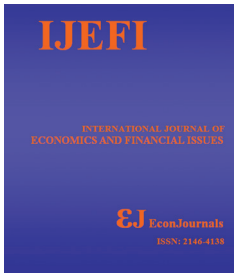

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Fuzzy Measures of Monetary and Non-monetary Deprivations in Tunisia

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ABSTRACT

The objective of this paper is to provide a measure of deprivation in Tunisia. The focus will be on non-monetary deprivation which will complement the profile of the poor in the country. The work is carried out on Tunisian data from the national survey on the budget, consumption, and the household's standard of living (2015). The study tries to explore, in addition to the monetary dimension, the deprivations in Tunisia in the essential dimensions of a dignified and respectable human life: housing, education and health. The results obtained show a great disparity in monetary and non-monetary deprivation, particularly in the housing and education dimensions. Household characteristics seem to be an important element in the extent of deprivation. These include the location, region of residence as well as the socio-economic characteristics of the household head. The present paper stands out from several recent works on the phenomenon in Tunisia, based mainly on monetary indicators. By this aspect, this study contributes to a better understanding of poverty in the country.

Keywords: Capabilities, Deprivations, Fuzzy Sets, Multidimensional Measures, Non-monetary Poverty
JEL Classifications: I32, I24, I14

1. INTRODUCTION

The fight against poverty today requires considering its monetary and non-monetary aspects. It is true that the income is an essential means to develop one's capacities, but also, the financial situation of individuals deeply depends on the choices and the possibilities offered. The generalization of education and access to health care services help improve the life quality of vulnerable populations. They also provide additional chances to earn a higher income and thus, escape the monetary poverty trap.

Nolan and Whelan (2010) confirmed the central role of financial resources while emphasizing the importance of non-monetary information in capturing a full picture of poverty. They use European data to refine income-based measures, covering indicators of deprivation on several dimensions: basic needs, goods possession, housing, and the neighborhood environment. In fact, this method was initiated by Ringen (1985, 1988) calling for the adoption of the "direct approach" that links poverty to difficulties encountered in various dimensions: health, employment, income, relationships, education, housing, and others (Mack and Lansley, 1985). In the same logic, Callan et al. (1993) as well as Baulch and Masset (2003) used monetary and non-monetary indicators which lead to the different results depending on them.

Also, Ruggeri Laderchi (1999) discussed the difference between the capability approach and the monetary approach. Salecker et al. (2020) find that using monetary measures does not provide a full picture of the extent of multidimensional poverty, especially in the context of low-income countries. This result corroborates with Evans et al. (2020) who consider the relationship between monetary and multidimensional poverty indices. Similarly, Pham et al. (2021), applying the fuzzy approach, on data on living conditions considered several dimensions of poverty. Tauseef (2020) demonstrated the importance of non-monetary deprivations in the evaluation of well-being and happiness. For

this reason, Das et al. (2021) recommended the incorporation of the multidimensional approach with the monetary approach given its great relevance.

Ruggeri Laderchi et al. (2003) reviewed four approaches to define poverty and conduct an empirical study on Peruvian and Indian data. The results differ depending on the definition used. The capabilities approach of Sen outlines a new way to conceive of well-being and study poverty as well as inequalities (Sen, 1985; 1993; 2003). The enhancement of well-being incorporates the freedom of choice between the various possible alternatives. In this way, well-being incorporates both the scope of all the possible choices and the actions carried out. Improving the well-being of individuals, therefore, boils down to widening the space of choice and allowing them to choose the options they value. Anand et al. (2021) developed new data on 29 dimensions with the aim of studying poverty in terms of capability, through a survey carried out in three countries (United States, United Kingdom and Italy).

Works on multidimensional poverty was largely relied on the theoretical framework provided by the capability approach. Thus, Schokkaert and Van Ootegem (1990), starting from the theoretical framework of Sen's approach, studied the situation of the unemployed in Belgium. Likewise, Cerioli and Zani (1990), Chiappero-Martinetti (2000), Clarck and Qizilbash (2002), Lelli (2001), Filippone et al. (2001) used the fuzzy set theory to provide multidimensional poverty measures. Chiappero-Martinetti (2005) showed this theory contribution in the implementation of capabilities vision during the study of poverty. Betti and Verma (1999) proposed a methodology for constructing a measure of monetary deprivation and additional non-monetary deprivations by fuzzy set theory. This methodology was also adopted by Betti et al. (2006, 2012, 2015); Betti and Verma (2008).

Chiappero-Martinetti (1994) tried to raise the methodological difficulties associated with the application of the capabilities approach. Chiappero-Martinetti and Moroni (2007) proposed a complete framework to study poverty, in consistency with the approach. This is in line with the work of Saith (2001) dealing with the operationalization of Sen's approach.

In Tunisia, monetary poverty undergoes a constant decline, as evidenced by the official figures provided by the National Institute of Statistics (INS). However, there is still a very significant difference, particularly according to the environment and the region of residence (INS 2010 and 2015; El Lagha and Bouassida, 2015; Ayadi et al., 2005).

Work on multidimensional poverty in Tunisia has multiplied in the recent years. Belhadj (2011) analyzed multidimensional poverty using fuzzy set theory, applied to Tunisian data from the 1990 budget and consumption survey. Nasri and Belhadj (2017) used household expenditure, retaining expenditure relating only to three headings: food, health, and education (Belhadj, 2012; Hasnaoui and Belhadj, 2015; Zedini and Belhadj, 2015).

The approach of this work offers the advantage of considering a multidimensional vision of poverty that deals with monetary and non-monetary aspects. This is in line with Ben Hassine and Sghairi (2021) who proposed the multidimensional poverty measures application of Alkire and Foster (2009), on Tunisian data from 2010.

Similarly, the objective of this work is to provide a measure of multidimensional poverty in Tunisia, based on fuzzy set theory, as developed by Betti and Verma (1999, 2008), using data from the national survey on the budget, consumption and household standard of living (2015). The theoretical foundations will be introduced in the first section. The second section will be devoted to the construction of measures. The results will be presented in the third section.

2. POVERTY IN TERMS OF CAPABILITIES

Capabilities represent the set of operations that an individual can implement. They stand for freedom of choice between different alternatives that indicate a person's lifestyle. They are formed by various combinations of human functioning. This definition highlights, essentially, two components:

i. Potentialities: S- Capabilities (S for skill) grouping together the achievement capacities of individuals due to the personal attributes as well as the various types of capital at their disposal: physical, human, social capital.
ii. The opportunities: O- Capabilities (O for opportunity) offered by society to the individual to be able mobilizing their potential which is usually about the political, social, and economic environment of the individual.

Functioning covers the different valued things that a person may aspire to do or be. They determine the possibilities for the individuals' action. Even more, they cover the possibilities of being and acting individuals which allow them to exploit the goods at their disposal such as: to be well fed, well housed, in good health, to remain worthy in their own eyes and to be able to take part in social life.

The originality of Sen's approach is to define poverty in relation to the lack of certain basic capabilities whose determination depends on the local framework of analysis. To deal with deprivation problems, it is better to look to the capability space - or the operations space - in the absence of statistical information availability.

In the capability approach, poverty is synonymous with non-achievement of the essential functions of human life: individuals are unable to implement and develop all their endowments to meet their aspirations. It provides a coherent framework for the study of multidimensional poverty as a lack of either basic functions or basic capabilities.

3. MULTIDIMENSIONAL POVERTY MEASURES

3.1. Construction

In this work, we use the procedure proposed by Betti et al. (2012) and Betti and Verma (1999, 2008) which allow us to calculate a new measure of monetary poverty:

$$FM_i = \left(1 - F_{M,i}\right)^{\alpha-1}\left(1 - L_{M,i}\right)$$

$$= \left(\frac{\sum_{\gamma=i+1}^{n} \omega_\gamma \mid X_\gamma > X_i}{\sum_{\gamma=2}^{n} \omega_\gamma \mid X_\gamma > X_1} \right)^{\alpha-1} \left(\frac{\sum_{\gamma=i+1}^{n} \omega_\gamma X_\gamma \mid X_\gamma > X_i}{\sum_{\gamma=2}^{n} \bar{\omega}_\gamma X_\gamma \mid X_\gamma > X_1} \right) \quad (1)$$

where X is the equivalised income, $F_{M,\,i}$ is the income distribution function, ω_γ is the sample weight of individual of rank γ ($\gamma = 1,\ldots,n$) in the ascending income distribution,

$L_{M,i}$ represents the value of the Lorenz curve of income distribution for individual *i*.

The parameter α is estimated so that the mean of the corresponding membership function is equal to the at-risk-of-poverty rate (ARPR) computed on the basis the official poverty line.

Each household i has an income Xi and a deprivation score $S_{h,i}$ in the dimension h (h=1,...,m) represented by j_h variables (j_h=1,…,k_h).

The score of an item j is calculated according to the following formula:

$$s_{j,i} = \frac{F\left(c_{j,i}\right) - F(1)}{1 - F(1)} \quad (2)$$

where c j,i is the value of the category of the j -th item for the i- th individual and F(c j,i) is the value of the j -th item cumulation function for the i -th individual.

The score is aggregated within each dimension h:

$$s_{hi} = \frac{\sum_{j=1}^{k_h} \omega_{hj} s_{hj,i}}{\sum_{j=1}^{k_h} \omega_{hj}} \quad (3)$$

The weights comprise two factors: the dispersion of a deprivation item and its correlation with other deprivation items in the given dimension (Betti and Verma, 2008; Betti et al. 2015):

$$\omega_{hj} = \omega_{hj}^{a} . \omega_{hj}^{b} \quad (4)$$

With:

$$\omega_{hj}^{a} = CV_{hj} \quad (5)$$

$$\omega_{hj}^{b} = \left(\frac{1}{1 + \sum_{k'=1}^{K} \rho_{k,k'} \mid \rho_{k,k'} < \rho_H} \right) \times \left(\frac{1}{\sum_{k'=1}^{K} \rho_{k,k'} \mid \rho_{k,k'} > \rho_H} \right) \quad (6)$$

While Betti et al. (2015) have defined the threshold ρ_H by the point of largest gap between the ordered set of correlation values encountered, we will set this threshold to 0.5.

Then for all the dimensions, the following formula allows to obtain the score by dimension:

$$s_i = \frac{\sum_{h=1}^{m} s_{hi}}{m} \quad (7)$$

Subsequently, and in the same way as the monetary measure, we can deduce the supplementary fuzzy measure:

$$FS_i = \left(1 - F_{S,i}\right)^{\alpha-1} \left(1 - L_{S,i}\right)$$

$$FS_i = \left(\frac{\sum_{\gamma=i+1}^{n} \omega_{h\gamma} \mid s_{h\gamma} > s_i}{\sum_{\gamma=2}^{n} \omega_{h\gamma} \mid s_{h\gamma} > s_1} \right)^{\alpha-1} \left(\frac{\sum_{\gamma=i+1}^{n} \omega_{h\gamma} s_{h\gamma} \mid s_{h\gamma} > s_i}{\sum_{\gamma=2}^{n} \omega_{h\gamma} s_{h\gamma} \mid s_{h\gamma} > s_1} \right) \quad (8)$$

3.2. Data

The data used are taken from the national survey on household budgets, consumption and living standards (2015). The survey was carried out over a period of 1 year from May 2015 to May 2016, to cover all seasonal variations in household spending.

The sample comprises 27,108 households spread across the entire national territory. The survey collects economic, social, and demographic data that include general characteristics of the population, housing, and households, as well as economic data on the ownership of goods and access to services and their values. This survey has three components: family expenses, nutrition, family living conditions and collective services.

The characteristics of the households are summarized in Table 1. Almost two-thirds of households live in the communal environment and more than 70% of households are made up of 3 to six people. It should also be noted that 35% of households' heads are over 60 years old. Households headed by women represent 15%.

3.3. Dimensions and indicators

The choice of poverty dimensions and associated indicators has been the subject of a broad discussion in the literature. On the theoretical level, Sen refuses to give a list of basic capabilities leaving the specialists with the task of selection through work of investigation and discussion at the level of the studied society. On the other hand, other works have been interested in determining the elements of such a list. However, Nussbaum (2000) defined a set of "basic human capabilities" composed of 10 universal functions.

Empirically, the selection of dimensions follows two approaches: a normative approach and a descriptive approach (Guio, 2009). In this work, both approaches havew been adopted by retaining dimensions universally recognized to be the main components of a dignified human life (the monetary dimension, education, housing, and health) and by an explanatory and confirmatory factor analysis. Table 2 presents the indicators associated with each dimension.

For the education dimension, two indicators were retained:

1. The education level of the household head
2. The reason for leaving studies which combines two complementary variables
   a. The reason for never having studied
   b. The reason for leaving the establishment.

The hierarchy of modalities respects the core of the capability approach by referring to the possibility of individuals' choice. Thus, an individual who has left the institution (or who has never studied) for reasons of "distant institution" or "expensive books and supplies" experiences a

Table 1: Characteristics of the sample

Character	Frequency (in %)	Character	Frequency (in %)
Region		Expense brackets*	
Great Tunis	17.63	−1000 DT	14.04
North East	13.68	[1000, 1500] TND	18.01
North West	13.77	[1500, 2000] TND	17.01
Centre East	18.62	[2000, 3000] TND	22.87
Mid-West	15.16	[3000, 4500] TND	15.29
South East	10.67	+4500 DT	12.78
South West	10.47		
Area of residence		Gender of household head	
Urban (Communal)	64.36	Female	15.2
Rural (Non communal)	35.64	Male	84.8
Socio-professional categories		Marital status of the head of household	
Higher and Intermediate managerial and professional occupations	8.67	Celibate	1.98
Other employees	7.76	Married	84.88
Small employers	7.30	Widower	11.72
Own account workers	2.78	Divorced (e)	1.43
Workers	27.38	Age of the head of household	
Farmers	11.61	−30 years	1.29
Non employed	1.89	[30, 40]	13.85
Retired	15.65	[40, 50]	26.08
Other inactive	12.14	[50, 60]	24.58
Support outside the household	4.80	+60 years	34.20
Household size			
1-2	15.34		
3-4	37.23		
5-6	35.16		
+ 7	12.27		

Table 2: Dimensions and associated indicators

Dimension	Indicator	Modalities	Frequencies (%)	Weights
Economic Resources	Annual expenditure per capita	Metropolitan threshold 1878 DT		
		Urban threshold 1703 DT		
		Rural threshold 1501 DT		
Education	Education level of the head of household	None	28.6	0.289
		Primary	38.02	
		Secondary	24.73	
		High	8.66	
	Reason for leaving Studies	End of studies	10.56	0.444
		Prefer to work	18.97	
		Ouster	4.49	
		Establishment away	10.54	
		Expensive books and supplies	17.04	
		Not useful studies	29.92	
		Must stay at home	4.31	
		Health reasons	0.25	
		Other raisons	3.92	
Housing	Bathroom	Bathroom with hot water	37.8	0.346
		Shower with hot water	23.2	
		Bathroom without hot water	14.81	
		No bathroom	24.18	
	Drinking water	Sonede with invoice	78.19	0.826
		Sonede without invoice	5.07	
		Private tank	0.97	
		Private well	3.79	
		Public tank	0.20	
		Public well without motor	0.58	
		Public fountain (Sonede)	0.79	
		Fountain ong	7.44	
		Uncontrolled source	2.88	
		Water course	0.10	
	Sanitation	Connection to the sewerage network	52.12	0.412
		No	47.88	
Health	Health coverage	Social funds	62.5	1.692
		Entitled via tutor	4.51	
		Free Health book	8.53	
		Reduced rate health card	15.47	
		No	8.99	
	Chronic disease	No	71.42	0.972
		Yes, with APCI	11.78	
		Yes, without APCI	16.79	
	Handicap	Yes	7.71	2.379
		No	92.29	

APCI: Affections Prises En Charge Intégralement, ASE: ailment Supported Entirely, HIF: by the National Health Insurance Fund, CNAM: Caisse Nationale d'Assurance Maladie

higher sense of deprivation, in comparison to an individual who has finished his studies or has preferred to work (Table 3).

The housing dimension is assessed according to three indicators: the source of drinking water, connection to the sewerage network and the existence of a bathroom in the accommodation. Likewise, three indicators relating to the health dimension were considered: health coverage, disability and suffering from chronic illness.

The exploratory and confirmatory factor analysis carried out on the selected indicators confirms the significance of the dimensions and associated indicators (Table 4). Table 2 also reports the weights of the non-monetary dimensions calculated according to formula (6).

4. RESULTS

For the dimension of economic (monetary) resources, the measure of deprivation corresponds to the poverty rate. The calculation of the membership function in this dimension was carried out according to equation (1) and (8). The parameter α, in these equations, was chosen to find a value equal to the monetary official poverty ratio. The calculations gave a value of 6.3 and 6.6 respectively for the Monetary and the Supplementary measures.

The measures differ significantly between households according to socio-economic characteristics. As a result, depending on the household's economic situation, the FM measure goes from 15.95% for the non-poor (depending on the monetary dimension) to 31.9% for the non-poor (Table 5).

The results show that monetary deprivation is greater in the Midwest and north-west regions (Table 6). These are regions where agriculture is the main activity. In addition, unemployment is more widespread in these regions. However, Table 7 shows that monetary deprivation is higher for the categories of farmers and the unemployed.

Deprivation measures in education and housing dimensions are also higher for poor households in the monetary sense. Thus, for non-poor households, the deprivation rates in these two respective dimensions are 15.48% and 16.24%. However, these rates rise to 21.32% and 36.8%, for poor households. Nevertheless, for the health dimension, the deprivation measure remains similar between the two groups (Table 5).

The results also show that non-monetary deprivations are more widespread:

- In the rural environment. In fact, total poverty doubles in value from the urban area to the rural area, going from 6.6% to 34.49%. This difference is mainly due to the dimensions: housing and education (Table 6).
- In the northwest and Midwest regions (Table 7), the deprivation measures are higher except for the health dimension
- Among households whose head works in agriculture (workers and operators), unemployed or inactive. For the health dimension, the unemployed, retirees and artisans are the most affected by deprivation (Table 8)
- The sex of the household head also seems to influence the degree of deprivation in the monetary and non-monetary dimensions, mainly in the education dimension (Table 9).

For the education dimension it is essential to note that the deprivation measure in the seems to take the highest values. This is justifiable given:

i. The high proportion of household heads with no education level. Indeed, the literacy challenge of the population has become insistent in recent years despite the considerable efforts made since the country's independence. Indeed, the Minister of Social Affairs affirmed, in a statement to local radio station dated September 2018 that the illiteracy rate increased by 1 point from 2017 (18.2%) to 2018 (19.1%)

Table 3: "Reason for leaving Studies" indicator (Education Dimension)

Variables	Modalities	Indicator level
Reason for leaving Studies	Establishment away	1
	Expensive books and supplies	1
	Ouster	2
	Not useful studies	3
	Prefer to work	4
	End of studies	4
Reasons for never having studied	Establishment away	1
	Expensive books and supplies	1
	Must stay at home	1
	Health reasons	1
	Not useful studies	3
	Other reasons	4

Table 4: Confirmatory factor analysis results

Index	Value
Goodness of fit (GFI)	0.975
Adjusted GFI	0.958
Standarized Root Mean Square Residual	0.026
Rmsea	0.036

Table 5: Multidimensional deprivation measures (%) and monetary poverty

Monetary		Non-monetary Deprivation		
Dimension	Non-Monetary Fuzzy Supplementary	Education	Housing	Health
Poor	31.9	21.32	36.8	14.46
Not Poor	15.95	15.48	16.24	14.24
Total	18.23	16.32	19.18	14.27

Table 6: Multidimensional poverty measures (%) according to the Area of residence

Area of residence	Monetary Deprivation FM	Non-Monetary Deprivation Fuzzy Supplementary FS	Education FS1	Housing FS2	Health FS3
Urban	8.95	6.6	11.45	4.1	14.95
Rural	28.72	34.49	21.1	40.77	14.22

Table 7: Multidimensional poverty measures (%) by region of residence

Regions	Monetary Deprivation FM	FS	Education FS1	Housing FS2	Health FS3
Great Tunis	5.05	6.31	12.77	2.74	14.36
Northeast	14.37	16.34	14.4	16.89	14.23
Northwest	27.28	31.32	23.72	36.07	11.08
Centre-east	10.8	9.37	9.5	9.84	16.28
Midwest	31.76	34.1	22.04	37.56	14.62
Southeast	17.67	13.69	13.41	13.11	18.05
Southwest	17.77	11.88	12.26	13.85	12.01

Table 8: Multidimensional poverty measures (%) according to the Socio-professional categories of the head of household

Socio-professional categories	Monetary Deprivation FM	FS	Education FS1	Housing FS2	Health FS3
Higher managerial and professional occupations	3.72	3.34	3.2	4.47	11.58
Intermediate managerial and professional occupations	5.4	4.37	5.07	4.53	12.43
Other employees	12.98	10.28	10.22	11.36	14.2
Small employers	6.28	6.79	9.2	6.65	13.63
Own account workers	11.09	11.78	11.53	11.86	15.84
Workers	20.02	15.59	13.64	17.24	13.81
Farmers	23.74	32.35	19.65	36.78	14.01
Agricultural workers	36.78	36.97	22.31	42.94	15.66
Non employed	32.88	21.84	15.14	25.54	17.02
Retired	6.38	9.84	14.48	7.33	15.69
Other inactive	20.11	24.99	26.31	21.67	17.71

Table 9: Multidimensional poverty measures (%) according to the Gender of household head

Gender	Monetary Deprivation FM	Non-Monetary Deprivation Fuzzy Supplementary			
		FS	Education FS1	Housing FS2	Health FS3
Male	15.5	14.95	13.27	15.77	14.41
Female	12.77	19.02	24.21	15.01	17.15

Table 10: Rank correlation between unidimensional deprivation measures

Dimensions	Monetary deprivation FM	FS	Education FS1	Housing FS2	Health FS3
FM	1.0000				
FS	0.3834	1.0000			
Education FS1	0.2179*	0.7769*	1.0000		
Housing FS2	0.4651*	0.7024*	0.2923*	1.0000	
Health FS3	−0.0275*	0.2715*	0.0812*	−0.0263*	1.0000

*Significant at 5%

ii. The importance of the school drop-out phenomenon, which has reached the figure of 100,000 individuals. Boughzou (2016) studied the phenomenon of school dropout in Tunisia through a survey carried out with students from three governorates: Monastir, Kairouan and Kasserine. The study shed lights the characteristics of these students and the reasons for dropping out of school.

The introduction of additional dimensions provides information not captured by monetary measures. Indeed, the rank-based spearman correlation test applied to the one-dimensional measurements shows a weak correlation between these measurements (Table 10). Also, it emerges an important result which shows a negative relationship (even weak) between deprivation of health and income poverty. This means that the more fortunate are more exposed to it. Housing deprivation appears to be more correlated with poverty of economic resources.

5. CONCLUSION

The objective of this work was to analyze poverty in the space of operations defined by the theoretical framework of Amartya Sen's capability approach. Poverty is defined as a lack in basic capabilities. In fact, these capabilities are linked to the capacity of individuals to achieve acceptable levels of functions essential for a dignified human life.

For operationalization, the work was based on the construction of a multidimensional deprivation measure that reflects deprivation in four dimensions, which concern economic resources, education, housing, and health, represented by monetary and non-monetary deprivation indicators.

We have adopted the methodology proposed by Betti *et al.* (2012) which allows monetary and non-monetary deprivation measures to be constructed according to a step-by-step approach. It is based on a reformulation of the multidimensional fuzzy measures developed by Cerioli and Zani (1990), Cheli and Lemmi (1995), Cheli and Lemmi (1995), Betti and Verma (1999, 2008).

The application was conducted on Tunisian data from the national survey on household budgets, consumption and living standards (2015). The results obtained by the fuzzy measures show a greater influence of deprivation in the dimensions of housing and education

than total poverty. The results also make it possible to target the population at risk according to their socio-economic characteristics.

REFERENCES

Anand, P., Jones, S., Donoghue, M., Teitler, J. (2021), Non-monetary poverty and deprivation: A capability approach. Journal of European Social Policy, 31(1), 78-91.

Ayadi, M., Chtioui, N., Ben Hassine, O. (2005), Analyse multidimensionnelle de la pauvreté en Tunisie: Une approche par les ensembles flous. Journées de Microéconomie Appliquée, 2005.

Baulch, B., Masset, E. (2003), Do monetary and non- monetary indicators tell the same story about chronic poverty? A study of Vietnam in the 1990s. World Development, 31(3), 441-453.

Belhadj, B. (2011), A new fuzzy unidimensional poverty index from an information theory perspective. Empirical Economics, 40, 687-704.

Ben Hassine, O. Sghairi, M. (2021), Multidimensional measures of deprivation in Tunisia. Journal of Economics and International Finance, 13(1), 32-39.

Betti, G., Cheli, B., Lemmi, A., Verma, V. (2006), Multidimensional and longitudinal poverty: An integrated fuzzy approach. In: Lemmi, A., Betti, G., editors. Fuzzy Set Approach to Multidimensional Poverty Measurement. Berlin, Germany: Springer. p115-137.

Betti, G., Gagliardi, F., Lemmi, A., Verma, V. (2012), Sub-national indicators of poverty and deprivation in Europe: Methodology and applications. *Cambridge Journal of Regions, Economy and Society*, 5(1), 149-162.

Betti, G., Gagliardi, F., Lemmi, A., Verma, V. (2015), Comparative measures of multidimensional deprivation in the European Union. Empirical Economics, 49(3), 1071-1100.

Betti, G., Verma, V. (1999), Measuring the Degree of Poverty in a Dynamic and Comparative Context: A Multi-Dimensional Approach Using Fuzzy Set Theory. Proceedings, ICCS-VI, 11, 289-301, Lahore, Pakistan, August 27-31, 1999.

Betti, G., Verma, V. (2008), Fuzzy measures of the incidence of relative poverty and deprivation: A multi-dimensional perspective. Statistical Methods and Applications, 17, 225-250.

Boughzou, K. (2016), L'abandon scolaire en Tunisie: Etat des lieux, caractéristiques et perspectives. L'Éducation en débats: Analyse comparée, 7, 47-58.

Callan, T., Nolan, B., Whelan, C.T. (1993), Resources deprivation and the measurement of poverty. Journal of Social Policy, 22(2), 141-172.

Cerioli, A., Zani, S. (1990), A fuzzy approach to the measurement of poverty. In: Dagum, C., Zenga, M., editors. Income and Wealth Distribution, Inequality and Poverty, Studies in Contemporary Economics, Berlin: Springer Verlag. p272-284.

Cheli, B., Lemmi, A. (1995), A 'totally' fuzzy and relative approach to the multidimensional analysis of poverty. Economic Notes, 24(1), 115-134.

Chiappero-Martinetti, E. (1994), A new approach to evaluation of well-being and poverty by fuzzy set theory. Giornale degli Economisti e Annali di Economia, Nuova Serie, 53(7/9), 367-388.

Chiappero-Martinetti, E. (2000), A multidimensional assessment of well-being based on Sen's functioning approach. Rivista Internazionale di Scienze Sociali, 108, 207-239.

Chiappero-Martinetti, E. (2005), Capability approach and fuzzy set theory: Description, aggregation and inference issues. In: Lemmi, A., Betti, G., editors. Fuzzy Set Approach to Multidimensional Poverty Measurement. Economic Studies in Inequality, Social Exclusion and Well-Being, 3. Boston: Springer. p93-113.

Chiappero-Martinetti, E., Moroni, S. (2007), An analytical framework for conceptualizing poverty and re-examining the capability approach. The Journal of Socio-Economics, 36, 360-375.

Clark, D., Qizilbash, M. (2002), Core Poverty and Extreme Vulnerability in South Africa. The Economics Research Centre, School of Economic and Social Studies, University of East Anglia, Discussion Paper 2002/3.

Costa, M., De Angelis, L. (2008), The multidimensional measurement of poverty: A fuzzy set approach. *Statistica*, 68(3-4), 303-318.

Das, P., Paria, B., Firdaush, S. (2021), Juxtaposing consumption poverty and multidimensional poverty: A study in Indian context. Social Indicators Research, 153, 469-501.

Esposito, L., Chiappero-Martinetti, E. (2010), Multidimensional poverty: Restricted and unrestricted hierarchy among poverty dimensions. Journal of Applied Economics, 13(2), 181-204.

Evans, M., Nogales, R., Robson, M. (2020), Monetary and Multidimensional Poverty: Correlations, Mismatches and Joint Distributions. OPHI Working Paprer, No 133.

Filippone, A., Cheli, B., D'Agostino, A. (2001), Addressing the Interpretation and the Aggregation Problems in Totally Fuzzy and Relative Poverty Measures. Mimeo, University of Pisa.

Hasnaoui, L., Belhadj, B. (2015), Fuzzy multidimensional inequality measurement. Policies to reduce inequality in Tunisia. Euroeconomica, 34(2), 21-28.

Guio, A.C. (2009), What Can Be Learned from Deprivation Indicators in Europe? Eurostat Methodologies and Working Paper, Eurostat, Luxembourg.

Lelli, S. (2001), Factor Analysis vs. Fuzzy Set Theory: Assessing the Influence of Different Techniques on Sen's Functioning Approach, Leuven, CES Discussion Paper 01.21. 16.

Mack, J., Lansley, S. (1985), Poor Britain. London: Allen and Unwin.

Nasri, K., Belhadj, B. (2017), Multidimensional poverty measurement in Tunisia: Distribution of deprivations across regions. The Journal of North African Studies, 22(5), 841-859.

Nolan, B., Whelan, C.T. (2010), Using non-monetary deprivation indicators to analyze poverty and social exclusion: Lessons from Europe? Journal of Policy Analysis and Management, 29(2), 305-325.

Nussbaum, M.C. (2000), Women and Human Development: The Capabilities Approach. Cambridge, United Kingdom: Cambridge University Press.

Pham, A.T.Q., Mukhopadhaya, P., Ha Vu, H. (2021), Estimating poverty and vulnerability to monetary and non-monetary poverty: The case of Vietnam. Empirical Economics, 61(6), 3125-3177.

Ringen, S. (1985), Toward a third stage in the measurement of poverty. Acta Sociologica, 28(2), 99-113.

Ringen, S. (1988), Direct and indirect measures of poverty. Journal of Social Policy, 17(3), 351-365.

Ruggeri Laderchi, C. (1999), The Many Dimensions of Deprivation in Peru: Theoretical Debates and Empirical Evidence. Queen Elizabeth House, University of Oxford, QEH Working Paper 29.

Ruggeri Laderchi, C., Saith, R., Stewart, F. (2003), Does it matter that we don't agree on the definition of poverty? A comparison of four approaches. Oxford Development Studies, 31(3), 243-274.

Saith, R. (2001), Capabilities the concept and its Operationalisation. Queen Elizabeth House, University of Oxford, QEH Working Paper 66.

Salecker, L., Ahmadov, A.K., Karimli, L. (2020), Contrasting Monetary and Multidimensional Poverty Measures in a Low-Income Sub-Saharan African Country. Social Indicators Research, 151, 547-574.

Schokkaert, E., Van Ootegem, L. (1990), Sen's concept of the living standard applied to the Belgian unemployed. Recherches Économiques de Louvain/Louvain Economic Review, 56(3/4), 1-10.

Sen, A.K. (1985), Well-being, agency and freedom: The Dewey lectures 1984. The Journal of Philosophy, 82(4), 169-221.

Sen, A.K. (1993), On Ethics and Economics. Oxford: Basil Blackwell.

Sen, A.K. (1999), Development as Freedom. New York: Oxford University Press.

Silber, J. (2007), Measuring poverty: Taking a multidimensional perspective. Revista de Economía Pública, 182(3/2007), 29-73.

Tauseef, S. (2020), Can Money Buy Happiness? Subjective Wellbeing and Its Relationship with Income, Relative Income, Monetary and Non-Monetary Poverty in Bangladesh. GDI Working Paper 2020-046. The University of Manchester.