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A Multilevel Simultaneous Equations Modelling Approach to Investigate the Relationship between Poverty and Labour-Force Participation among the Elderly in Egypt

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Abstract

In this study, we explore the effect of participation in the labour force on poverty among older people while addressing the issues of endogeneity and the hierarchical structure in the Egyptian household survey data. The households are nested within governorates, which results in dependency among those within the same governorate. We also find that the endogeneity is caused by a simultaneous relationship between poverty and participation in the labour force. A multilevel simultaneous equations model is implemented, and the results support the hypothesis that participating in the labour force has a significant effect on reducing older people's poverty.

Keywords: Older people; Poverty; Labour force; Endogeneity; Hierarchical analysis; Multilevel analysis

Introduction

Egypt is going through a significant demographic change since the last few decades, in which the population ageing is one of its main characteristics. As the most populous Arab nation, Egypt's population reaches almost 95 million people. In 1996, there were 5.7% older persons aged 60 and more. By 2006, the ratio increased to 6.1% of the total population [1]. The proportion of persons aged 60+ in the population is expected to reach 11% by 2025 and will continue to grow to 18% by 2050 [2]. With ageing, people often lack the capacity to work and earn. According to 2006 census data, 23.7% of older persons aged 60-64 were engaged in the labour market. This percentage declines to about 15% for the category 65-69 and only 6.6% for the category 75+ [1].

Older people who can no longer participate in the labour market are more likely to seek other sources of income. Traditionally, the most common formal source of income in old age is the social support system in addition to an informal extended families source of support. However, the formal support system has put older people in a vulnerable position due to limited resources and coverage [3]. Since the societies' structure shifts away from the tradition multigenerational families to more nuclear families, the extended families also seem to be imperfect [4]. Even where the traditional structure still exists, older people cannot rely on their relatives as they would have done in the past, because the decline in the fertility rate has reduced the number of family members who can become potential supporters. The United Nations [2] projects a decline in the potential support ratio in Egypt from around thirteen supporters per one older person in 2007 to only five supporters per older person in 2050.

Considering the significant changes in the structure of the population, this paper explores the main factors that determine older people's poverty status focusing on the effect of participating in the labour force. We take account of two main modelling. The first issue is that is the hierarchical structure of the data as the households are nested within governorates, which affects the independence of the observations. Both poverty and participation in the labour force show dependency within each governorate. Our modelling results support that 26.45% of the variability in poverty and 6.74% of the variability in labour-force participation can be attributed to differences between governorates. Ignoring the hierarchical structure of the data could result in low estimates of the standard error of the coefficients associated with the variables measured at higher levels, and therefore produce an apparently significant effect of these variables which is false [5]. Treating highly heterogenous governorates as one group also distorts the results in our study. To overcome this problem, we implement a standard multilevel model that allows for a generalised covariance structure so that the households from the same governorate can be correlated.

The second issue is the endogeneity between poverty and participation in the labour force. On the one hand, being poor may force older people into work as a strategy to reduce their poverty, which indicates a positive relationship between these two variables. On the other hand, participating in the labour force may reduce poverty, which suggests a negative relationship between the two variables. Dealing with this complex interdependency appropriately enables us to achieve a consistent estimate of the parameters by using simultaneous equations [6].

To address both of these issues, we developed a multilevel simultaneous equations model that overcomes the endogeneity problem and the hierarchical structure of the data. In this study, we first explore the issue of poverty among older people in Egypt by constructing a poverty index using data represented at the national level. We then use the poverty index in the multilevel simultaneous equations model to investigate the simultaneous relationship between poverty and participation in the labour force among people aged 60 and over.

The rest of this paper is organised as follows. In the next section, we briefly review the literature on multilevel modelling and endogeneity before addressing its contributions and limitations. We then present and describe the dataset in section 3. In section 4, we construct and illustrate the multidimensional measure of poverty using factor analysis. In section 5, we outline the econometric model. We present the hypothesis tests in section 6 and discuss the empirical results in section 7. Further discussions and concluding remarks on policy relevance are presented in section 8.

Literature Review

The topic of endogeneity has received more attention from researchers in the context of fixed-effects models than hierarchical models. Empirical results show that the presence of even a modest correlation between the regressor and the random disturbance affects the bias and consistency of the regression parameter [7]. A widely used approach to overcome the problem of endogeneity in fixed-effects models is to construct an instrumental variable, which is correlated with the endogenous regressor but not with the random term. This instrumental variable is then regressed on the dependent variable instead of the original endogenous variable. Spencer [8] suggested applying the same approach to overcome endogeneity in hierarchical models. Similarly, Spencer & Fielding [9] constructed instrument variables to study how the individual and contextual characteristics affect their test scores. To obtain a consistent estimate of the endogenous variable, Rice et al. [10] recommended using instrumental variables or conditioning on the group-level effect. Dee [11] adopted an assumption-free approach to account for within-group dependencies in the error structure rather than using the multilevel model technique.

Steele et al. [12] developed a two-level simultaneous equations model to examine the endogeneity results from the selection bias of school resources on pupils' attainment. They used the reweighted iterative generalised least squares method. More recently, Steele et al. [13] identified other two-level simultaneous equations to model the relationship between children's educational transition and family disruption. They again demonstrated the importance of tackling endogeneity, since ignoring it led to over-estimating the effects of disruption in the family on children's outcomes. In their most recent study, Steele et al. [14] considered a multilevel framework to examine the simultaneous influence of individuals within the same social group, based on longitudinal data. They focused on reciprocal parent-child causal effects and sibling effects by setting two multilevel simultaneous equations autoregressive cross-lagged model for the parents' and children's responses.

A review of the relevant literature shows that most of the existing studies on older people's participation in the labour force have focused on variables measured at the individual level, such as age, gender, marital status, education and health, as the main determinants [15,16]. Other studies on participation in the labour force have also looked at the effects of individual characteristics, including being a married woman [17], adult education [18], losing a job [19], and receiving a social security pension [20,21].

Several studies have captured variables that were measured at the national level. However, some of these attempts encountered methodological difficulties. Yamada [22] used Japanese aggregated census data to identify the determinants of the supply of older people in the labour market. Their study identified that social security retirement benefits and the rate of unemployment were the main determinants of older men participating in the labour force. A study that heavily depends on aggregated data can result in the problem of ecological fallacy [23] as the correlation between the dependent variable and an independent variable can be distinctively different for the whole observations than within each group. Making implications regarding only the overall participation in the labour force, for example, could justify the use of aggregated data and reduce aggregation bias. Some studies have combined variables at an individual and a national level. Munnell et al. [24] used a probit regression model to examine how important the following factors were in determining older people's participation in the labour force: the rate of unemployment, the age structure of the population, the nature of employment and specific individual characteristics. However, when the individual- and national-level variables are combined into a single fixed-effects model only, this violates the assumption of the independence of error, yielding a highly significant effect of the predictors due to the low estimated standard error [5,25].

Simultaneity among variables is another important issue that should be taken into consideration whenever it exists; otherwise, it leads to inconsistent results for the effects of key variables. Parsons' [26] study stresses the importance of the endogeneity of self-reported health by using different health indicators to com-

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pare the determinants of the supply of older people in the labour market. Chang & Yen [27] and Bound et al. [28] found that self-reported health is an endogenous variable, and that those who are in good health are less likely to retire unless they have plentiful economic resources. Although Mitchell and Dwyer [29] found no support for the evidence of the endogeneity of self-reported health, they believe that poverty has a significant influence on retirement decisions.

Broadly relating to poverty, researchers have identified several endogenous variables. Cameron & Cobb-Clark [30] considered whether receiving financial transfers from children is endogenous to the supply of older people in the labour market. They found that the only significant effect of receiving transfers was to reduce the supply of co-resident mothers (mothers who live with their children) in the labour force. More recently, they explored the effects of living with children as another endogenous variable that should, along with transfers from children, determine the supply of older people in the labour market [31]. Life satisfaction is another variable that has been found to be endogenous to older people's participation in the labour force [27]. Amuedo-Dorantes [32] investigated the endogeneity of poverty on the involvement of household heads in the informal sector and found that there is a positive relationship between poverty and working in the informal sector.

Data

This study uses data from the Egyptian Household Observatory Survey – Round 7, Egypt 2010 database [33]. In 2010, Egypt was divided for administrative purposes into twenty-nine governorates representing three main regions: Upper Egypt, which has ten governorates, Lower Egypt, which has fourteen governorates, and the frontier regions, which have five governorates. The data includes households in twenty-four governorates from Lower Egypt and Upper Egypt; the governorates in the frontier regions were excluded due to their low population density. The Household Observatory Survey was conducted to collect information on a broad range of topics related to households' health, socio-economic circumstances and perception of a wide range of services. All the households headed by a person aged 60 or over were used in this study, resulting in data from a total of 2,102 households. The definitions of the variables used, along with their summary statistics, are presented in Table 1.

Table1: Descriptive statistics.

Variable	Definition	Mean	S.D
AG1	A dummy variable which takes the value1 if the elderly is between 65-69 years old and 0 otherwise.	0.258	0.438
AG2	A dummy variable which takes the value1 if the elderly is 70 years old or above and 0 otherwise.	0.33	0.47
MALE	A dummy variable which takes the value 1 if the elderly is male and 0 if female.	0.726	0.446
MRR	A dummy variable which takes the value 1 if the elderly is currently married and 0 otherwise.	0.641	0.479
ILLTER	A dummy variable which takes the value 1 if the elderly is illiterate and 0 otherwise.	0.53	0.499
UNI	A dummy variable which takes the value 1 if the elderly has university degree or above and 0 otherwise.	0.105	0.307
DISB	A dummy variable which takes the value 1 if the elderly has disability and 0 otherwise.	0.014	0.117
CHR	A dummy variable which takes the value 1 if the elderly has chronic disease and 0 otherwise.	0.585	0.493
DISBCHR	A dummy variable which takes the value 1 if the elderly has both chronic disease and disability and 0 otherwise.	0.025	0.157
HHSUP	A continuous variable represents the ratio of working family members aged 15-59 to the elderly aged 60+.	0.622	0.868
PI	A continuous variable range from 0 to 100 which represents the constructed poverty index where 0 are the richest and 100 are the poorest	54.71	21.38
INLAB	A dummy variable which takes the value 1 if the elderly is currently working and 0 otherwise.	0.266	0.442
INCS	A dummy variable which takes the value 1 if the elderly receives sources of income other than from work.	0.8297	0.376
RU	A dummy variable which takes the value 1 if the elderly resides in rural area and 0 otherwise.	0.489	0.5
UNEMP	A continuous variable represents the unemployment rate for each governorate, unemployed people as a ratio of total labour force.	10.51	5.518
PRIN	A continuous variable represents the percentage of population 15 and above being economic active for each governorate.	30.3	5.07
INEQUAL	A continuous variable represents income inequality in each governorate it ranges from 0 to 100 where 0 indicates perfect equality and 100 indicates perfect inequality.	0.264	0.061

Table 2: Variables measured at governorate-level.

Governorate	N	Gini Coefficient (INEQUAL)	Percentage of Population in Labour Force (PRIN)	Unemployment Rate (UNEMP)
Cairo	163	38%	29.21%	12.04%
Alex	128	30%	25.93%	14.11%
Portsaid	73	34%	37.46%	27.25%

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Sweis	61	29%	28.97%	15.29%
Helwan	71	38%	24.30%	10.69%
6th October	53	38%	25.29%	4.67%
Damitta	64	21%	30.61%	7.01%
Daqahlya	112	22%	34.29%	13.81%
Sharqya	97	19%	29.67%	8.88%
Qalyobia	102	23%	29.01%	7.87%
Kafr Alshekh	64	21%	31.47%	9.05%
Gharbya	114	24%	33.58%	10.54%
menofia	63	23%	36.20%	6.75%
Bhera	107	19%	39.64%	9.53%
Ismaillia	40	27%	32.05%	9.53%
Giza	94	34%	26.79%	11.34%
Banisuif	73	21%	37.77%	3.34%
Fayoum	73	21%	28.93%	3.56%
Menia	130	24%	33.20%	4.36%
Asuit	92	27%	27.45%	9.60%
Sohag	103	23%	24.86%	7.47%
Qina	92	23%	32.91%	9.51%
Aswan	75	27%	29.45%	25.77%
Luxor	58	24%	12.79%	15.32%

Meanwhile, three variables measured at the governorate level were merged with the dataset. For each governorate in the same year (2010), these variables describe the unemployment rate, the percentage of the population in the labour force, and the level of income inequality, which was measured using the Gini coefficient. The data was obtained from the Egypt Human Development Report [34] and is presented in Table 2. For example, 163 households were selected from the Cairo governorate, where 29.21% of the population is in the labour force and the unemployment rate is 12.04%.

Constructing a Poverty Index using Factor Analysis

Poverty is not restricted to a lack of income: it also includes factors that reduce the quality of life. The most widely used measure of poverty is based on a money metric dimension using poverty lines. Another dimension is wealth, which can be measured using various indicators of household welfare, such as ownership of durable goods and housing conditions [35].

One of the major concerns of older people is insecurity, which can be measured by access to health insurance and pension schemes. Access to health insurance is more important for older people than for other age groups. In this study, we used information about an individual's inability to afford the necessary medical treatment as a proxy for lack of access to health insurance. A pension is another important source of security. In Egypt, the government is facing serious difficulty with providing income security for older people because of the low level of coverage of formal pension schemes. More than two-thirds of older Egyptians who have reached state pension age do not receive a pension [2]. When older people do not have a secure source of income, they can become trapped in a cycle of poverty. Thus, we consider lack of access to a pension scheme as an indicator of poverty.

We also considered subjective poverty, which relies on an individual's perception of his or her economic status and provides information about poverty from those who are directly experiencing it. To bring the above-mentioned multidimensional perspectives together, we then used factor analysis to assign a weight to each indicator of poverty. The model can be expressed as:

$$X - \mu_{(p\times 1)} = L_{p\times m}F_{m\times 1} + \varepsilon_{p\times 1} \quad (1)$$

where L is a matrix of factor loadings, l_{ij} is the loading of the ith variable on the jth factor, $F_1, F_2, \ldots, F_m$ are the common factors, which are assumed to have a mean of 0 and an identity variance-covariance matrix, and $\varepsilon_1, \varepsilon_2, \ldots\ldots \varepsilon_p$ are the specific factors, which are assumed to follow the normal distribution with a mean of 0 and a variance–covariance matrix.

The factor score is estimated as a linear combination of the original variables. Thus, for the individual K, the factor score is calculated according to the following formula:

$$I_k = \sum_{i=1}^{p} \hat{f}_i z_{ik} \quad (2)$$

where I_k is the index score of the individual K, $\hat{f}_i$ is the factor score coefficient of the ith variable, z_{ik} is the standardised value of the ith variable for the individual K, and is the number of variables.

We construct a composite poverty index using factor analysis. First, we construct an index of durable goods owned by each household. Then we set up an index of households' housing condi-

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tions (these results are available upon request). Finally, we create the poverty index from the two indices of durable goods and housing conditions, along with other variables that represent different dimensions of poverty. These variables include poverty status by the Egyptian objective poverty line (OP) and subjective poverty (SP). More specifically, the OP indicates whether or not per capita spending is below or above the official Egyptian poverty line; and the SP is measured by the individual's responses to questions about their perception of their poverty status. We also incorporate two variables to reflect the security dimensions: access to health insurance and coverage by a pension scheme. The definitions of the variables used to construct this composite poverty index, along with the summary statistics, are presented in Table 3.

Table 3: Definition of variables used to construct poverty index.

Variable	Variable Definition	Mean	S.D
DGI	A constructed index representing the ownership of durable goods ranges from 0 (the poorest) to 100 (the richest).	20.35	15.66
HCI	A constructed index represents housing conditions and services available to the household ranges from 0 (the poorest) to 100 (the richest).	84.78	11.75
OPR	A dummy variable, equals 1 if per capita expenditure is above the poverty line and 0 otherwise.	82.4	0.381
HI	A dummy variable which takes the value 1 if the individual has access to health insurance scheme and 0 otherwise.	0.58	0.494
PC	A dummy variable which takes the value 1 if the individual has access to a pension and 0 otherwise.	0.56	0.497
SPR	A dummy variable which takes the value 1 if the individual assesses his status as "not poor" and 0 otherwise.	0.55	0.498

A factor analysis of these six variables yields a two-factor solution, as reported in Table 4. The communalities of the variables used to construct the poverty index ranged from 0.274 to 0.743. The amount of variance accounts for by the principal component is about 57%. The Kaiser-Meyer-Olkin (KMO) value is 0.7, which shows that the model is an acceptable fit. Moreover, Bartlett's test of sphericity is significant at the level of 0.01, so we are confident the validity in the analysis. To integrate the two factors into the poverty index, we weight each factor's score by the percentage of variance it explained as a proportion of the total percentage of variance explained by the two factors together. The factor is rescaled to range between 0 and 1 and then multiplied by 100. Therefore, each individual is assigned a score in the poverty index that lay between 0 and 100, where 0 represents the poorest and 100 represents the richest.

Table 4: Results of factor analysis on the poverty index.

Variables	Communalities	Rotated Factor Loading		Factor Score	
		F1	F2	F1	F2
OP	0.743	-0.155	0.843	-0.29	0.687
DGI	0.616	0.569	0.54	0.207	0.283
HCI	0.561	0.568	0.488	0.219	0.242
SP	0.274	0.292	0.435	0.069	0.267
PC	0.498	0.683	0.179	0.359	-0.023
HI	0.736	0.848	-0.128	0.528	-0.299
% of variance: Total=56.97839.12817.850					
K-M-O test of sampling adequacy: 0.700					
Number of observations =2102					
Bartlett's test of sphericity: (=2063.018, sig=0)					

The Econometric Model

We need to address two issues in the modelling. The first is the hierarchical structure of the data, and the second is endogeneity. As the households are nested within governorates, this results in a certain degree of dependency among households within the same governorate; for example, they may share similar geographical features, social norms and regulations. Consequently, this violates the ordinary least squares (OLS) assumption of independence of observations and biases the variances of the estimates. For example, it would produce a lower estimate of the standard errors that yield unrealistically significant results (Hox, 2010) [5]. Moreover, we believe that older people are likely to be poor when they do not receive income from employment. However, being poor might force those people to join the labour force as a strategy to reduce their poverty; thus, poverty may be diminishing in response to participation in the labour force. This endogeneity from the simultaneous relationship between poverty and participation in the labour force should be addressed appropriately in the modelling. To do so, our model considers the hierarchical structure of the data while correcting for the endogeneity of participation in the labour force. The standard approach to modelling the hierarchical structure of the data with clustering at the governorate level is to fit a two-level random-effects model and then allow the intercept

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term and other parameters to vary randomly across governorates (Snijders and Brsker, 1999; Steele et al., 2007) [12]. We propose the following models:

$$PI_{ij} = \beta_{0,j} + \beta_{1,j} ILLTER_{ij} + \beta_{1,j} INCS_{ij} + \beta_{3,j} INLAB_{ij} + \sum_{q=4}^{11} \beta_{q,j} X_{qij} + u_j + \varepsilon_{ij} \quad (3)$$

where X_{qij} stands for the poverty index, which is derived in the previous section, X_{qij} represents the q[th] predictor for an individual *i* nested in a governorate *j*, ε_{ij} is the q[th] parameter associated with X_{qij} , $\beta_{0,j}$ is the intercept term of governorate *j*, u_j and ε_{ij} are the random error terms for the governorates and the households, respectively, which are assumed to be normally distributed: $u_j \sim N(0, \sigma_u^2)$ and $e_{ij} \sim N(0, \sigma_e^2)$.

The individual-level variables in equation (3) include both demographic and socio-economic variables, such as AG1, AG2, MALE, MRR, ILLTER, UNI, HHSUP, INCS, RU, and INLAB and the interaction term $INCS_{ij} \times RU_{ij}$.

The difference caused by random effects can be modelled by letting $\beta_{0,j}$, $\beta_{1,j}$ and $\beta_{2,j}$ consist of a fixed component which represents the population average and the random governorate difference from the population average. Specifically, we construct the following three sets of equations to capture this variation by introducing random terms to $\beta_{0,j}$, $\beta_{1,j}$ and $\beta_{2,j}$:

$$\beta_{0,j} = \gamma_{0,0} + \sum_{h=1}^{3} \gamma_{0,h} Z_{hj} + U_{0j} \quad (4)$$

$$\beta_{1,j} = \gamma_{1,0} + \sum_{h=1}^{3} \gamma_{1,h} Z_{hj} + U_{1j} \quad (5)$$

$$\beta_{2,j} = \gamma_{2,0} + \sum_{h=1}^{3} \gamma_{2,h} Z_{hj} + U_{2j} \quad (6)$$

Other slopes parameters are assumed to be fixed across governorates, i.e., $\beta_{q,j} = \gamma_{q,0}$ for q = 3, 4, ..., 11. We let *j* = 0 because there is no variation between governorates in the effect of the predictors on the poverty index.

Combine equations (3) to (6), a single equation for the poverty model is given by:

$$PI_{ij} = \gamma_{0,0} + \sum_{h=1}^{3} \gamma_{0,h} Z_{hj} + \left(\gamma_{1,0} + \sum_{h=1}^{3} \gamma_{1,h} Z_{hj} \right) ILLTER_{ij} + \left(\gamma_{2,0} + \sum_{h=1}^{3} \gamma_{2,h} Z_{hj} \right) INCS_{ij} + \gamma_{3,0} INLAB_{ij} + \sum_{q=4}^{11} \gamma_{q,0} X_{qij} + \left\{ \varepsilon_{ij} + U_{0j} + U_{1j} ILLTER_{ij} + U_{2j} INCS_{ij} \right\} \quad (7)$$

Similarly, the structural equation for participation in the labour force was set up by using a multilevel logistic model. The log odds of being in the labour force at the individual level can be expressed using the following logit link function via the logistic model:

$$n_{ij} = \beta_{0,j}^{*} + \beta_{1,j}^{*} PI_{ij} + \sum_{q=2}^{13} \beta_{q,j}^{*} X_{qij} \quad for \;\; i = 1,........,2102; \; j = 1,....,24 \quad (8)$$

where η_{ij} is the predicted log odds of being in the labour force as opposed to being in the base category (not in the labour force), X_{qij} is the q[th] predictor for the individual i (nested) in governorate *j*, $\beta_{q,j}^{*}$ is the q[th] parameter associated with the q[th] predictor, $\beta_{0,j}^{*}$ is the intercept of governorate *j*, and is the poverty index. The slope parameters, $\beta_{q,j}^{*}$ are assumed to have fixed effects across governorates. We denote this by letting *j* = 0, since the effect of the predictors on participation in the labour force does not vary across governorates. Thus, $\beta_{q,j}^{*} = \gamma_{q,0}^{*}$ for q = 1, ..., 13. Here, the individual-level variables are demographic and socio-economic, such as AG1, AG2, MALE, MRR, ILLTER, UNI, DISB, CHR, DISBCHR, HHSUP, INCS, RU and PI.

With a further assumption of the random effects in the intercept term, $\beta_{0,j}^{*}$ is written as:

$$\beta_{0,j}^{*} = \gamma_{0,0}^{*} + \sum_{h=1}^{3} \gamma_{0,h}^{*} Z_{hj} + V_{0j} \quad (9)$$

where is the intercept term, Z_{hj} is the h[th] governorate-level predictor of governorate *j*, $\gamma_{0,h}^{*}$ is the h[th] parameter associated with, and V_{0j} is the white noise error term. In our study, the predictors at the governorate level included the rate of unemployment within the governorate (UNEMP), the percentage of the population in the labour force (PRIN) and income inequality within the governorate (INEQUAL).

Putting (8) and (9) together, we now have a single equation version of the multilevel logistic model as follows:

$$\eta_{ij} = \gamma_{0,0}^{*} + \gamma_{1,0}^{*} PI_{ij} + \sum_{q=2}^{13} \gamma_{q,0}^{*} X_{qij} + \sum_{h=1}^{3} \gamma_{0,h}^{*} Z_{hj} + V_{0j} \quad (10)$$

Thus, the full set of structural equations consists of equations (7) and (10). To identify these equations, the set of explanatory variables included in equation (7) should contain at least one variable that is not included in the explanatory variables in equation (10). The selected variables must have a direct effect on participation in the labour force, but they should not have a direct influence on poverty. We consider using health condition because several studies have found out that health is one of the main determinants of participation in the labour force Barnay, 2009 [15,16]. Bound et al. [28] argue that older people who are in good health are less likely to retire unless they have plentiful economic resources. Health is measured by three indicators: having a disability, having a chronic disease, or both. These three indicators are excluded from equation (7) but are used in equation (10). The results of the multilevel reduced-form model of participation in the labour force show that having these health problems has a highly significant effect on the log odds of older people participating in the labour force. Thus, an argument can be made that in the context of the older population, healthy people tend to continue working beyond their 60s. This indicates a negative relationship between health problems and participation in the labour force. The effect of health on poverty among older people passes through the channel of the labour force participation.

In addition, to account for endogeneity, we develop a multilevel model for the endogenous variable (INLAB) using regressors assumed to be exogenous and independent of the random part of model 7. The exogenous variables at the individual level included AG1, AG2, MALE, MRR, ILLTER, UNI, DISB, CHR, DISBCHR, HHSUP, INCS, RU, while we includedUNEMP, PRIN and INEQUAL as the exogenous variables at the governorate level. Hence, the reduced-form equation for the log odds of participating in the labour force is expressed as follows:

$$\eta_{ij}^{'} = \gamma_{0,0}^{'} + \sum_{q=1}^{12} \gamma_{q,0}^{'} X_{qij} + \sum_{h=1}^{3} \gamma_{0,h}^{1} Z_{hj} + V_{0j}^{'} \quad (11)$$

This reduced-form equation is fitted using the logistic model, and its estimates are used to obtain the predicted values of participation in the labour force, . These predicted values, , do not correlate with the error term in the poverty model in equation (7) as the original variable, which has a correlation with the error

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term. The predicted values were used in the multilevel equation of poverty, and the two-stage least-squares (2SLS) procedure was applied to estimate the multilevel model of poverty as follows:

$$PI_{ij} = \gamma_{0,0} + \sum_{h=1}^{3}\gamma_{0,h}Z_{hj} + \left(\gamma_{1,0} + \sum_{h=1}^{3}\gamma_{1,h}Z_{hj}\right)ILLTER_{ij} + \left(\gamma_{2,0} + \sum_{h=1}^{3}\gamma_{2,h}Z_{hj}\right)INCS_{ij} + \gamma_{3,0}\widehat{INLAB}_{ij} + \sum_{q=4}^{11}\gamma_{q,0}X_{qij} + \left\{\varepsilon_{ij} + U_{0j} + U_{1j}ILLTER_{ij} + U_{2j}INCS_{ij}\right\} \quad (12)$$

Among the terms in equation (12), $\gamma_{0,0} + \gamma_{1,0}ILLTER_{ij} + \gamma_{2,0}INCS_{ij} + \gamma_{3,0}\widehat{INLAB}_{ij} + \sum_{q=4}^{11}\gamma_{q,0}X_{qij}$ represents the fixed effects at the individual level. This is followed by a governorate-level effect of $\sum_{h=1}^{3}\gamma_{0,h}Z_{hj}$, and a cross-level interaction term of $\sum_{h=1}^{3}\gamma_{1,h}Z_{hj}ILLTER_{ij} + \sum_{h=1}^{3}\gamma_{2,h}Z_{hj}INCS_{ij}$. The last component in (12) captures the random part of the model, which includes an individual-level random component,, and the governorate-level random component, $U_{0j} + U_{1j}ILLTER_{ij} + U_{2j}INCS_{ij}$.

Hypotheses Tests

Based on the models described in section 5, we have proposed the following hypotheses tests. We first examine whether or not the variance of governorate-level residuals in the *poverty model* differed significantly among governorates; in other words, whether there was evidence of the hierarchical structure of the data.

More specifically, for the intercept and each variable in poverty model 7, we test H_1: var (U_{qj}) > 0 for q = 0,1,2,...11 and j = 1,2,...24 against the null hypothesis of no variation. We include a set of demographic and socio-economic variables, such as age, gender, marital status, education, household or family support, location and participation in the labour force. We expected to find evidence of var (U_{0j}) > 0, which would emphasise the importance of accounting for the hierarchical data structure.

Similarly, for the reduced form of the *labour-force participation model*, we test whether or not the variance of governorate-level residuals differs significantly among governorates. Thus, for the intercept and each variable, we test H_2: var V'_{qj} > 0 for q = 0,1,2,...11and j = 1,2,...24 against no effects. We expect the results to support H_2.

Meanwhile, among the factors that would influence poverty, we are particularly interested in testing the age-related variables. In Egypt, the retirement age is 60. According to data from the 2006 Egypt census, 23.7% of older people aged between 60 and 64 were participating in the labour market. This percentage fell to about 15% for people in the 65-69 age group and only 6.6% for people aged 75 or older. Thus, against the null hypothesis of no effect, we test $H_3: \gamma_{AG1} > 0$ and $H_4: \gamma_{AG2} > 0$. We expected to reject the null hypothesis and find that people in the older age groups are more likely to be poor than people in the 60-64 age group; that is, we expected to find evidence to support the alternative hypotheses of H_3 and H_4.

Finally, as far as the effect of participation in the labour force is concerned, we expected to find that there is a significant relationship with poverty and that joining the labour force decreases poverty. The alternative hypothesis is $H_5: \gamma_{INLAB} < 0$ against the null hypothesis of no effect.

Empirical Results

The results from the likelihood ratio test (Table 5) suggest that the effects of being illiterate (ILLTER) and receiving other sources of income (INCS) differ substantially across governorates in the poverty index model *with the* χ^2*value of* 19.614, which is highly significant at the level of 1%. We also found that there is a significant variation across the intercept terms. Of the variability in labour-force participation, 6.74% lies between governorates, and this proportion increases to 26.45% of the variability in the poverty model. We then assign random components to the parameters ILLTER and INCS and allow them to vary across governorates. The varying slopes of ILLTER and INCS by governorate are plotted in Figure 1. Thus, the results support H_1 and H_2 on the heterogeneous effects of ILLTER and INCS across governorates.

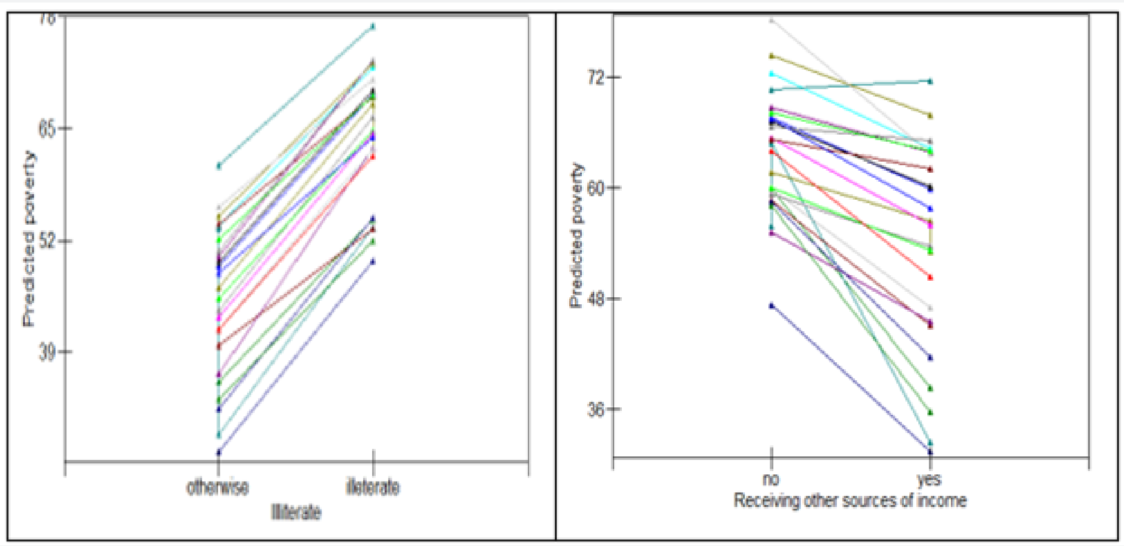

Figure 1: Slopes of being illiterate and receiving other sources of income across the governorates.

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Table 5: The Results of the null models.

Parameter	Labour Force Participation Model		Poverty Model	
	Estimate	Standard Error	Estimate	Standard Error
Fixed Effect				
Intercept	-1.058***	0.113	55.306***	2.255
Variance Component				
τ_{00}	0.238		117.9	
σ'^2	3.29		327.8	
VPC	6.74%		26.45%	

*** denotes that the estimated coefficient is Significant at .01** denotes that the estimated coefficient is Significant at .05* denotes that the estimated coefficient is Significant at .1.

Meanwhile, the results presented in Table 6 show that when the multilevel structure is accounted for, the model is more able to explain the variability in labour-force participation between governorates. The variance partition coefficient (VPC) is 3.04% when accounting for the multilevel structure, which is half the VPC when the multilevel structure is not considered. Furthermore, the results indicate that a multilevel approach is necessary for both the poverty and the labour-force participation models.

Table 6: The results of the multilevel reduced form model for labour force participation.

Variables	Coefficient	Std. Err
Intercept	3.174***	0.551
AG1	-0.205	0.162
AG2	-1.054***	0.178
MALE	.513**	0.236
MRR	.521**	0.228
ILLTER	.416***	0.118
UNI	0.08	0.227
HHSUP	-.196***	0.066
CHR	-.590***	0.148
DISB	-2.102***	0.751
DISBCHR	-2.101***	0.616
INCS	-2.854***	0.161
RU	.394**	0.196
INEQUAL	-4.692***	1.214
UNEMP	-0.006	0.011
PRIN	-.035***	0.013
Random Part		
τ^*_{00}	0.103	0.067
VPC*3.04%		

***denotes that the estimated coefficient is Significant at .01** denotes that the estimated coefficient is Significant at .05* denotes that the estimated coefficient is Significant at .1.

In the previous section, we established the endogeneity of participation in the labour force with respect to poverty. The results in Table 6 are used in a reduced form to obtain the predicted values of participation in the labour force, $\widehat{INLAB_{ij}}$. $\widehat{INLAB_{ij}}$ was then included in equation 12. To obtain unbiased estimates, we applied the 2SLS model. For the purposes of comparison, all the modelling results for the determinants of poverty using the OLS, 2SLS and multilevel 2SLS modelling approaches are presented in Table 7. We focus on the multilevel 2SLS model in this section, because it addresses the issues of endogeneity and the hierarchical structure of the data.

Two main sets of variables were expected to affect poverty among older people. The first set is at the individual level and includes demographic and socio-economic characteristics, such as age, gender, marital status, educational attainment, household potential support ratio, receipt of other sources of income, and place of residence. The second set of variables includes the governorate characteristics: income inequality, the rate of unemployment and the percentage of the population participating in the labour force. We add to the second set of variables some cross-level interaction variables which result from the significant variation between governorates in the effect of the predictors (ILLTER and INCS) on poverty index.

As far as the individual-level variables are concerned, being 70 or older (AG2) has a significant effect on exacerbating poverty, while being in the 65-69 age group does not affect poverty status. Therefore, we find evidence to support H_4 but not H_3.

Being male (MALE), holding a university degree or above (UNI), having a high household potential support ratio (HHSUP) and participating in the labour force $\left(\widehat{INLAB_{ij}}\right)$ all reduce the likelihood of being in poverty. The interaction effect of $INCS_{ij} \times RU_{ij}$ is significant and positive, which indicates that older people living in rural areas and receiving income from fewer sources other than work are more likely to be living in poverty. Our data show that approximately 30% of older people living in rural areas receive government assistance and more than 23% receive support from relatives. For households in urban areas, the other main source of income is pension schemes. In urban areas, 72.3% of residents receive a pension; in rural areas this figure is only 38%. This broadly supports the finding that far fewer households living in rural areas receive income support.

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As far as the governorate-level variables are concerned, the higher the income inequality rate, the more people in the labour force and higher unemployment rate have a significant effect on reducing poverty. Due to the complex function of income-distribution channels during a country's economic growth, there is no consensus on the exact impact of income inequality on growth, and, therefore, on poverty [36]. In our study, we found that there is a significant, negative relationship between income inequality and poverty status.

As noted in H_1 and H_2, we have assigned two random slopes for ILLTER and INCS to account for the heterogeneity of effects. To do so, we consider the cross-level interaction between the governorate-level variables and these two variables. The results show that the interactions between these variables and some of the governorate-level variables have a significant effect on poverty. The results show that the interaction between illiteracy and the percentage of the population participating in the labour force ($ILLTER_{ij} \times PRIN_j$) exerts a significant, positive influence on the poverty index. This further indicates that for older people who are illiterate, participating in the labour force has a smaller effect on reducing poverty. The results also suggest that in governorates with a high level of income inequality, receiving other sources of income significantly reduces poverty.

As far as the random factor is concerned, the results suggest that variance at the governorate level (τ_{00}) decreases substantially from 117.9 (Table 3) to 0 (Table 7). Accordingly, a multilevel simultaneous equations model reduces the variance partition coefficient (VPC) from 26.45% (Table 5) to only 10.34% (Table 7).

It is also interesting to compare the results of the multilevel simultaneous equations model with those of the OLS and 2SLS models (Table 7). The first estimation is the OLS model, which ignores the endogeneity and the hierarchical structure of the data. The second is the 2SLS model, which accounts for endogeneity but ignores the hierarchical structure of the data. The results show that, in general, the multilevel 2SLS model yields larger standard error terms than the other two models for the variables whose effects differ significantly among governorates (i.e. ILLTER and INCS) and for the cross-level interaction variables. This is because applying single-level models of OLS and 2SLS on our hierarchical data violate the assumption of independence of observations. They disaggregate the variables measured at the governorate level to the individual level, which yields lower standard errors for the estimated parameters and, therefore, exaggerates their significance.

Table 7: Estimation results of OLS, 2SLS, and Multilevel 2SLS models.

Variables	OLS		2SLS		Multilevel2SLS	
Fixed part	Coefficient	Std.Err	Coefficient	Std.Err	Coefficient	Std.Err
Intercept	72.39***	7.69	80.64***	8.24	79.08***	7.51
Demographic						
AG1	0.02	0.76	-0.21	0.77	-0.31	0.74
AG2	2.39***	0.75	1.73**	0.75	1.49***	0.76
MALE	-4.33***	1.19	-4.06***	1.19	-3.78***	1.16
MRR	-0.33	1.11	0.03	1.11	-0.07	1.09
Socio-economic						
ILLTER	-5.25	5.73	-4.36	5.76	-6.58	6.91
UNI	-16.56***	1.08	-16.48***	1.09	-16.39***	1.06
HHSUP	-1.35***	0.36	-1.46***	0.36	-1.47***	0.35
INCS	6.99	7.5	0.3	8.05	4.79	9.37
INLAB	3.6***	0.83	-3.94**	2.39	-1.37*	1.05
RU	7.2***	1.73	7.29***	1.74	7.29***	1.71
INCS × RU	6.83***	1.87	7.05***	1.88	5.69***	1.85
Governorate var.						
UNEMP	-0.23*	0.16	-0.23*	0.16	-0.26*	0.16
PRIN	-0.32**	0.17	-0.35**	0.17	-0.38***	0.17
INEQUAL	-17.71	16.4	-23.64	16.63	-24.39*	16.01
Cross-level interaction						
ILLTER × UNEMP	-0.08	0.12	-0.08	0.12	-0.05	0.15
ILLTER × PRIN	0.45***	0.13	0.44***	0.13	0.48***	0.16
ILLTER × INEQUAL	20.91**	11.82	19.79*	11.87	20.37	14.32

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INCS × UNEMP	0.098	0.16	0.09	0.16	0.12	0.2
INCS × PRIN	-0.25	0.16	-0.25	0.16	-0.25	0.21
INCS × INEQUAL	-45.29***	16.34	-41.51**	16.54	-44.74**	20.48
Random Part						
τ_{00}	-----	-----	-----	-----	0	
τ_{11}	-----	-----	-----	-----	4.822***	
τ_{22}	-----	-----	-----	-----	12.151***	
σ^2	186.817	13.67	188.25	13.72	174.052***	13.193
VPC					10.34%	

Take, for example, the effect of being in the labour force (INLAB), which is the variable we have focused on in this study. When using the OLS model without correcting the endogeneity, this variable has a significant effect on increasing poverty; after fixing the endogeneity problem, INLAB has a significant effect on reducing poverty. The single-level 2SLS model and the multilevel 2SLS model both suggest that the effects of participating in the labour force have a signisssficant effect on reducing poverty.

Discussion and Conclusion

We have investigated the main determinants of poverty among people aged 60 and over, with a particular focus on the relationship between poverty among older people and their participation in the labour force. Our study has used a multidimensional measure of poverty in later life to capture a range of dimensions of poverty rather than depending solely on financial deprivation. We then used this poverty index as a dependent variable to model the determinants of poverty among older people.

The study contributes to developing a multilevel 2SLS model that simultaneously accounts for the two key issues of endogeneity and the hierarchical structure of the data. We have constructed a variance framework by allowing two of the regression parameters to vary across governorate-level units. We have also compared the multilevel 2SLS model with the traditional OLS model and the basic 2SLS model. It is interesting to observe the change in the coefficient of INLAB from a positive to a negative relationship with a reduction in poverty.

In addition to overcoming these two methodological issues, we have identified several main determinants of poverty among older people. All the models tested showed that being in the 70+ age group significantly increases poverty. It is widely believed that female-headed households are poorer than their male counterparts because women have fewer opportunities to obtain a university degree and, as a consequence, less access to equal employment opportunities. Our study also supports the assertion that gender has a significant influence on poverty, with older men being less likely to be in poverty than older women. Our results showed that holding a university degree or higher also decreases poverty significantly, compared with other education groups. The ratio of potential supporters in the household, where the burden is placed on younger members of the household to support their older relatives, showed that as the number of potential supporters increases, poverty among older people decreases. Consistent with previous studies, rural residents are poorer than their urban counterparts. Moreover, rural residents who receive income from sources other than work are poorer than those who do not receive other sources of income. The results showed that the most common source of income other than pay among urban residents is a retirement pension; while in rural areas, receiving assistance from either relative or the governorate is almost as high compared to urban residents.

At the governorate level, the rate of unemployment showed a negative association with poverty. As high unemployment can happen when the economy either grows rapidly or is in recession, it is not necessarily an indicator of reduced poverty. Because participation in the labour force measures the overall strength of the labour market, including people who are looking for part-time jobs, increasing the percentage of the population in the labour force will decrease poverty. A large volume of literature discusses the theoretical link between income inequality and economic growth, and the influence of these factors on poverty [36]. There is no consensus in theory or the empirical evidence. From our cross-sectional data, we have found that income inequality decreases poverty status. This could be an effect of Egypt's economic growth policy, which was put in place to reduce poverty but has also widened the dispersion of income.

Policy Relevance

Within the broader debate on how best to improve the welfare of older people in Egypt, there are calls to improve accuracies in modelling. Our study has revealed that being in the labour force has a significant effect on decreasing poverty. To encourage older people to stay in the labour market will require a strong focus from policymakers, especially in light of the fact that the percentage of older people in the labour force is expected to decrease to

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just 7.5% in 2020 from 31.9% in 1980 [2]. This can be done in various ways; for example, by informing older people who are nearing retirement of the advantages of continuing to work. Older people can be encouraged to work beyond their 60s by providing more opportunities for them to extend their working life. Our study provides evidence to support Egypt's new retirement policy, which calls for extending the retirement age from 60 to 65.

Our study calls for policymakers to take an innovative approach to reforming Egypt's social support systems. Our results have also revealed that people who are older, female, have fewer potential supporters and are not working are more likely to be poor. To strengthen the support systems in place for these vulnerable groups, and for older people in general, requires collaboration between governmental organisations, non-governmental organisations and the private sector. Social security systems and safety nets must be improved to protect older people's well-being and ensure they receive an adequate income. Furthermore, health insurance and access to a pension scheme should be available to all older people [37-52].

Also, to ensure that information is represented accurately in poverty studies, researchers should consider specific indicators of poverty for older people. Further research can be carried out in several areas. For instance, this study stresses that poverty levels and participation in the labour force differ among governorates. However, within each governorate there are still heterogeneous groups. In addition, if data is made available on the characteristics of the neighbourhoods within each governorate, this will allow another level of data hierarchy to be considered. Another important issue that can be explored further is that of gender differences. In Egypt, the percentage of older men participating in the labour force is expected to decrease dramatically. However, the participation rate for older women is expected to increase. Thus, it may be useful to model the determinants of poverty separately for older men and older women. Furthermore, it is also important to consider poverty throughout a person's life to differentiate between those who were poor before retirement and those who became trapped in the cycle of poverty after leaving work. Therefore, longitudinal studies that examine the factors associated with the transition from and into the poverty cycle will be valuable in the future.

References

1. Central Agency for Public Mobilization and Statistics (2006) Population and Housing Census (PHC) Arab Rep. Egypt.
2. United Nations (2007) Department of Economic and Social Affairs, Population Division. USA.
3. Khadr Z (2004) Work and retirement behavior in Old Age: The Experience of Older Egyptian Men. The Egyptian Population and Family Planning Review, Institute of Statistical Studies and Research, Cairo, Egypt.
4. Schwarz Antia M (2003) Old age Security and Social Pensions, Social protection. World Bank: Human Development (Social Protection). USA.
5. Hox J (2010) Multilevel analysis: techniques and applications, (2nd edn). Routledge, London, United Kingdom.
6. Goldstein H (2003) Multilevel Statistical Models. (3rd edn). Arnold, London.
7. Ebbes Peter (2004) Regressor and Random-Effects Dependencies in Multilevel Models. Statistica Neerlandica 58(2): 161-178.
8. Spencer Neil H (1998) Consistent Parameter Estimation for Lagged Multilevel Models. Journal of Data Science 1(2003): 123-147.
9. Spencer NH, Fielding A (2000) An instrumental variable consistent estimation procedure to overcome the problem of endogenous variables in multilevel models. Multilevel Modelling Newsletter 12(1): 4-7.
10. Rice N (1998) Multilevel Models where the Random Effects are Correlated with the Fixed Predictors: a Conditioned Iterative Generalised least Square Estimator (CIGLS). Multilevel Modelling Newsletter 10(1): 10-14.
11. Dee T (1998) Competition and the quality of public schools. Economics of Education Review 17 (4): 419-427.
12. Fiona Steele, Anna Vignoles, Andrew Jenkins (2007) The effect of school resources on pupil attainment: a multilevel simultaneous equation modelling approach. Journal of the Royal Statistical Society 170(3): 801-824.
13. Steele F, Sigle Rushton W, Kravdal Q (2009) Consequences of family disruption on children's educational outcomes in Norway. Demography 46(3): 553-574.
14. Steele F, Rasbash J, Jenkins J (2013) A multilevel simultaneous equations model for within-cluster dynamic effects, with an application to reciprocal parent-child and sibling effects. Psychological Methods 18(1): 87.
15. Costa D (1996) Health and labor force participation of older men, 1900-1991.The Journal of Economic History 56: 62-89.
16. Campolieti M (2002) Disability and the labor force participation of older men in Canada. Labour Economics 9(3): 405-432.
17. Shirle T (2008) Why have the labor force participation rates of older men increased since the mid-1990s? Journal of Labour Economics 26(4): 549-585.
18. Stenberg A Luna X, Westerlund O (2012) Can adult education delay retirement from the labour market? Journal Population Economics 25: 677-696.
19. Chan S, Stevens A (2001) Job Loss and Employment Patterns of older Workers. Journal of Labour Economics 19(2): 484-521.
20. French E (2005) The effects of health, wealth, and wages on labour supply and retirement behaviour. Review of Economic Studies 72: 395-427.
21. Klaauw W, Wolpin K (2008) Social security and the retirement and saving behaviour of low-income households. Journal of Econometrics 145: 21-42.
22. Yamada T (1990) The labor force participation of elderly males in Japan. Journal of the Japanese and international economics 4: 1-23.
23. Robinson WS (1950) Ecological correlations and the behavior of individuals. American Sociological Review 15: 351-357.
24. Munnell A, Soto M, Triest K, Zhivan N (2008) How much do state economics and other characteristics affect labor force participation of older workers? Center for Retirement Research at Boston College, United Kingdom.
25. Steenbergen M, Jones B (2002) Modelling Multilevel Data Structures. American Journal of Political Science 46: 218-237.
26. Parsons D (1989) The male labour force participation decision: health, reported health, and economic incentives. Economica 49: 81-91.

How to cite this article: Hend Gabr, Fiona Carmichael and Hui Li. A Multilevel Simultaneous Equations Modelling Approach to Investigate the Relationship between Poverty and Labour-Force Participation among the Elderly in Egypt. Int J Environ Sci Nat Res. 2019; 22(1): 556076. DOI: 10.19080/IJESNR.2019.22.556076

27. Chang H, Yen S (2011) Full-time, part-time and life satisfaction of the elderly. The Journal of socio-economics 40: 815-823.

28. Bound J, Stinebrickner T, Waidmann T (2010) Health, economic resources and the work decisions of older men. Journal of Econometrics 156: 106-129.

29. Mitchell O, Dwyer D (1999) Health problems as determinants of retirement: Are self-rated measures endogenous? Journal of Health Economics 18: 173-193.

30. Cameron LA, Cobb Clark DA (2002) Old-age labour supply in the developing world. Applied Economics Letters 9(10): 649-652.

31. Cameron LA, Cobb Clark D (2008) Do coresidency and financial transfers from the children reduce the need for elderly parents to works in developing countries? Journal of Population Economics 21(4): 1007-1033.

32. Amuedo Dorantes C (2004) Determinants and Poverty Implications of Informal Sector Work in Chile. Economic Development and Cultural Change 52(2): 347-368.

33. IDSC (2010) Egyptian household observatory survey database-Round 7. Egypt.

34. UNDP (2010) Egypt Human Development Report 2010: youth in Egypt: building our future. United Nations Development Programme, and the Institute of National Planning, Egypt.

35. Zimmer Z (2008) Poverty, Wealth Inequality, and Health Among Older Adults in rural Cambodia. Social Sciences 66(1): 57-71.

36. Bourguignon F (2004) The Poverty-Growth-Inequality Triangle. Conference paper at the Indian Council for Research on International economic relations, New Delhi.

37. Baker K, Ofstedal M, Zimmer Z, Tang Z, Cauang Y (2005) Reciprocal Effects of Health and Economic well-being among older adults in Taiwan and Beijing. working paper No.197, population council, New York.

38. Burholt V, Windle G (2006) The Material Resources and Well-Being of Older People. Joseph Rowntree Foundation, York.

39. Falkingham J, Namazie C (2002) Measuring health and poverty: a review of approaches to identifying the poor. Department for International Development Health Systems Resource Centre (DFID HSRC). London, UK.

40. Hegazi E (1999) Elderly in rural Egypt: Ikhtab village- Daqahlya Governorates. National Center for Social and Criminological Research, Cairo, Egypt.

41. Jones K (2008) Do multilevel models ever give different results? USA.

42. Miller F, Mcbrewster J (2009) Factor Analysis. Alphascripts. USA.

43. Noumbissis A (2004) Poverty among the elderly in South Africa. South Africa.

44. Nwar L, Abdelghany M (2006) Health, social and economic profile of the elderly in Egypt. Cairo demographic centre, Cairo, Egypt.

45. Osman M, Zakarya I, Mahrous W (2006) Targeting The Poor In Egypt. A ROC Approach. ERF Annual Conference 16-18 December 2006, Kuwait.

46. Radner D (1992) The Economic Status of the Aged. Social Security Bulletin 55(3): 3-23.

47. Rendall M (1996) Aggregating poor and near poor elderly under different resource definitions. Journal of Gerontology 51(4): 209-216.

48. Saunders P (2004) State and family in the living condition of the aged in China: changing roles, attitudes and outcomes. Social policy research centre, University of New South Wales, Sydney, Australia.

49. Leila R (2004) Grow old, get poor. Al-Ahram Weekly 691: 20-26.

50. UN (2002) World Population Ageing 1950-2050. New York: Population Division of the Department of Economics and Social Affairs (DESA), United Nations Secretariat.

51. World Population Ageing (2007) New York.

52. UNDP (2003) Subjective Poverty and Social Capital: Towards a Comprehensive Strategy to Reduce Poverty, UNDP, Cairo.

DOI: 10.19080/IJESNR.2019.21.556076

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