original	alternative
Elementary occupations	0.539	0.540	0.488	0.554	0.523	0.545
Skilled agricultural and fishery workers	0.620	0.640	0.584	0.628	0.608	0.636
Unemployment	0.818	0.760	0.785	0.747	0.808	0.756
Out of labor	1.000	0.922	1.000	0.914	1.000	0.920
<b>Dwelling Attributes</b>						
<b>Source of heating</b>						
Electricity	0.000	0.060	0.000	0.113	0.000	0.078
Gas	0.451	0.319	0.076	0.255	0.335	0.298
Kerosene	0.560	0.565	0.130	0.304	0.428	0.478
Wood	0.918	0.771	0.445	0.448	0.773	0.663
No-heating	1.000	0.964	1.000	0.785	1.000	0.904
<b>Durable Goods</b>						
<b>Private car</b>						
yes	0.000	0.156	0.000	0.073	0.000	0.128
no	1.000	0.656	1.000	0.573	1.000	0.628
<b>Electric sweeper</b>						
yes	0.000	0.132	0.000	0.052	0.000	0.105
no	1.000	0.632	1.000	0.552	1.000	0.605
<b>Home library</b>						
yes	0.000	0.112	0.000	0.096	0.000	0.107
no	1.000	0.611	1.000	0.596	1.000	0.607
<b>Phone line</b>						
yes	0.000	0.208	0.000	0.176	0.000	0.197
no	1.000	0.708	1.000	0.676	1.000	0.697
<b>Home computer</b>						
yes	0.000	0.135	0.000	0.103	0.000	0.124
no	1.000	0.635	1.000	0.603	1.000	0.624
<b>Satellite (dish)</b>						
yes	0.000	0.320	0.000	0.339	0.000	0.327
no	1.000	0.821	1.000	0.839	1.000	0.827
<b>Income deciles</b>						
0 (richest 10%)	0.000	0.052	0.000	0.056	0.000	0.055
1	0.112	0.154	0.103	0.157	0.111	0.160
2	0.218	0.251	0.213	0.252	0.216	0.256
3	0.320	0.345	0.326	0.351	0.328	0.353
4	0.433	0.441	0.443	0.453	0.437	0.451
5	0.539	0.539	0.565	0.559	0.548	0.548
6	0.650	0.637	0.670	0.660	0.660	0.648
7	0.757	0.734	0.789	0.759	0.771	0.747
8	0.874	0.834	0.895	0.860	0.884	0.846
9 (poorest 10%)	1.000	0.944	1.000	0.954	1.000	0.949

**Table 4.2.3a: TFR Poverty Indices according to the Original Specification  
using  $w_j = \ln(1/P_j)$  type of weights**

Poverty indicators	$w_j = \ln(1/P_j)$					
	West Bank		Gaza Strip		Palestinian Territory	
	Weight ( $w_j$ )	m.f ( $p_j$ )	Weight ( $w_j$ )	m.f ( $p_j$ )	Weight ( $w_j$ )	m.f ( $p_j$ )
<b>Scio-economic indicators of the household</b>	<b>0.768</b>	<b>0.464</b>	<b>0.762</b>	<b>0.467</b>	<b>0.773</b>	<b>0.462</b>
Number of children	0.638	0.528	0.589	0.555	0.641	0.527
Number of income earners in the household	0.875	0.417	0.894	0.409	0.881	0.414
<b>Scio-economic indicators of the head of household</b>	<b>0.775</b>	<b>0.461</b>	<b>0.605</b>	<b>0.546</b>	<b>0.684</b>	<b>0.505</b>
Age of head of household	0.505	0.604	0.511	0.600	0.507	0.602
Refugee status of head of household	1.128	0.324	0.443	0.642	0.843	0.430
Educational level of head of household	0.570	0.566	0.628	0.534	0.592	0.553
Occupation of head of household	0.706	0.494	0.767	0.464	0.727	0.484
<i>Dwelling Attributes</i>	<b>0.522</b>	<b>0.593</b>	<b>0.600</b>	<b>0.549</b>	<b>0.607</b>	<b>0.545</b>
Source of heating	0.522	0.593	0.600	0.549	0.607	0.545
<i>Lack of Durable Goods</i>	<b>0.569</b>	<b>0.566</b>	<b>0.613</b>	<b>0.542</b>	<b>0.570</b>	<b>0.565</b>
Private car	0.374	0.688	0.158	0.854	0.296	0.744
Electric sweeper	0.306	0.736	0.110	0.896	0.236	0.790
Home library	0.253	0.777	0.214	0.807	0.240	0.787
Phone line	0.536	0.585	0.432	0.649	0.500	0.607
Home computer	0.314	0.730	0.230	0.794	0.285	0.752
Satellite (dish)	1.025	0.359	1.135	0.321	1.061	0.346
<i>Income deprivation</i>	<b>0.697</b>	<b>0.498</b>	<b>0.705</b>	<b>0.494</b>	<b>0.704</b>	<b>0.494</b>
<i>TFR Poverty Index</i>		<b>0.508</b>		<b>0.516</b>		<b>0.510</b>

**Table 4.2.3b: TFR Poverty Indices according to the Original Specification**  
**using  $w_j = e^{-P_j}$  type of weights**

Poverty indicators	$w_j = e^{-P_j}$					
	West Bank		Gaza Strip		Palestinian Territory	
	Weight ( $w_j$ )	m.f ( $p_i$ )	Weight ( $w_j$ )	m.f ( $p_i$ )	Weight ( $w_j$ )	m.f ( $p_i$ )
<b>Scio-economic indicators of the household</b>	<b>0.625</b>	<b>0.469</b>	<b>0.621</b>	<b>0.477</b>	<b>0.627</b>	<b>0.467</b>
Number of children	0.590	0.528	0.574	0.555	0.590	0.527
Number of income earners in the household	0.659	0.417	0.664	0.409	0.661	0.414
<b>Scio-economic indicators of the head of household</b>	<b>0.616</b>	<b>0.485</b>	<b>0.574</b>	<b>0.555</b>	<b>0.599</b>	<b>0.513</b>
Age of head of household	0.547	0.604	0.549	0.600	0.548	0.602
Refugee status of head of household	0.724	0.324	0.526	0.642	0.650	0.430
Educational level of head of household	0.568	0.566	0.587	0.534	0.575	0.553
Occupation of head of household	0.610	0.494	0.628	0.464	0.617	0.484
<i>Dwelling Attributes</i>	<b>0.553</b>	<b>0.593</b>	<b>0.578</b>	<b>0.549</b>	<b>0.580</b>	<b>0.545</b>
Source of heating	0.553	0.593	0.578	0.549	0.580	0.545
<i>Lack of Durable Goods</i>	<b>0.536</b>	<b>0.624</b>	<b>0.508</b>	<b>0.678</b>	<b>0.525</b>	<b>0.643</b>
Private car	0.502	0.688	0.426	0.854	0.475	0.744
Electric sweeper	0.479	0.736	0.408	0.896	0.454	0.790
Home library	0.460	0.777	0.446	0.807	0.545	0.787
Phone line	0.557	0.585	0.552	0.649	0.471	0.607
Home computer	0.482	0.730	0.452	0.794	0.707	0.752
Satellite (dish)	0.699	0.359	0.725	0.321	0.610	0.346
<i>Income deprivation</i>	<b>0.608</b>	<b>0.498</b>	<b>0.610</b>	<b>0.494</b>	<b>0.610</b>	<b>0.494</b>
<i>TFR Poverty Index</i>		<b>0.530</b>		<b>0.546</b>		<b>0.530</b>



Table 4.2.3a shows that the  $P$  index (equation 11) of the original specification of TFR, using  $w_j = \ln(1/P_j)$ , stood at 51.0% in the Palestinian Territory. This index shows that the Palestinian Territory displays the lowest value for the socio-economic indicators, and highest value for durable goods deprivations. In particular, with the original specification, using  $w_j = \ln(1/P_j)$ , the Palestinian Territory appears to be poorer according to durable goods and dwelling attributes. The results in Table 4.2.3b show that the  $P$  index of the original specification of TRF, using  $w_j = e^{-P_j}$ , follows a similar pattern.

In spite of the fact that  $P$  index can be calculated for all indicators, it can be calculated for particular categories of them. The socio-economic indicators of the household gave a deprivation of 46.2%, the socio-economic indicators of the household head gave a deprivation of 50.5%, while dwelling attributes gives a deprivation of 54.5%, and income gave a deprivation 49.4%.

The  $P$  index of the original specification of TFR, using  $w_j = \ln(1/P_j)$ , stood at 50.8% in the West Bank. This index shows that the West Bank displays the lowest value for the socio-economic indicators of the head of household, and the highest value for dwelling attributes and lack of durable goods deprivations. In particular, with the original specification, using  $w_j = \ln(1/P_j)$ , the West Bank households appears to be poorer according to durable goods and dwelling attributes. The results show that the  $P$  index of the original specification of TFR, using  $w_j = e^{-P_j}$ , follows a similar pattern. The socio-economic indicators of the West Bank households gave a deprivation of 46.4%, the socio-economic indicators of the heads of households in the West

Bank gave a deprivation of 46.1%, while dwelling attributes gives a deprivation of 59.3%, and income gave a deprivation 49.8%.

While in Gaza Strip, The  $P$  index of the original specification of TRF, using  $w_j = \ln(1/P_j)$ , gave a deprivation of 51.6%. This index shows that Gaza Strip displays the lowest value of dwelling attributes and lack of durable goods and highest value of socio-economic indicators of household and income deprivations. The results showed that the  $P$  index of the original specification of TRF, using  $w_j = e^{-P_j}$ , follows a similar pattern.

To compare the different situations (populations or sub-regions or categories, etc..), there is a need to anchor the m.f to a reference situation\ or category. In this section, the Palestinian Territory will be used as a reference population. This kind of anchor (standardization) can be defined as follows, (Bruno Cheli 2001):

$$P^{B/A} = \sum_{k=1}^m g(x)^A . h(x)^B \quad (18)$$

where  $B$  is the compared population, and  $A$  is the reference population.

Table 4.2.4 shows the comparison at the geographical regions (West Bank and Gaza Strip) using the National level as reference category . Results obtained using the original m.f specification, using  $w_j = \ln(1/P_j)$  weighting system are reported in Table 4.2.4 whereas Table 4.2.5 contains results obtained using the alternative specification. Comparing the two different m.f. specifications, an identical pattern for the specific indices was observed. The figures show that

Gaza Strip appears to be the poorest region. In addition to that the results show that Gaza Strip displays the lowest value of socio-economic indicators and highest value of dwelling attributes, while the results show that the West Bank displays the lowest value of socio-economic deprivation and highest value for lack of durable goods. This fact suggests that in Gaza Strip a fixed income amount allows a worse standard of living than West Bank.

Since there is no robust “arithmetic” method, to tell us how to choose the indicators, the TFR poverty index was calculated using the common indicators compared with the European countries. These are income, dwelling condition and durable goods. According to these indicators, the TFR poverty index, using the original specification and  $w_j = \ln(1 / P_j)$ , gave a deprivation of 53.2% in the Palestinian Territory, (of which 54.7% in the West Bank, and 52.7% in Gaza Strip), while using  $w_j = e^{-P_j}$ , gave a deprivation of 55.7% in the Palestinian Territory, (of which 56.9% in the West Bank and 56.8% in Gaza Strip).

**Table 4.2.4: TFR Poverty Indices according to the Original Specification (reference category National Level)**

Poverty indicators	Palestinian Territory		West Bank	Gaza Strip	PT	West Bank	Gaza Strip
	$w_j = \ln(1/P_j)$	m.f			$w_j = e^{-P_j}$		
<b>Scio-economic indicators of the household</b>	<b>0.773</b>	<b>0.462</b>	<b>0.452</b>	<b>0.482</b>	<b>0.627</b>	<b>0.456</b>	<b>0.490</b>
Number of children	0.641	0.527	0.500	0.581	0.590	0.500	0.581
Number of income earners in the household	0.881	0.414	0.417	0.409	0.661	0.417	0.409
<b>Scio-economic indicators of the head of household</b>	<b>0.684</b>	<b>0.505</b>	<b>0.479</b>	<b>0.556</b>	<b>0.599</b>	<b>0.492</b>	<b>0.554</b>
Age of head of household	0.507	0.602	0.604	0.600	0.548	0.604	0.600
Refugee status of head of household	0.843	0.430	0.324	0.642	0.650	0.324	0.642
Educational level of head of household	0.592	0.553	0.578	0.504	0.575	0.578	0.504
Occupation of head of household	0.727	0.484	0.491	0.469	0.617	0.491	0.469
<i>Dwelling Attributes</i>	<b>0.607</b>	<b>0.545</b>	0.489	0.656	<b>0.580</b>	0.489	0.656
Source of heating	0.607	0.545	0.489	0.656	0.580	0.489	0.656
<i>Lack of Durable Goods</i>	<b>0.570</b>	<b>0.565</b>	<b>0.552</b>	<b>0.592</b>	<b>0.525</b>	0.622	0.687
Private car	0.296	0.744	0.688	0.854	0.475	0.688	0.854
Electric sweeper	0.236	0.790	0.736	0.896	0.454	0.736	0.896
Home library	0.240	0.787	0.777	0.807	0.545	0.777	0.807
Phone line	0.500	0.607	0.585	0.649	0.471	0.585	0.649
Home computer	0.285	0.752	0.730	0.794	0.707	0.730	0.794
Satellite (dish)	1.061	0.346	0.359	0.321	0.610	0.359	0.321
<i>Income deprivation</i>	<b>0.704</b>	<b>0.494</b>	0.503	0.489	<b>0.610</b>	0.503	0.489
<i>TFR Poverty Index</i>		<b>0.510</b>	<b>0.500</b>	<b>0.555</b>		<b>0.503</b>	<b>0.565</b>
<i>TFR Poverty Index*</i>		<b>0.532</b>	<b>0.513</b>	<b>0.574</b>	<b>0.557</b>	<b>0.535</b>	<b>0.606</b>

\* TFR poverty index covers: dwelling attributes, Lack of durable goods and Income deprivation

Table 4.2.4 represents the comparison at the geographical regions (West Bank and Gaza Strip) using the National level as reference category. Results obtained using **the original m.f specification**, using  $w_j = \ln(1/P_j)$  and  $w_j = e^{-P_j}$  weighting system. The figures showed that Gaza Strip appears to be the poorest region, what ever weighting system is used.

**Table 4.2.5: TFR Poverty Indices according to the Alternative Specification (reference category National Level)**

Poverty indicators	Palestinian Territory	West Bank	Gaza Strip
<b>Scio-economic indicators of the household</b>	<b>0.5</b>	<b>0.489</b>	<b>0.525</b>
Number of children	0.5	0.476	0.552
Number of income earners in the household	0.5	0.501	0.498
<b>Scio-economic indicators of the head of household</b>	<b>0.5</b>	<b>0.494</b>	<b>0.513</b>
Age of head of household	0.5	0.501	0.497
Refugee status of head of household	0.5	0.447	0.606
Educational level of head of household	0.5	0.502	0.460
Occupation of head of household	0.5	0.507	0.487
<i>Dwelling Attributes</i>	<b>0.5</b>	0.447	0.606
Source of heating	0.5	0.447	0.606
<i>Lack of Durable Goods</i>	<b>0.5</b>	<b>0.448</b>	<b>0.525</b>
Private car	0.5	0.472	0.555
Electric sweeper	0.5	0.473	0.553
Home library	0.5	0.495	0.510
Phone line	0.5	0.489	0.521
Home computer	0.5	0.489	0.521
Satellite (dish)	0.5	0.506	0.488
<i>Income deprivation</i>	<b>0.5</b>	0.508	0.495
<b>TFR Poverty Index</b>	<b>0.5</b>	<b>0.485</b>	<b>0.553</b>

Table 4.2.5 represents the comparison at the geographical regions (West Bank and Gaza Strip) using the National level as reference category. Results obtained using the **alternative *m.f* specification**, using  $w_j = \ln(1/P_j)$  weighting system. The figures showed that Gaza Strip appears to be the poorest region.

## Chapter Five

### **Comprehensive Analysis among the different Approaches**

The main purpose of this chapter is to discuss dichotomization in the monetary classification and examine a number of model-based alternatives to measure and analyze basic poverty indicators using a multidimensional approach that utilize additional information for classifying households by poverty status using fuzzy set conceptual framework and latent class analysis.

#### ***5.1 Latent class analysis approach***

The analysis presented in this section is based on Latent Class Analysis (LC) using the software of Latent Gold 3.0, which is based on Newton-Raphson algorithm. The specification of symptoms used in the analysis are the same as the characteristics used in the definition of the membership function of fuzzy set approach mentioned earlier.

The notion of using LC analysis is to group the fuzzy membership indicators in a way that will enables us to compare the outcome with the monetary standard classification. This analysis will enable us to judge which poverty classification method is more fit for the Palestinian data.

If the outcome of LC analysis classified the fuzzy membership indicators into two clusters (cluster 1 and cluster 2), and if the cross-tabulation between the outcome of LC and monetary clusters (poor and non-poor) showed that the poor were identical to the cluster 1 and non-poor were identical to cluster 2,

then the monetary approach fits the Palestinian data better otherwise the TFR will be fit better to the Palestinian data.

Table 5.1.3 presents the mean probability that households belong to a certain latent cluster. The out-put of the LC shows that the TFR indicators were classified into six clusters. This means that the characteristics of the Palestinian households are not identical and can not be classified as just into poor and non-poor and this can be proved by looking at Table 5.1.1 and see how poor households according to the monetary approaches are spread over the LC clusters not only into two clusters. In other words, if monetary approach was used then we are classifying different households with different characteristics in the same cluster.

Table 5.1.3 shows that the first cluster is highly identical to TFR definition (significant), and cluster 2 is partially identical (significant), while other clusters are only marginally identical to TFR definition (less significant). When the indicator is increasing with respect to risk of poverty, its mean probability is more likely to fall in cluster 1. For example, in TFR, more children in the household means high risk of poverty, and less number of children in the households means low risk of poverty. The same approach can be said about other clusters. More children in the households means more probability to be in cluster 1, (the mean probability of households with no children to be classified in cluster 1 is 0.02, while the mean probability of households with nine children and more to be classified in cluster 1 is 0.76), and less number of children means less probability to be in cluster 1 and more probability to be classified in other clusters, (the mean probability of

households with no children to be classified in cluster 5 is 0.44, while the mean probability for households with nine children or more is 0.0). this analysis follows the same direction for other indicators and clusters. The analysis assumes interesting findings supporting the argument that TFR is more fit to the Palestinian situation than the monetary “one-proxy” approach.

### ***5.2 The degree of Overlapping between the Various Approaches***

To check the degree of the overlapping between the various poverty indices, the value of TFR index, using the original specification, was ranked into two categories (category 1 gives highest risk of poverty,  $P > 0.50$ , and assumed to be poor, while category 2 gives lowest risk of poverty,  $P \leq 0.50$ , and assumed to be non-poor). Cluster 1 is assumed to represent the poor households, whatever the poverty index was selected. The comparison between the assumed poverty and the different types of poverty is presented in Table 5.1.1.

**Table 5.1.1: Distribution of households by Poverty Status by Type Poverty Line and latent Cluster Model**

Poverty Line	Clusters						Total
	1	2	3	4	5	6	
National	66.1	5.8	9.9	2.1	14.2	1.8	25.6
Absolute	73.8	6.9	8.6	3.1	6.9	0.7	26.0
US\$ 2 per day	84.8	2.4	4.9	1.7	5.9	0.2	13.9
Relative	68.7	4.7	9.4	1.7	13.9	1.7	21.6
Subjective	38.2	19.9	16.7	9.0	9.8	6.3	25.0
TFR	58.4	7.6	10.0	0.8	20.2	3.1	50.0

The results show that 19.6% (66.1% out of 25.6%) of households defined as poor are the same household if the national poverty line is used, 19.2% if the absolute poverty line is used, 11.8% if the US\$2 is used, 14.8% if the relative poverty line is used, 9.6% if the subjective poverty line is used, and 29.2% of poor households are the same households if the TFR poverty line is used.



Another comparison is made between the assumed TFR poverty line ( $P=0.50$ ) and the monetary approaches. The comparison is presented in table (5.1.2). it appears that 5.6% of households were poor whatever poverty index was selected. The highest common percentage is observed if the TFR is used, and the other percentages are somehow lower. 1.4% (25.6% out of 5.6%) when comparing the average with the national poverty line, 1.5% when comparing with the absolute index, 1.2% when comparing with relative poverty index, and 1.4% when comparing with subjective poverty index. The lowest common percentage is observed when comparing with US\$2 index, (0.8%).

**Table 5.1.2: Degree of Overlapping between the Various Approaches of Monetary Poverty Line and TRF Poverty Line**

	National	Absolute	US\$2	Relative	Subjective	TRF	Total
National	<b>100.0</b>	86.4 (22.1)	54.1 (13.8)	84.2 (21.6)	42.1 (10.8)	81.6 (20.9)	25.6
Absolute	84.9 (22.1)	<b>100.0</b>	53.2 (13.8)	75.2 (19.6)	42.1 (10.9)	81.5 (21.2)	26.0
US\$2	100.0 (13.8)	100.0 (13.8)	<b>100.0</b>	98.8 (13.7)	47.4 (6.6)	89.9 (12.5)	13.9
Relative	100.0 (21.6)	90.9 (19.6)	63.5 (13.7)	<b>100.0</b>	43.2 (9.3)	84.1 (18.2)	21.6
Subjective	43.2 (10.8)	43.9 (10.9)	26.3 (6.6)	37.3 (9.3)	<b>100.0</b>	54.1 (13.5)	25.0
TFR	41.7 (20.9)	42.4 (21.2)	24.9 (12.5)	36.3 (18.2)	27.0 (13.5)	<b>100.0</b>	<b>50.0</b>
Average	25.6	26.0	13.9	21.6	25.0	100.0	<b>5.6</b>
<i>Numbers between brackets represent Symmetrical Matrix</i>							

**Table 5.1.3: Mean Probability of Latent Class Analysis of Households by Cluster**

Symptom	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
<b>Overall Probability</b>	0.321	0.209	0.148	0.123	0.114	0.081
<b>Number of children</b>						
0	0.022	0.025	0.158	0.076	0.442	0.277
1-2	0.155	0.163	0.282	0.145	0.131	0.124
3-4	0.332	0.296	0.168	0.150	0.032	0.023
5-6	0.549	0.264	0.056	0.124	0.004	0.002
7-8	0.615	0.269	0.010	0.101	0.000	0.004
9+	0.763	0.197	0.009	0.030	0.000	0.001
<b>Number of income earners</b>						
At least one income earner	0.298	0.233	0.163	0.111	0.106	0.088
No-income earners	0.350	0.186	0.133	0.134	0.122	0.075
<b>Age of head of household</b>						
Up to 24 years	0.064	0.023	0.896	0.017	-	0.000
25-34	0.275	0.160	0.451	0.109	0.001	0.003
35-44	0.456	0.307	0.069	0.155	0.005	0.008
45-54	0.403	0.299	0.015	0.168	0.039	0.077
55-64	0.250	0.110	0.001	0.115	0.270	0.254
65+	0.059	0.027	-	0.019	0.613	0.282
<b>Refugee status of head of household</b>						
Non-refugee	0.298	0.233	0.163	0.111	0.106	0.088
refugee	0.350	0.186	0.133	0.134	0.122	0.075
<b>Educational level of head of household</b>						
Bsc+	0.055	0.151	0.044	0.699	-	0.051
diploma	0.111	0.278	0.091	0.430	-	0.090
secondary	0.291	0.307	0.231	0.109	0.001	0.061
preparatory	0.383	0.291	0.235	0.028	0.009	0.054
elementary	0.451	0.211	0.177	0.007	0.057	0.098
none	0.350	0.077	0.051	0.001	0.408	0.113
<b>Occupation of head of household</b>						
Legislators, senior officials, managers, Professionals, technical and clerks	0.041	0.114	0.103	0.723	0.002	0.017
Plant and machine operators and assemblers	0.308	0.400	0.270	0.012	0.000	0.009

**Table 5.1.3-Cont.: Mean Probability of Latent Class Analysis of Households by Cluster**

<b>Symptom</b>	<b>Cluster 1</b>	<b>Cluster 2</b>	<b>Cluster 3</b>	<b>Cluster 4</b>	<b>Cluster 5</b>	<b>Cluster 6</b>
Service, shop and market workers	0.261	0.377	0.245	0.000	0.044	0.074
Craft and related trade workers	0.309	0.368	0.269	-	0.015	0.040
Elementary occupations	0.490	0.160	0.222	-	0.063	0.064
Skilled agricultural and fishery workers	0.508	0.134	0.079	-	0.197	0.082
Unemployment	0.573	0.178	0.078	-	0.078	0.094
Out of labor	0.238	0.094	0.035	-	0.423	0.209
<b>Dwelling Attributes</b>						
<b>Source of heating</b>						
Electricity	0.168	0.259	0.216	0.197	0.075	0.085
Gas	0.143	0.328	0.156	0.170	0.072	0.132
Kerosene	0.223	0.268	0.140	0.145	0.097	0.127
Wood	0.471	0.154	0.109	0.060	0.152	0.054
No-heating	0.505	0.084	0.139	0.083	0.150	0.039
<b>Durable Goods</b>						
<b>Private car</b>						
yes	0.155	0.430	0.098	0.202	0.007	0.108
no	0.378	0.141	0.164	0.098	0.147	0.073
<b>Electric sweeper</b>						
yes	0.017	0.429	0.082	0.286	0.006	0.179
no	0.395	0.159	0.163	0.086	0.139	0.059
<b>Home library</b>						
yes	0.096	0.315	0.072	0.357	0.018	0.141
no	0.387	0.180	0.169	0.059	0.140	0.065
<b>Phone line</b>						
yes	0.137	0.362	0.038	0.236	0.057	0.171
no	0.437	0.118	0.214	0.055	0.148	0.028
<b>Home computer</b>						
yes	0.089	0.452	0.021	0.301	0.014	0.124
no	0.399	0.133	0.188	0.066	0.146	0.068
<b>Satellite (dish)</b>						
yes	0.239	0.287	0.156	0.164	0.047	0.108
no	0.488	0.062	0.133	0.045	0.240	0.032

**Table 5.1.3-Cont.: Mean Probability of Latent Class Analysis of Households by Cluster**

Symptom	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
<b>Income deciles</b>						
0 (richest 10%)	0.009	0.199	0.153	0.295	0.064	0.280
1	0.015	0.227	0.171	0.236	0.124	0.228
2	0.040	0.269	0.225	0.214	0.127	0.123
3	0.079	0.303	0.211	0.179	0.150	0.079
4	0.192	0.275	0.211	0.146	0.136	0.040
5	0.311	0.257	0.213	0.066	0.122	0.030
6	0.411	0.251	0.139	0.057	0.129	0.013
7	0.579	0.164	0.076	0.023	0.148	0.012
8	0.770	0.093	0.055	0.012	0.066	0.005
9 (poorest 10%)	0.840	0.055	0.026	0.002	0.074	0.004

*The optimal number of clusters was chosen on the basis of minimum BIC and p value >5%.*

*BIC (based on L2), AIC (based on L2) and CAIC (based on L2). In addition to model fit, these statistics take into account the parsimony (df or Npar) of the model. When comparing models, the lower the BIC, AIC and CAIC value the better the model.*

*L-squared (L2). The Model Fit likelihood ratio chi-squared statistic (L2) is used to assess how well the model fits the data. It indicates the amount of the relationship between the variables that remains unexplained by a model; the larger the value, the poorer the model fits the data. As a rule of thumb, a good fit is provided by a model when the L2 for that model is not substantially larger than the degrees of freedom.*

*X-squared and Cressie-Read. These are alternatives to L2 that should yield a similar p-value according to large sample theory if the model specified is valid. If they do not yield similar p-values, the reported p-value for L2 may not be valid.*

## Chapter Six

### **Conclusions and Recommendations**

#### ***6.1 Main Findings***

The approaches discussed in the above chapters are based on different scientific ground references. All models (monetary, fuzzy and latent class) depend on well-established mathematical concepts. Monetary approach is based on the concept of dichotomization the population into two groups, poor and non-poor, using a cut-off point with sharp boundaries. Fuzzy approach is based on the concept of fuzziness and lack of sharp boundaries in the categorization of households in reference to poverty indicators, and latent class analysis is based on the concept of statistical independence in classifying households with respect to certain symptoms on the basis of parametric model.

As for the drawbacks of each model, one could easily identify that the monetary approach is too summarized and leads to loss of information and ignores also vital information, which might lead to irrelevant comparisons between different situations and different populations. The fuzzy set approach suffers from explanation and the possibilities of comparing indices. The other drawback of the fuzzy set is that it gives an equal weight for all vector variables used in the specification, and this may be not true since homogeneity of the variables differs within the same population and between populations.

As for the precision of each model in describing the data, we should have a true model to compare with, but as we don't have the true model, we restrict

ourselves on the comparison between the data generated by the monetary classification with the data generated by the different model-based alternatives.

## **6.2 Recommendations**

To conduct a comprehensive study and to identify the determinants of poverty in the Palestinian Territory, there is a need to use and analyze all models together.

Even within the drawbacks of the fuzzy models, it seems to be a better model to be used in the Palestinian Territory compared with the monetary one. This argument based on the following:

1. Same concept of the monetary poverty approach can be calculated by different ways, which leads to misleading comparison within and between regions and countries. In addition to that, various definitions of the monetary approach give different results.
2. The analysis showed that the monetary approaches classifies different households in the same cluster even they have different characteristics.
3. The TFR method has an advantage of covering a wider array of attributes for the measurement of poverty compared with the monetary approach.
4. While monetary approach is useful of understanding the living conditions, but our interest is in other non-monetary indicators. First, households with the same amount of money (income or consumption), may have different interests and priorities. For example, a newly wedded couple interest in having a dwelling is more than other groups, either if both have the same amount of money.

5. Another issue is that sometimes the monetary approach gives a misleading results and does not give a full picture about the reasons of poverty if we deal of poverty as a development index not only as a hunger matter. Even the monetary and TFR figures show that Gaza Strip appears to be the poorest region, but the results show that poverty in Gaza Strip is a matter of dwelling attributes deprivation, while in the West Bank, it is a matter of lack of durable goods. In addition to that, the TFR poverty index shows that the household standard of living in Gaza Strip is worse than the West Bank, which means that with a fixed income amount, either in the West Bank or Gaza Strip, allows a worse standard of living in Gaza Strip than the West Bank, (Table 4.2.4).

Using LC analysis seems to be an essential parallel step to fuzzy model. Using LC analysis to group the fuzzy membership indicators enables us to determine the most deprived households (specifying the characteristics of households with highest risk of poverty), (Table 5.1.3).

To face the weakness in the fuzzy models, there is a need to establish a robust statistical solution for the following drawbacks in the model:

The model suggests a weighting system for the indicators within the same population, but it does not give a solution (method) how to reflect the importance (weights) of these indicators if comparisons between two populations is made.

Literature review shows that the choice of poverty indicators, used in the model, depend on the experience of the researcher and it does not give a mathematical procedure how to choose these indicators.

The model depends basically on the discrete and ordinal variables and gives the same distance (weights) for the categories of the variable.



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## **Appendixes**

## Appendix I

**Results of the Logit Regression using the Alternative Monetary Poverty  
Lines in the Palestinian Territory, 2004**

**Definition of explanatory variables used in the logit regression**

Variable name	Descriptive
dependen	Number of dependents
ag18	Number of aged-working adults
agschool	School years of working aged adults (total)
males	Number of adults males
refugee	Living in refugee camp
rural	Living in a rural area
gs	Living in Gaza Strip
wbn	Living in northern West Bank
wbs	Living in southern West Bank
agworkin	Number of working adults
pa	Number of working adults in PA
isi	Number of working adults in Israel
msincom	Household business as main source of income

**Appendix I: National Poverty Index**

```
logit national dependen ag18 agschool males refugee rural gs wbn wbs agworkin
> pa isi msincom [iweight = rw]
Iteration 0: log likelihood = -1762.1086
Iteration 1: log likelihood = -1463.103
Iteration 2: log likelihood = -1436.6717
Iteration 3: log likelihood = -1435.2908
Iteration 4: log likelihood = -1435.2819
Iteration 5: log likelihood = -1435.2819
Logistic regression
Number of obs = 3098
LR chi2(13) = 653.65
Prob > chi2 = 0.0000
Pseudo R2 = 0.1855
Log likelihood = -1435.2819
```

national	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
dependen	.1833493	.0185375	9.89	0.000	.1470164 .2196821
ag18	.4987787	.0638389	7.81	0.000	.3736567 .6239008
agschool	-.0524467	.0046585	-11.26	0.000	-.0615772 -.0433162
males	-.1002781	.089098	-1.13	0.260	-.274907 .0743507
refugee	.2503086	.1311887	1.91	0.056	-.0068165 .5074337
rural	.3925946	.1181559	3.32	0.001	.1610134 .6241758
gs	2.562626	.1935077	13.24	0.000	2.183358 2.941894
wbn	1.756971	.1897216	9.26	0.000	1.385124 2.128819
wbs	1.8274	.1955205	9.35	0.000	1.444187 2.210613
agworkin	-.0027645	.0594849	-0.05	0.963	-.1193528 .1138239
pa	-.4700031	.1091678	-4.31	0.000	-.683968 -.2560381
isi	-.086848	.1031881	-0.84	0.400	-.289093 .115397
msincom	-.580974	.1353993	-4.29	0.000	-.8463516 -.3155963
_cons	-4.03943	.216818	-18.63	0.000	-4.464386 -3.614475



**Appendix I: Absolute Poverty Index**

```
. logit absolute dependen ag18 agschool males refugee rural gs wbn wbs agworkin
> pa isi msincom [iweight = rw]
```

```
Iteration 0: log likelihood = -1776.6172
Iteration 1: log likelihood = -1353.8563
Iteration 2: log likelihood = -1307.6208
Iteration 3: log likelihood = -1303.8422
Iteration 4: log likelihood = -1303.7854
Iteration 5: log likelihood = -1303.7854
```

```
Logistic regression                                Number of obs =      3098
                                                    LR chi2(13)    =      945.66
                                                    Prob > chi2    =      0.0000
Log likelihood = -1303.7854                       Pseudo R2     =      0.2661
```

	absolute	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
dependen		.4083495	.0217732	18.75	0.000	.3656748 .4510242
ag18		.1623724	.0670929	2.42	0.016	.0308727 .2938721
agschool		-.0523759	.0050235	-10.43	0.000	-.0622218 -.04253
males		-.1296533	.0978236	-1.33	0.185	-.321384 .0620773
refugee		.2239652	.1402344	1.60	0.110	-.0508892 .4988195
rural		.5185631	.1244655	4.17	0.000	.2746152 .762511
gs		2.864187	.2121672	13.50	0.000	2.448347 3.280027
wbn		2.150963	.2067647	10.40	0.000	1.745712 2.556214
wbs		2.035946	.2127744	9.57	0.000	1.618916 2.452976
agworkin		.269799	.0648171	4.16	0.000	.1427599 .3968382
pa		-.4484043	.113395	-3.95	0.000	-.6706545 -.2261541
isi		-.0470912	.1098032	-0.43	0.668	-.2623015 .1681191
msincom		-.7635409	.1439911	-5.30	0.000	-1.045758 -.4813235
_cons		-4.872341	.2437327	-19.99	0.000	-5.350048 -4.394633

**Appendix I: US\$2 Poverty Index**

```
. logit us2 dependen ag18 agschool males refugee rural gs wbn wbs agworkin pa i
> si msincom [iweight = rw]
```

```
Iteration 0: log likelihood = -1246.1907
Iteration 1: log likelihood = -978.04785
Iteration 2: log likelihood = -920.62861
Iteration 3: log likelihood = -914.29608
Iteration 4: log likelihood = -913.88687
Iteration 5: log likelihood = -913.88269
Iteration 6: log likelihood = -913.88269
```

```
Logistic regression                                Number of obs =      3098
                                                    LR chi2(13)    =      664.62
                                                    Prob > chi2    =      0.0000
Log likelihood = -913.88269                       Pseudo R2     =      0.2667
```

	us2	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
dependen		.3943203	.0253983	15.53	0.000	.3445405 .4441
ag18		.1718983	.0809249	2.12	0.034	.0132884 .3305082
agschool		-.0550457	.0060726	-9.06	0.000	-.0669478 -.0431437
males		-.0711865	.1226025	-0.58	0.561	-.3114829 .16911
refugee		.2252738	.1672283	1.35	0.178	-.1024875 .5530352

rural		.356465	.1590862	2.24	0.025	.0446618	.6682681
gs		3.252018	.3480962	9.34	0.000	2.569762	3.934274
wbn		2.415958	.3495727	6.91	0.000	1.730808	3.101108
wbs		2.462527	.3491905	7.05	0.000	1.778127	3.146928
agworkin		.1338032	.0774752	1.73	0.084	-.0180453	.2856518
pa		-.3865156	.15284	-2.53	0.011	-.6860765	-.0869546
isi		-.0037491	.1276889	-0.03	0.977	-.2540147	.2465165
msincom		-.4983482	.1746989	-2.85	0.004	-.8407517	-.1559447
_cons		-6.112649	.3873264	-15.78	0.000	-6.871795	-5.353503

**Appendix I: Relative Index**

```
. logit relative dependen ag18 agschool males refugee rural gs wbn wbs agworkin
> pa isi msincom [iweight = rw]
```

```
Iteration 0: log likelihood = -1614.6339
Iteration 1: log likelihood = -1342.0792
Iteration 2: log likelihood = -1312.4624
Iteration 3: log likelihood = -1310.5931
Iteration 4: log likelihood = -1310.5725
Iteration 5: log likelihood = -1310.5725
```

```
Logistic regression                                Number of obs =          3098
                                                    LR chi2(13) =           608.12
                                                    Prob > chi2 =            0.0000
Log likelihood = -1310.5725                       Pseudo R2 =             0.1883
```

relative		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
dependen		.1786896	.0192781	9.27	0.000	.1409053 .216474
ag18		.5124674	.0661081	7.75	0.000	.3828979 .6420369
agschool		-.0521653	.0048738	-10.70	0.000	-.0617177 -.0426129
males		-.1608901	.0934945	-1.72	0.085	-.3441359 .0223557
refugee		.264312	.1376937	1.92	0.055	-.0055626 .5341867
rural		.4714982	.1261557	3.74	0.000	.2242376 .7187588
gs		2.716428	.2170398	12.52	0.000	2.291038 3.141818
wbn		1.785485	.2139833	8.34	0.000	1.366085 2.204884
wbs		1.934221	.2183632	8.86	0.000	1.506237 2.362205
agworkin		.0245037	.0617827	0.40	0.692	-.0965882 .1455956
pa		-.5518502	.1202804	-4.59	0.000	-.7875953 -.316105
isi		-.0668523	.1069139	-0.63	0.532	-.2763998 .1426951
msincom		-.5985124	.144331	-4.15	0.000	-.8813959 -.3156289
_cons		-4.391691	.2413484	-18.20	0.000	-4.864725 -3.918657

**Appendix I: Subjective Poverty Index**

```
. logit subjtive dependen ag18 agschool males refugee rural gs wbn wbs agworkin
> pa isi msincom [iweight = rw]
```

Iteration 0: log likelihood = -1740.883  
Iteration 1: log likelihood = -1690.2232  
Iteration 2: log likelihood = -1689.0576  
Iteration 3: log likelihood = -1689.0554

Logistic regression

Number of obs	=	3098
LR chi2(13)	=	103.66
Prob > chi2	=	0.0000
Pseudo R2	=	0.0298

Log likelihood = -1689.0554

subjtive	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
dependen	.0482128	.0172339	2.80	0.005	.014435	.0819907
ag18	-.0474704	.0609272	-0.78	0.436	-.1668856	.0719448
agschool	-.0160462	.0041478	-3.87	0.000	-.0241758	-.0079166
males	.0268619	.0874696	0.31	0.759	-.1445753	.1982992
refugee	-.2423839	.133598	-1.81	0.070	-.5042312	.0194633
rural	-.2201572	.0999845	-2.20	0.028	-.4161232	-.0241911
gs	-.5535081	.1307467	-4.23	0.000	-.8097669	-.2972492
wbn	.0521743	.1196339	0.44	0.663	-.1823038	.2866525
wbs	.0856903	.1308821	0.65	0.513	-.1708339	.3422146
agworkin	.0198429	.0582754	0.34	0.733	-.0943748	.1340607
pa	-.068692	.0950881	-0.72	0.470	-.2550612	.1176773
isi	-.1349735	.094206	-1.43	0.152	-.3196138	.0496668
msincom	-.1791471	.1213155	-1.48	0.140	-.4169212	.0586269
_cons	-.5738942	.1393072	-4.12	0.000	-.8469312	-.3008571

## Appendix II

**Criteria of Selecting Poverty Totally Fuzzy Relative Approach Indicators**

The household expenditure and consumption survey conducted by PCBS 2004 was used to select the variable list. It is important to choose indicators which are highly correlated with poverty from one side and not be common to everybody or non-exist. In order to choose the indicators of membership function of the fuzzy set, two steps were taken. First step, a stepwise regression model is used. The logarithm individual consumption is regressed against various households characteristics which be believed to affect poverty in the Palestinian Territory. Table II-1 presents the independent variables which have been taken into account:

Table II-1: Definition of explanatory variables of the Membership function of the TFR

<b>Variable name</b>	<b>Descriptive</b>
lnpcons	Logarithm of individual consumption (dependent variable)
child	Number of children in the household
wrkdl1	Number of working adults in the household
nwrkd1	Number of un-employment adults in the household
tenur2	Dwelling is rented
occup	Occupation of head of household-
depen	Number of persons per room
hhrefug	Refugee status of head of household
hhag2	Age square of head of household
h14	Bathroom
wrkplac1	Place of work of head of household- Palestinian Territory
h16a2	Main source of cooking-wood
h16b0	Main source of heating-no heating
h211	Availability of private car
h212	Availability of refrigetor
sect	
h214	Availability of washing machine
h216	Availability of dishwasher
h217	Availability of central heating

h218	Availability of electrical sweeper
h219	cloth dryer
h2110	Availability of library
h2111	Availability of TV
h2112	Availability of video
h2113	Availability of telephone
h2114	Availability of mobile phone
h2116	Availability of computer
h2117	Availability of satellite
educ2	Educational level of head of household-elementary or preparatory
i01	Receiving emergency assistance
i05a	Receiving remittances from abroad
employ1	Employment status of head of household-employer
educ3	Educational level of head of household-secondary or diploma
hhag	Age of head of household
<b>Variables which were dropped of the model because of multi-co linearity</b>	
h16a1	Main source of heating used for cooking:
wrkplac2	Work place of head of household
educ1	Educational level of head of household:
employ2	Employment status of head of household
marit1	Marital status of head of household
h213	solar boiler
land	Availability of land
hhd16	If the head of household has another job
animal	Availability of animals
h2118	Availability of satellite
Purpose	
h12b	Dwelling connection to networks -electricity
h12c	connection to networks - sewage

The variables which were statistically significant to the consumption were selected, (*Model 4.2.2*). Second step, any indicators seemed to be owned by the majority or rarely owned were excluded from the model.

#### **Model 4.2.2**

```
sw regress lnpcns child wrkdlt nwrkdlt tenur2 purpose depden h12b h12c h14 h16a1
h16a2 h16b0 h211 h212 h213 h214 h216 h217 h218 h219 h2110 h2111 h2112 h2113 h2114
h2116 h2117 h2118 i01 i05a land animal hhag hhag2 hhrefug educ1 educ2 educ3 marit1
employ1 employ2 wrkplac1 wrkplac2 occup sect hhd16 [aw = pwr], pr(.2)
begin with full model
p = 0.9000 >= 0.2000 removing h16a1
p = 0.8740 >= 0.2000 removing wrkplac2
p = 0.8159 >= 0.2000 removing educ1
p = 0.8036 >= 0.2000 removing employ2
p = 0.6995 >= 0.2000 removing marit1
p = 0.6312 >= 0.2000 removing h213
p = 0.5938 >= 0.2000 removing land
p = 0.4905 >= 0.2000 removing hhd16
```

p = 0.5308 >= 0.2000 removing animal  
 p = 0.4791 >= 0.2000 removing h2118  
 p = 0.4380 >= 0.2000 removing purpose  
 p = 0.3864 >= 0.2000 removing h12b  
 p = 0.2120 >= 0.2000 removing h12c

Source	SS	df	MS	Number of obs =	3088
Model	693.540337	33	21.0163739	F( 33, 3054) =	122.33
Residual	524.689963	3054	.171804179	Prob > F =	0.0000
				R-squared =	0.5693
				Adj R-squared =	0.5646
Total	1218.2303	3087	.394632426	Root MSE =	.41449

lnpcons	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
child	-.0778681	.0032839	-23.71	0.000	-.084307 -.0714291
wrkdlt	.021353	.0071299	2.99	0.003	.007373 .0353329
nwrkdlt	-.0631064	.0112519	-5.61	0.000	-.0851685 -.0410443
tenur2	-.1104481	.0706231	-1.56	0.118	-.2489217 .0280255
occup	.1432528	.0241588	5.93	0.000	.0958836 .190622
depden	-.0851794	.0072156	-11.80	0.000	-.0993275 -.0710314
hhrefug	-.0511693	.0157066	-3.26	0.001	-.0819659 -.0203728
hhag2	.000112	.0000414	2.71	0.007	.0000309 .0001931
h14	.1896602	.06207	3.06	0.002	.0679569 .3113635
wrkplac1	-.109262	.0201908	-5.41	0.000	-.1488508 -.0696731
h16a2	-.1772212	.0545762	-3.25	0.001	-.284231 -.0702114
h16b0	-.0931356	.0203456	-4.58	0.000	-.1330281 -.0532431
h211	.1376878	.0187913	7.33	0.000	.1008429 .1745326
h212	.1282505	.0350947	3.65	0.000	.0594389 .1970622
sect	.0976664	.0269494	3.62	0.000	.0448256 .1505071
h214	.1037339	.0311016	3.34	0.001	.0427518 .1647161
h216	.2857962	.07914	3.61	0.000	.1306231 .4409693
h217	.2045261	.0609908	3.35	0.001	.084939 .3241133
h218	.1521406	.0224664	6.77	0.000	.1080898 .1961914
h219	.1416705	.0429111	3.30	0.001	.057533 .225808
h2110	.0795253	.0204456	3.89	0.000	.0394367 .1196138
h2111	.0821168	.0367917	2.23	0.026	.0099778 .1542559
h2112	.1252006	.0221033	5.66	0.000	.0818618 .1685394
h2113	.1276138	.0176845	7.22	0.000	.0929392 .1622885
h2114	.180236	.0772618	2.33	0.020	.0287457 .3317263
h2116	.0477026	.0196023	2.43	0.015	.0092676 .0861377
h2117	.1090842	.0180585	6.04	0.000	.0736761 .1444923
educ2	.025032	.0187476	1.34	0.182	-.0117272 .0617913
i01	-.1554291	.0177197	-8.77	0.000	-.1901728 -.1206855
i05a	.1420073	.0332993	4.26	0.000	.076716 .2072986
employ1	.1226845	.0333778	3.68	0.000	.0572392 .1881298
educ3	.0396951	.02195	1.81	0.071	-.0033432 .0827335
hhag	-.0113028	.0041062	-2.75	0.006	-.0193539 -.0032516
_cons	6.303877	.1475243	42.73	0.000	6.01462 6.593134

## Appendix III

## Appendix III: Distribution Function according to the Original and Alternative Specification

Poverty indicators	West Bank			Gaza Strip			Palestinian Territory		
		Original	Alternative		Original	Alternative		Original	Alternative
	$h(x)$	$H(x)$	$\tilde{H}(x)$	$h(x)$	$H(x)$	$\tilde{H}(x)$	$h(x)$	$H(x)$	$\tilde{H}(x)$
<b>Number of children</b>									
0	0.178	0.178	0.089	0.145	0.145	0.072	0.167	0.167	0.083
1-2	0.228	0.406	0.292	0.183	0.328	0.236	0.213	0.380	0.274
3-4	0.312	0.718	0.562	0.252	0.580	0.454	0.292	0.672	0.526
5-6	0.195	0.913	0.816	0.243	0.823	0.701	0.211	0.883	0.783
7-8	0.070	0.983	0.948	0.121	0.944	0.884	0.087	0.970	0.926
9+	0.017	1.000	0.992	0.056	1.000	0.972	0.030	1.000	0.985
<b>Number of income earners</b>									
At least one income earner	0.583	0.583	0.291	0.591	0.591	0.295	0.586	0.586	0.293
No-income earners	0.417	1.000	0.792	0.409	1.000	0.796	0.414	1.000	0.793
<b>Age of head of household</b>									
Up to 24 years	0.018	0.018	0.009	0.029	0.029	0.015	0.022	0.022	0.011
25-34	0.240	0.258	0.138	0.222	0.251	0.140	0.234	0.256	0.139
35-44	0.316	0.573	0.416	0.333	0.584	0.418	0.321	0.577	0.416
45-54	0.194	0.767	0.670	0.190	0.773	0.679	0.192	0.769	0.673
55-64	0.115	0.882	0.824	0.118	0.892	0.832	0.116	0.886	0.827
65+	0.118	1.000	0.941	0.108	1.000	0.946	0.114	1.000	0.943
<b>Refugee status of head of household</b>									
Non-refugee	0.676	0.676	0.338	0.358	0.358	0.179	0.570	0.570	0.285
refugee	0.324	1.000	0.838	0.642	1.000	0.679	0.430	1.000	0.785
<b>Educational level of head of household</b>									
Bsc+	0.083	0.083	0.009	0.126	0.126	0.063	0.097	0.097	0.049
diploma	0.070	0.153	0.138	0.065	0.192	0.159	0.069	0.166	0.132
secondary	0.119	0.272	0.416	0.213	0.404	0.299	0.151	0.317	0.242
preparatory	0.223	0.496	0.670	0.200	0.604	0.504	0.216	0.532	0.425
elementary	0.264	0.760	0.824	0.175	0.779	0.691	0.234	0.766	0.649
none	0.240	1.000	0.941	0.221	1.000	0.889	0.234	1.000	0.883
<b>Occupation of head of household</b>									
Legislators, senior officials, managers, Professionals, technical and clerks	0.145	0.145	0.073	0.199	0.199	0.099	0.163	0.163	0.081
Plant and machine operators and assemblers	0.079	0.223	0.185	0.069	0.268	0.234	0.075	0.238	0.201

### Appendix III-Cont.: Distribution Function according to the Original and Alternative Specification

Poverty indicators	West Bank			Gaza Strip			Palestinian Territory		
		Original	Alternative		Original	Alternative		Original	Alternative
	$h(x)$	$H(x)$	$\tilde{H}(x)$	$h(x)$	$H(x)$	$\tilde{H}(x)$	$h(x)$	$H(x)$	$\tilde{H}(x)$
Service, shop and market workers	0.109	0.332	0.277	0.130	0.398	0.333	0.116	0.354	0.296
Craft and related trade workers	0.142	0.474	0.403	0.119	0.517	0.458	0.135	0.489	0.422
Elementary occupations	0.132	0.606	0.540	0.073	0.590	0.554	0.112	0.601	0.545
Skilled agricultural and fishery workers	0.068	0.675	0.640	0.077	0.667	0.628	0.071	0.672	0.636
Unemployment	0.169	0.844	0.760	0.161	0.828	0.747	0.167	0.839	0.756
Out of labor	0.156	1.000	0.922	0.172	1.000	0.914	0.161	1.000	0.920
<b>Dwelling Attributes</b>									
<b>Source of heating</b>									
Electricity	0.121	0.121	0.060	0.225	0.225	0.113	0.156	0.156	0.078
Gas	0.396	0.517	0.319	0.060	0.284	0.255	0.283	0.439	0.298
Kerosene	0.097	0.613	0.565	0.042	0.326	0.304	0.078	0.517	0.478
Wood	0.315	0.928	0.771	0.244	0.570	0.448	0.291	0.808	0.663
No-heating	0.072	1.000	0.964	0.430	1.000	0.785	0.192	1.000	0.904
<b>Durable Goods</b>									
<b>Private car</b>									
yes	0.312	0.312	0.156	0.146	0.146	0.073	0.256	0.256	0.13
no	0.688	1.000	0.656	0.854	1.000	0.573	0.744	1.000	0.63
<b>Electric sweeper</b>									
yes	0.264	0.264	0.132	0.104	0.104	0.052	0.210	0.210	0.105
no	0.736	1.000	0.632	0.896	1.000	0.552	0.790	1.000	0.605
<b>Home library</b>									
yes	0.223	0.223	0.112	0.193	0.193	0.096	0.213	0.213	0.107
no	0.777	1.000	0.611	0.807	1.000	0.596	0.787	1.000	0.606
<b>Phone line</b>									
yes	0.415	0.415	0.208	0.351	0.351	0.176	0.393	0.393	0.196
no	0.585	1.000	0.708	0.649	1.000	0.676	0.607	1.000	0.696
<b>Home computer</b>									
yes	0.270	0.270	0.135	0.206	0.206	0.103	0.248	0.248	0.124
no	0.730	1.000	0.635	0.794	1.000	0.603	0.752	1.000	0.624
<b>Satellite (dish)</b>									
yes	0.641	0.641	0.320	0.679	0.679	0.339	0.654	0.654	0.327
no	0.359	1.000	0.821	0.321	1.000	0.839	0.346	1.000	0.827



### Appendix III-Cont.: Distribution Function according to the Original and Alternative Specification

Poverty indicators	West Bank			Gaza Strip			Palestinian Territory		
		Original	Alternative		Original	Alternative		Original	Alternative
	$h(x)$	$H(x)$	$\tilde{H}(x)$	$h(x)$	$H(x)$	$\tilde{H}(x)$	$h(x)$	$H(x)$	$\tilde{H}(x)$
<b>Income deciles</b>									
0 (richest 10%)	0.104	0.104	0.052	0.111	0.111	0.056	0.110	0.110	0.055
1	0.100	0.204	0.154	0.092	0.203	0.157	0.099	0.209	0.160
2	0.095	0.299	0.251	0.097	0.300	0.252	0.093	0.302	0.256
3	0.092	0.391	0.345	0.101	0.401	0.351	0.101	0.402	0.353
4	0.101	0.492	0.441	0.104	0.505	0.453	0.097	0.499	0.451
5	0.095	0.587	0.539	0.108	0.613	0.559	0.098	0.598	0.548
6	0.099	0.686	0.637	0.094	0.707	0.660	0.099	0.697	0.648
7	0.097	0.782	0.734	0.104	0.812	0.759	0.100	0.796	0.747
8	0.104	0.887	0.834	0.095	0.907	0.860	0.101	0.897	0.846
9 (poorest 10%)	0.113	1.000	0.944	0.093	1.000	0.954	0.103	1.000	0.949

## Appendix IV

**Calculating the Human Development Indices*****The Human Development Index (HDI)***

The three basic dimensions of human development index are:

- A long and healthy life, as measured by life expectancy at birth.
- Knowledge, as measured by the adult literacy rate (with two-thirds weights) and the combined gross enrolment ratio (with one-third weight).
- A decent standard of living, as measured by GDP per capita (PPP US\$).

Before the HDI itself is calculated, an index needs to be created for each of these dimensions. To calculate these dimensions indices, minimum and maximum values (goalposts) are chosen for each indicator.

**Goalposts for calculating the HDI**

Indicator	Maximum Value	Minimum Value
Life expectancy at birth (years)	85	25
Adult literacy rate (%)	100	0
Combined gross enrolment ratio (%)	100	0
GDP per capita (PPP US\$)	40,000	100

*Source: Human Development Report 2004*

Each dimension is expressed as a value between 0 and 1 by applying the general formula:

$$\text{Dimension index} = (\text{actual value} - \text{minimum value}) / (\text{maximum value} - \text{minimum value})$$

Then, the HDI is calculated as a simple average of the dimension indices.

For the Palestinian data:

With a life expectancy of 72.4 years in 2004, the life expectancy index is 0.790

$$\text{Life expectancy index} = (72.4-25)/(85-25) = 0.790$$

With an adult literacy rate of 92.4 in 2004 and a combined gross enrolment ratio 75.9% in the school year 2003/04, the education index is 0.869

$$\text{Adult literacy index} = (92.4-0)/(100-0) = 0.924$$

$$\text{Gross enrolment index} = (75.9-0)/(100-0) = 0.759$$

$$\begin{aligned}\text{Education index} &= 2/3(\text{adult literacy index}) + 1/3(\text{gross enrolment index}) \\ &= 2/3(0.924) + 1/3(0.759) = 0.869\end{aligned}$$

With a GDP per capita of US\$ 1,246 (current exchange) in 2004, the GDP index is 0.421

$$\text{GDP index} = [\log(1,246) - \log(100)] / [\log(40,000) - \log(100)] = 0.421$$

Then, the Palestinian HDI for 2004 stood at **0.693**

$$\begin{aligned}\text{HDI} &= 1/3(\text{life expectancy index}) + 1/3(\text{education index}) + 1/3(\text{GDP index}) \\ &= 1/3(0.796) + 1/3(0.869) + 1/3(0.421) = 0.693\end{aligned}$$

### ***The Human Poverty Index for developing countries (HPI-1)***

While the HDI measures average achievement, the HPI-1 measures deprivations in the three basic dimensions of human development captured in HDI:

- A long and healthy life, as measured by the probability at birth of not surviving to age 40.
- Knowledge, as measured by the adult illiteracy rate.
- A decent standard of living, as measured by the un-weighted average of the population sustainable access to an improved water source and the percentage of children under weight for age.

The HPI-1 is calculated as follows: 
$$HPI-1 = \left[ \frac{1}{3} \left( p_1^\alpha + p_2^\alpha + p_3^\alpha \right) \right]^{1/\alpha}$$

$p_1$  = probability at birth of not surviving to age 40 (items 100)

$p_2$  = adult illiteracy rate

$p_3$  = unweighted average of the two indicators used to measure deprivation in a decent standard of living.

=  $\frac{1}{2}$ (Unweighted average of population without sustainable access to an improved water source) +  $\frac{1}{2}$ (children under weight for age)

$\alpha = 3$

For the Palestinian data:

Population without sustainable access to an improved water source = 10.5%

Children under weight for age = 4.9%

Probability at birth of not surviving of not surviving to age 40 (items 100) = 5.6

Adult illiteracy rate = 7.7%.

Then, the Palestinian HPI-1 for 2004 stood at **7.13**