Fertility, health and female labour force participation: there is a missing link!

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Fertility, Health and Female Labour Force Participation: There is a missing link !♣

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Abstract:

Many studies report empirical relationship either between fertility and labour supply or, between health and labour market outcomes. In this paper, an extension of these ideas involves explicitly considering how fertility and health affect each other, and how they interrelate with labour force participation. A unifying framework is provided and a simultaneous three equations model developed to capture the interdependence between these variables as well as their respective determinants. The model is estimated using a cross-section data set obtained from a survey of the urban Cameroon population. The results indicate that: (i) fertility and health status are significantly interrelated, thus separate estimations of fertility (or health status) and participation will produce misleading results; (ii) working in either sector of the labour market significantly reduces fertility but, unlike many previous studies, fertility has a positive impact on the probability of labour force participation; (iii) there is strong evidence that health and disability status is a significant determinant of employment, but the reverse depend on the labour market sector and on the health indicator used.

Keywords: Fertility, self-reported health, disability, labour supply, simultaneous equations model, limited dependent variable

JEL Classification: C350, I120, J13, J22, J200

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Introduction

Since the pioneering work by Mincer (1962) and Cain (1966), there have been numerous studies on female labour force participation. These studies highlight that women's labour supply depends upon economic and demographic characteristics such as female earnings, male earnings, non-earnings income, schooling, age and the number of children (see Hill, 1983 for a review). Some of them have documented strong ties between women's work patterns and changes in their family status (Ellingsæter & Rønsen 1996, Rindfuss et al 1999, Rosenfeld 1996). These results are based on the evidence that women who work for pay have fewer children (on average) than women who do not, and that mothers spend less time in paid employment (on average) than childless women.

As the body of literature on labour supply grown, models were implemented to demonstrate that health was one of human capital characteristics (Scheffler and Iden, 1974; Bartel and Taubman, 1979; Parsons, 1980) and as such, health status variables influence labour force decisions; therefore, models could be refined in order to include these variables. An extensive literature demonstrates there is a positive relationship between health and economic prosperity (Marmot et al, 1991). Using self-reported measures, Bound et al. (1996) find that health have positive and significant effects on labour force participation; they demonstrate that the lower labour force participation rates of blacks (relative to whites) can be explained by differences in health status.

While there is evidence that fertility is endogenous to labour force decisions (Cramer, 1980; Mroz, 1987; Angrist and Evans, 1998), Stern (1989) and Leung and Wong (2002) document the fact that health and labour force participation are interrelated (see also Haveman et al., 1989; Lavy et al., 1995). Yet, most of these studies treat these relationships separately (we mean fertility-labour supply on one hand, and health-labour supply on the other hand) and ignore the well documented influence of fertility and health on each other (see Adair and Popkin 1992; Merchant and Martorell 1988; Miller, Rodriguez, and Pebley 1994). The paper argues that failing to account for this relationship may have lead to biased estimates of the impact of fertility and health on labour force participation.

The objective of this study is thus to determine the impact of fertility and health to labour force participation in a simultaneous equations framework. The next section reviews the literature, section III sets the methodology, section IV gives the results, and section V discusses the results and concludes.

2. Literature review.

Over the life-cycle, female labour force behavior is governed by various factors. Very complex mechanisms determine the decision to enter, stay on, or leave the labour market (Lelièvre-Gauthier 1994) amongst others we have, economic (that is the labour market structure), individual (skills, marital status, labour force attachment, incentives, career expectations about), and household characteristics (structure, domestic workload, presence and number of children) to name few. Many studies aimed at analysing trends (Chase, 1995 ; Bonin et Euwals, 2002), economic and social determinants of labour force decision (Benjamin, 1992; Fong et Lokshin, 2000; Hausman, 1980; Hill 1988, 1994; Saget, 1999)[3] either at micro or macro level. Here, we concentrate on the influence of individual and household characteristics on female labour force participation.

[3] See Griliches and Intriligator (1986) for a review.

Economists and demographers have been interested on the impact of the *number of children* on how likely is a woman to go out to work, and if she does go out to work, for how many hours (Iacovou, 2001). Although there is no reason to believe *a priori* that the effect should go in either direction (or be positive or negative)[4], Cramer (1980) and Weller (1977) give four possible explanations of the association between fertility and female labour force participation: women's fertility influences their labour force behaviour; women's labour force behaviour influences their fertility; a reciprocal relationship exists between the two variables; the association is spurious, reflecting other factors. If some evidence supports the first three hypotheses, the fourth one has proven more difficult to support. Further, most estimates of this relationship have found a negative relationship between the number of children and a woman's labour supply (see Brewster and Rindfuss, 2000 for a review). The problem with these estimates is that they can't say anything about causality.

Following Grossman's work, economists' interest about the impact of poor health on the economy as a whole, the interaction between health and labour market decisions and outcomes has received lots of attention among researchers[5]. In a study of disability and labour force participation (LFP), Stern (1989) finds that disability lowers the probability of LFP, but LFP increases the probability of disability. The finding on the effect of employment on health is not as unambiguous. Ekerdt et. al. (1983) discuss the ambiguity concerning whether work improves or deteriorates health. Self-esteem, identity, and personal fulfilments from supplying labour efforts improve health. However, work pressure or poor working environment worsens health. Ross and Mirowsky (1995) find that health is protected by employment and improvements in health increase the probability of employment. Still, most of these studies have ignored the interrelationship between fertility and health status.

Velkoff and Adlakha (1998) stressed the fact that female health problems in India are related to or exacerbated by high levels of fertility. Jejeebhoy and Rao (1995) show that numerous pregnancies and closely spaced birth increase health risk for mothers. Unwanted pregnancies terminated by unsafe abortions, diseases like malaria, HIV/AIDS, tuberculosis, also have negative consequences for women's health. Through the negative effect of poor health on birth outcomes, health status impact on fertility.

In 2004, the fertility rate was 5.0 in Cameroon; the highest (6.1) being observed in rural areas (INS/DNSC, 2004). About 45% of women suffer from anaemia; those who have a child are almost 49%, the highest rates being observed in urban areas (54% in Yaoundé, 44% in Douala, and 42 % in rural areas). Female nutritional status (measured by the Body Mass Index), an important determinant of female mortality (WHO, 1995), is also a concerned in Cameroon; 7% of women have a BMI les than 18.5 and 29% are over 25, the highest BMIs being observed in Yaoundé and Douala (25.5). These cumulate in high maternal mortality rates. Between 1998 and 2004, this rate was evaluated at 669 female deaths for 100,000; this rate is far beyond what is observed in developed countries.

In a context of high fertility rates, as it is the case in Cameroon, women are exposed to many fertility related health problems and health matters are likely to determine their fertility choices. Thus, any attempt to determine the contributions of these two variables to female LFP must bear in mind their interactions.

[4] In fact, one may argue that a woman with more children will be less inclined to go out to work, since the time she spends at work will be time foregone with her children, and the expense of childcare will reduce her effective wage. On the other hand, children are extremely expensive, and a mother may have to work more with every additional child to maintain the family income.

[5] Curie and Madrian (1999) and Chirikos (1993) review the literature on this issue.

3. Methodology.

3.1 Data source and sample characteristics.

The data set used in this study was collected in 2005 by the Department of Human Resource of the University of Yaoundé-II in order to analyze female labour market behaviour in urban Cameroon. The sample is made of 2096 women aged 18-64 living in Yaoundé and Douala. It comprises 59.92% working women and 43.08% not working (see table 1). Non-working women in each town represent 42.07% in Yaoundé and 44.04% in Douala. Taking into considerations the different sectors of the labour market, it appears that the informal sector has the highest proportion of women (27.3% in Yaoundé and 25.71% in Douala); this result is typical of the Cameroonian labour market.

Table 1: Characteristics of the final sample of women surveyed.

	Yaoundé	Douala	Total
Number of observations	1022	1074	2096
Not working	430	473	903
Public Sector	159	95	254
Formal Private sector	154	230	384
Informal Sector	279	276	555

Source: From the survey.

3.2 Measurement of fertility, health status and labour force participation.

While fertility is measured by the number of children born from a woman, this study uses two measures of women's health status. The first measure of a woman's health status is obtained from her answer to the following question of the survey: "*How would you rate health: bad, fair, good or very-good ?*" This is a commonly used indicator in surveys and in models measuring the interaction between health and labour force participation. This subjective measure (labelled $Sub - Health$) is defined as:

$$Sub - Health = \begin{cases} 3 \; if \;\; \mu_3 < Health^* < \mu_4 \\ 2 \; if \;\; \mu_2 < Health^* \leq \mu_3 \\ 1 \; if \;\; \mu_1 < Health^* \leq \mu_2 \\ 0 \; if \;\; \mu_0 < Health^* \leq \mu_1 \end{cases} \qquad (1)$$

There are a number of concerns with such a measure (Bound, 1991, Tessier and Wolf, 2005). It may not be entirely comparable across respondents, it may not be independent of labour market outcomes, or respondents out of the labour market may mention health limitations to rationalize their behaviour. In short, such a health measure is endogenous to the labour force status and each of the problems just listed may lead to a different kind of bias (Bound, 1991)[6]. Despite these and other concerns, this measure stills the most popular measure of health available. Tausman and Rosen (1982) even argue that this measure is close to the "*objective*" health. But, in seeking for appropriate ways to measure the relationship between women's health and labour force participation, the paper develops another measure of health status. Following the work by Dumont (1999), a ***Composite Index of disability*** (***CID***) is defined as:

[6] Lack of comparability across individuals represents measurement error that is likely to lead to underestimates of the impact of health on labour force participation, while the endogeneity of self-reported health is likely to lead to overestimates. Biased estimates of health's impact on outcomes will also bias coefficients on any variable correlated with health. Finally, the dependence of self-reported health on economic characteristics will bias estimates of the impact of economic variables on participation, even if one correctly measures the impact of health itself.

$$CID^{*} = \sum_{i} SRH_{i} \qquad (2)$$

Where, in *SRH* we have the self-rated health and reports of health limitations (answers to the question whether or not they had problems with *Seeing, Walking long distances, Hearing, or Standing long hours*). For the purpose of constructing the index of disability, all the health indicators were recoded in order to express poor health[7]. After the summation of these indicators, the obtained index ranges from 0 to 7. This index measures the potential of disability involved in each woman of the sample. It appears from table 2 that 16.8% of working women have a potential of disability greater or equal to 4, while the same group is composed of 23.5% of non-working women. Then a woman is classified of as "*Disabled*" if her composite index of disability is greater or equal to four, that is:

$$Disabled^{*} = \begin{cases} 1 & if \quad CID \geq 4 \\ 0 & otherwise \end{cases} \qquad (3)$$

Table 2: Prevalence of potential disability in the sample

	Values	***Not employed$***	***Employed$***
Composite Index of Disability *(CID)*	0	14,6	14,4
	1	22,8	23,5
	2	21,3	25,7
	3	17,8	19,6
	4	13,0	10,1
	5	5,3	4,6
	6	3,4	2,0
	7	4,0	0,1
Total		100	100

($) Values represent percentages of women concerned with each level of disability.
Source: Author's construction.

The most notable difference between developed and developing countries labour markets concerns the economic opportunities available to job seekers. Unlike developed countries where almost all the workers are employees, labour markets in developing countries were first characterised by dualism (see Ranis, 1988 for a survey on dualism) and the last two decades have been marked by the emergence of the informal sector. In Cameroon, the urban labour market is characterised by two homogeneous sectors (public and formal private) and an heterogeneous one, the informal sector (Abessolo, 2001). The informal sector comprises self-employed, unpaid family-workers and casual-workers with reduced job security, hazardous working conditions, and dangerous work environments. Factors determining labour market decisions and outcomes are thought to be different from one sector to another. Thus, instead of the usual dichotomy "*to work or not to work*" observed in industrialised countries and used in many studies, this study generalizes the standard labour force participation model by expanding the set of alternatives to four: working either in the *public sector, in the formal private sector, in the informal sector, or not working.*

Let's assume that preferences are described by a well-behaved utility function, the maximum utility attainable by individual *i* if she chooses the participation status *j* (*j=p, fp,*

[7] The *Sub-Health* was recoded as follows: *Very-good =0, Good =1, Fair = 3 and Bad=4*. Then health limitations were coded : *No=0 and Yes=1*.

inf, np)[8], and that this indirect utility function is composed of a stochastic (ε_{ji}) and a non stochastic (S_{ji}) components, the indirect utility function is given by equation (4) and the probability P_{ji} for individual *i* to choose alternative *j* is given by equation 5:

$$V_{ji}^{*} = S_{ji} + \varepsilon_{ji} \tag{4}$$

$$P_{ji} = \Pr ob\left[S_{ji} - S_{ki} > \varepsilon_{ki} - \varepsilon_{ji}, k \neq j, k = p, fp, \inf, np \right] \tag{5}$$

3.3 Model formulation

Consider the following simultaneous equations model:

$$\begin{cases} Y_1 = \alpha_f Y_2^{*} + \beta_f Y_3^{*} + \delta_f X_f + \varepsilon_f & (a) \\ Y_2^{*} = \alpha_s Y_1 + \beta_s Y_3^{*} + \delta_s X_s + \varepsilon_s & (b) \\ Y_3^{*} = \alpha_p Y_1 + \beta_p Y_2^{*} + \delta_p X_p + \varepsilon_p & (c) \end{cases} \tag{6}$$

Where, equation *(a)* represents the fertility equation, *(b)* is the health equation and *(c)* the participation equation. Fertility (Y_1) is a function of the latent value of health status (Y_2^{*}), the participation status (Y_3^{*}), and exogenous variables (X_f); ε_f represents the error term. Equations *(b)* and *(c)* are defined along the same lines.

4. Estimation of the econometric models and results.

4.1. Model estimation.

The estimation procedure of equation 6 involves two steps. In the first step, we estimate reduced form equations (see equation 7) and then results from these are predicted and replaced in the structural form model.

$$\begin{cases} Y_1 = X\theta_f + \upsilon_f & (a) \\ Y_2^{*} = X\theta_s + \upsilon_s & (b) \\ Y_3^{*} = X\theta_p + \upsilon_p & (c) \end{cases} \tag{7}$$

Predicted values from these estimates $(\hat{Y}_1)$, $(\hat{Y}_2)$ and $(\hat{Y}_3)$ are replaced in the structural equations as expressed in equation 8.

8 *p=public sector; fp=formal private sector ; inf=informal sector; np= non-participation.*

$$\begin{cases} Y_1 = \alpha'_f \hat{Y}_2 + \beta'_f \hat{Y}_3 + \delta'_f X_f + \varepsilon_f & (a) \\ Y_2^* = \alpha'_s \hat{Y}_1 + \beta'_s \hat{Y}_3 + \delta'_s X_s + \varepsilon_s & (b) \\ Y_3^* = \alpha'_p \hat{Y}_1 + \beta'_p \hat{Y}_2 + \delta'_p X_p + \varepsilon_p & (c) \end{cases} \quad (8)$$

4.2. Description of variables.

Female labour force participation is the main focus of this study, with a special emphasis on the impact of fertility and health. Table 3 displays a list of variables used in the estimations. Table 4 presents some descriptive statistics of the variables. The mean and the standard deviation of fertility are 2.59 and 2.38. A group mean comparison test between working women and not working shows that working women have more children than those who don't work. The mean and standard deviation of self-reported health are 1.76 and 0.92 respectively. Hence, on average the respondents report a fair health condition[9]. The average age is 33.038, hence our sample is much younger than (closer to) the ones studied in the literature on health status (fertility) and labour supply. For example, the mean age of the sample studied in Leung and Wong (2002) is 43.1[10], while the study of Iacovou (2001) the mean ages of her samples are 33 and 35. Here follows a brief discussion of some possible relationship between the variables and our dependent variables.

Province: A well-known result in demography state that people from regions with high rate of fertility tend to reproduce same habits no matter the place they lives (urban or rural areas), even if they have migrated to other regions (Locoh, 1988). As far as Cameroon is concerned, people from the northern part and from west provinces have a high propensity to fertility related behaviour.

While Deaths is meant to capture the replacement hypothesis, Relatives and Child-not in charge capture respectively the idea that procreation is influenced by the household structure, and the extend to which own-child rearing fees are supported by somebody else (mainly relatives). This practice in common is Cameroon.

Education is expected to exert a positive effect on health at least in two ways. First, it improves health by increasing knowledge and efficiency in the production of health capital. Second, more education may imply higher willingness to invest in long-term capital including health capital.

A problem (14 days) controls for short term shocks which may affect perception of health. Since health is naturally determined, then after controlling for Long-term disease, other behavioural variables (such as age and education, to name few) may not determine health.

4.3. Results.

Tables 5 through 10 present the estimation results. These results are obtained by using a 2SLS procedure. Two different specifications of the health equation are used and presented in all these tables. Specification (1) corresponds to estimates obtained using *Sub-health*, the self-reported health and (2) is obtained using the index of disability (*Disabled*).

[9] The sample mean 1.762882 is statistically equal to 2 as the t-ratio is equal to (0.237/0.925) and Pr(|T| > |t|) = 0.0000.

[10] In Sickles and Taubman (1986)'s study of the relationship between health and labour force participation, the mean age is 63,3.

The Fertility equation

Fertility is a count data variable and due to overdispersion estimates are obtained using a negative binomial as suggested by Winkelmann (1997). To compare the two specifications[11], the *Consistent Akaike Information Criterion (CAIC)* proposed by Gurmu and Trivedi (1996) is used. The test shows that they do not significantly differ. It appears from the estimates that tertiary education have a negative impact on parity. This is consistent with the view that education increases the opportunity cost of female employment, and thus changes the objective conditions under which fertility decisions are taken (Ainsworth, 1988; Johnson-Hanks, 2002). Support from relatives in rearing children and the presence of other relatives in the household exert a positive influence on fertility. This result comes into as a confirmation to the fact that, through reduced costs of rearing children, intrafamily (and interfamily) solidarities hamper rational microeconomic behaviours (Rwenge, 1999), and leads to high levels of fertility. Health status exerts a positive and significant effect on fertility, but disability status does not. Participation to the labour market exerts a negative influence on fertility.

The Health equations

Health equations are estimated using probit (for *disability index*) and ordered-probit (for *the self-reported health*). Our results show that controlling for short-term and long-term diseases reduces the impact of behavioural variables like age and education. Actually, age and health have a nonlinear relationship, the disability status increases with age at a decreasing rate; education has no impact neither on self-reported health nor on the disability status, though from first stage results, it appears that education fosters health by reducing the probability on being disabled. These results are consistent with those obtained by Cai and Kalb (2004). Fertility has negative influence on health. It decreases the probability of reporting *very-good* health by 5.2% (while it increases the probability of reporting fair health by 5.8%). As expected, health limitations, long-term disease and problems within 14 days are found to negatively related to health. Employment is found to be a significant determinant of health. Compared to non-employed women, public and informal workers are less likely to be disabled. Workers of the formal private sector, compared to not-workers, increases the propensity to declare *Fair* health by 40.4% but reduces the propensity to declare *Good (Very-good)* by 14% (36.3%). The positive effect of public and informal worker status on self-reported health indicates that justification bias is likely to be observed in these sectors. For instance, civil servants in Cameroon usually justify absenteeism by health problems. All these considered, the influence of employment status on health differs from one sector to another. The negative impact is likely to be caused by bad working conditions and stress.

The Participation equations

Labour force participation decision is influenced by age, education, marital status fertility, health and the origin. There's a concave relationship between age and participation, the highest contribution being observed in the formal private sector. Single women (single, separated, divorced, and widowed), compared to married and cohabiting, have a greater tendency to participate in the labour market; the coefficients obtained using relative risk ratios (RRR) between these two groups are 1.476 for the public sector, 1.718 for the formal private sector and 1.756 for the informal sector; these coefficients highlight a greater propensity for singles to participate to the labour market. In general, education increases the probability of labour force participation; the higher the level of education, the higher the probability of working in the formal sector (private and public). But higher levels of

[11] $CAIC = -2l + k(\ln n + 1)$; where, l represents the value of likelihood function, k is the number of parameters and n refers to the number of observations. For both specifications, *CAIC* is equal to 6870.167 and 6869.48.

education reduce this probability of working in the informal sector. Compared to those didn't attend school, having a tertiary education induces a RRR (between working and not working) equal to 7.890 for the public sector, 2.238 for the formal private, and 0.172 for the informal sector.

The origin of the woman (ethnic group) has a significant impact of her participation to the private sector (formal and informal). To compare the influence of the ethnic group of the woman on her choice of the labour market sector, as suggested by Lanot and Muller (1997), RRR risk ratios using public sector as the base outcome were computed. These results show that, women coming from the northern part of Cameroon (compared to those from the littoral) are 25.74% less likely to work in the formal private sector and 30.82% less likely to work in the informal sector. Women from the southern part of Cameroon are 41.86% less likely to participate into the formal private sector and 64.76% less likely to work in the informal sector. Unlike these groups, women from the grass-roots (West-provinces of the country) have a greater propensity to choose the private sector, be it formal or informal; the propensities are 27.15% and 100.2% higher for the formal private and informal sectors.

As far as Fertility and Health are concerned, estimates show that, fertility increases the probability of working by 2.4% in the public sector, by 1.7% in the formal private sector, and by 7.5% in the informal sector. Good health is a significant and a positive determinant of labour force participation, although this influence differs across the labour market sectors. Using the self-reported health indicator, it appears that improvements in health induce a 2.4% increase in the probability of working in the public sector and a 4.7% increase for the formal private sector. The disability status reduces these probabilities by 8.1% and 22.2% (respectively for the public and private sectors). Influences on the informal sector participation decision are not significant.

5. Discussion and conclusion.

This study aimed at determining the impact of fertility and health status on female labour force participation. Econometric analyses were based on a sample of urban female workers aged 18 to 64. In contrast to previous models in the literature, this paper demonstrates the interrelationship between fertility and health status, and argues that failing to account for this interrelationship may lead to biased estimates of the impact of either health or fertility on female labour force participation. Analyses show that it is not relevant to consider a single labour market as in the traditional neoclassical labour market; individual behaviours and labour force determinants differ across the various sectors. The fact that the number of children exerts a positive influence on the participation contrasts with the results of other studies, which consider fertility as an exogenous variable. This result stills consistent with those of Cain and Dooley (1976), Hout (1978), and Iacovou (2001). The non-significant impact of fertility in the informal sector is close to Hill and Stafford's (1985) conclusions.

The differentiated impacts of health status (using either the self-reported health or the disability status) on participation of were questioned. Therefore relative risk ratios were computed for fertility, self-reported health and disability status, and estimates reported in table 11. As a mean of comparison between the two indicators, results show that the use of self-reported health leads to an upper-bias of the impact of health status on labour market participation.

Another result of this paper is the evidence that fertility determines health status and vice versa. These results suggest that estimates of either the impact of fertility or the influence of

health status, on women labour force participation must take into consideration the interrelationship between health and fertility.

Throughout this paper, only 2SLS estimates of the multiple simultaneous equations model were considered. However, one could argue that these equations could have been estimated jointly. Attempts in this direction have not been successful; handling a trivariate model being technically and computationally difficult. We hope this attempt contributes to defining the steps of this line of inquiry.

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Table 3 : Description of variables

Variables	Description
Participation	1= if employed in the public sector ; 2= formal private sector ; 3= informal sector ; 0= not employed
Fertility	Fertility refers to the parity that is, the number of children born to a woman at the date of the survey.
Child-non-charge	Number of children whose charges are not supported by the woman nor her husband.
Deaths	Number of own child born alive who died.
Relatives	Number of relatives (other children and adults) living in the same house with the woman.
Health status	
Sub-health	Self-rated health: 0= bad ; 1= fair ; 2= good ; 3= very-good.
Problems (14 days).	1 if the respondent has any health-related problem in the last 14 days prior to the survey, 0 otherwise.
Long-term disease	1 if the respondent has any disease which has lasted more than one month.
Health Limitations	
Mobility / Standing Watching / Hearing	Each of these variables is dummy coded 1 if the woman reports a health problem related to it and 0 otherwise.
Disabled	1 if the Composite index of disability, CID≥ 4 and 0 otherwise.
Education	Highest level of education (for those who completed schooling) Education was classified in four levels: 0= No education; 1= Primary; 2= Secondary; 3= Tertiary (University and other related categories of higher education).
Age	Continuous variable ranges from 18 to 64.
$Age^2/100$	Age squared divided by 100.
Single	1 if the respondent is single, separated, divorced or widowed; 0 if the respondent cohabitates or is married.
Religion	1 if Catholic; 2= Protestant; 3= Muslims, 4=Otherwise; These categories were transformed into specific dummies.
Province	Cameroon has ten provinces out of which, we defined five groups according to social habits and customs. we have: 1= North grouping the Far-North, North, and Adamaoua provinces; 2= Centre province ; 3= South is composed of South and East Provinces; 4= West is made of West, North- West, South- West ; 5= Littoral province

Table 4: Descriptive Statistics of variables (N=2096)

Variables	Mean	Standard Deviation	Min	Max
Participation	1.281966	1.262713	0	3
Fertility	2.594943	2.384027	0	14
Child-not in-charge	0.3330153	1.097525	0	14
Deaths	0.2977099	0.7932378	0	14
Relatives	3.029103	2.595317	0	10
Health status				
Sub-health	1.762882	0.9256752	0	3
Problems (14 days).	0.365458	0.4816733	0	1
Long-term disease	0.2437977	0.4294745	0	1
Health Limitations				
Mobility	0.1665076	0.3726246	0	1
Standing	0.2676527	0.4428411	0	1
Watching	0.4446565	0.4970462	0	1
Hearing	0.1292939	0.335605	0	1
Disability	0.197042	0.3978592	0	1
Education	3.9375	1.899731	0	7
Primary	0.1397901	0.3468519	0	1
Secondary	0.6402672	0.4800365	0	1
Tertiary	0.158874	0.3656458	0	1
Age	33.03865	10.02098	18	64
Single	0.4255725	0.4945475	0	1
Religion	1.918416	1.45071	0	7
Catholic	0.5267176	0.4994048	0	1
Protestant	0.3024809	0.459442	0	1
Muslim	0.057729	0.2332859	0	1
Province	5.33063	2.807922	0	10
North	0.0500954	0.2181939	0	1
Centre	0.3010496	0.4588237	0	1
South	0.1402672	0.3473469	0	1
West	0.3401718	0.4738798	0	1
Littoral	0.1669847	0.3730512	0	1

Table 5 : Second stages maximum likelihood estimates of Fertility equation.

Variables	Coefficients (t-student) (1)	(2)
Age	0,172 (11,36)***	0,173 (11,35)***
Age2/100	-0,182 (-9,71)***	-0,184 (-9,80)***
Single	-0,242 (-7,45)***	-0,236 (-7,02)***
Education		
Primary	0,053 (0,97)	0,052 (0,91)
Secondary	-0,081 (-1,22)	-0,092 (-1,40)
Tertiary	-0,499 (-4,99)***	-0,841 (-4,97)***
Child-not in-charge	0,098 (7,01)***	0,099 (7,17)***
Deaths	0,219 (10,43)***	0,219 (10,30)***
Relatives	0,102 16,76)***	0,102 (17,06)***
Health status (predicted)		
Subjective-Health	0,046 (1,88)*	-----
Disability	----	-0,153 (-1,38)
Labor F. Participation (predicted)		
Public sector	-0,468 (-2,12)**	-0,558 (-2,30)**
Formal Private sector	-0,466 (-1,78)*	-0,403 (-1,37)***
Informal sector	-0,750 (-3,75)***	-0,868 (-4,01)***
Constant	-2,589 (-10,03)***	-2,576 (-10,02)***
Lnalpha	-16,915 (0,120)	-17,113 (0,117)
alpha	4,50e-08 (5,41e-09)	3,70e-08 (4,34e-09)
Observations =	2064	2064
Wald (13) =	2688,90	2685,49
Prob > chi2 =	0,0000	0,0000
Log pseudolikelihood	-3374,9731	-3374,3135

Dependent variable: **Fertility**; (1) is estimated using *Sub-Health* as the health indicator*;* (2) is estimated using *Disabled* as the health indicator. Variables *No-education, Other religions, Not-employed,* are base outcomes for education, religion, participation status. Values within parentheses next to estimators represent *t*-Student. ***(**){*} significant at 0,000(0,005) {0,01}.

Table 6: Second stages maximum likelihood estimates of Health equations

Variables	Coefficients (t-student)	
	Sub-health	***Disability***
Age	0,053 (1,80)*	0,127 (2,08)***
$Age^2/100$	-0,080 (-2,29)**	-0,105 (-2,02)**
Education		
Primary	0,115 (0,94)	-0,175 (-1,04)
Secondary	0,175 (1,33)	-0,023 (-0,13)
Tertiary	0,121 (0,65)	-0,379 (-1,51)
Fertility (predicted)	-0,188 (-2,64)**	0,005 (0,04)
Participation Status (predicted)		
Public	0,304 (0,79)	-4,097 (-6,40)***
Formal Private	-1,294 (-2,55)**	-0,970 (-1,34)
Informal	0,034 (0,09)	-3,274 (-6,43)***
Health Limitations		
Mobility	-0,336 (-4,56)***	
Watching	-0,096 (-1,82)*	
Hearing	-0,217 (-2,70)**	
Problems (14 days)	-0,905 (-15,37)**	0,649 (8,37)***
Long-term disease	-0,799 (-10,98)***	0,705 (8,25)***
Ancyllary Parameters		
μ_1	-1,837 (0,495)	
μ_2	-0,246 (0,493)	
μ_3	0,811 (0,493)	
Constant		-2,781 (-3,83)**
Observations =	2096	2096
Wald chi2 (14) [(11)] =	690,35	428,77
Prob > chi2 =	0,0000	0,0000
Pseudo R2 =	0,1437	0,12462
Log likelihood =	-2295,744	-784,0628

Dependent variable: **Health Status**; Variables *No-education, Not-employed,* are base outcomes for education, participation status. Values within parentheses under estimators represent *t*-Student. ***(**){*} significant at 0,000(0,005) {0,01}.

Table 6 (continued): Marginal Effects.

	Sub-Health			*Disabled*
Variables	*Fair*	*Good*	*Very-good*	
Age	-0,016 (-1,79)*	0,006 (1,77)*	0,015 (1,79)*	0,029 (2,90)***
Age^2/100	0,025 (2,29)**	-0,008 (-2,25)**	-0,022 (-2,29)**	-0,024 (-2,03)**
Education				
Primary	-0,036 (-0,94)	0,011 (1,09)	0,033 (0,91)	-0,037 (-1,12)
Secondary	-0,054 (-1,34)	0,020 (1,25)	0,048 (1,36)	-0,005 (-0,13)
Tertiary	-0,037 (-0,64)	0,011 (0,76)	0,035 (0,63)	-0,075 (-1,76)
Fertility	0,058 (2,63)***	-0,020 (-2,60)***	-0,053 (-2,62)***	0,001 (0,04)
Participation Status				
Public	-0,095 (-0,79)	0,033 (0,79)	0,085 (0,79)	-0,941 (-6,49)***
Formal Private	0,404 (2,53)**	-0,140 (-2,49)**	-0,363 (-2,54)**	-0,222 (-1,34)
Informal	-0,011 (-0,09)	0,004 (0,09)	0,009 (0,09)	-0,752 (-6,43)***
Health Limitations				
Walking	0,101 (4,80)***	-0,047 (-3,68)***	-0,085 (-5,07)***	
Seeing	0,030 (1,82)**	-0,011 (-1,78)*	-0,027 (-1,83)*	
Understanding	0,066 (2,77)**	-0,028 (-2,26)**	-0,057 (-2,92)***	
Problem (14 days)	0,255 (14,82)***	-0,120 (-10,23)***	-0,227 (-16,36)***	0,163 (7,98)***
Long-term disease	0,219 (12,32)***	-0,125 (-7,84)***	-0,185 (-13,63)***	0,192 (7,24)***
Health Probability[§]	0,377	0,386	0,201	0,146

Dependent variable: **Health Status**; Variables *No-education, Not-employed,* are base outcomes for education, participation status. Values within parentheses under estimators represent *t* -Student. ***(**){*} significant at 0,000(0,005) {0,01}.

Table 7: Second stages maximum likelihood estimates of Participation equations.

	Public Sector		*Formal Private Sector*		*Informal Sector*	
Variables	(1)	(2)	(1)	(2)	(1)	(2)
Age	0,442 (5,52)***	0,429(5,27)***	0,287 (4,37)***	0,270 (4,40)***	0,129 (2,50)**	0,123 (2,39)***
Age²/100	-0,470 (-4,77)***	-0,447 (-4,42)***	-0,365 (-4,50)***	-0,334 (-4,02)***	-0,194 (-3,10)***	-0,180 (-2,84)
Single	0,389 (2,04)**	0,406 (2,10)**	0,541 (3,36)***	0,572 (3,51)***	0,563 (3,94)***	0,571 (4,00)***
Education						
Primary	-0,450 (-0,86)	-0,569 (-1,08)	0,193 (0,48)	0,061 (0,15)	0,202 (0,78)	0,144 (0,55)
Secondary	1,345 (3,10)***	1,212 (2,77)***	0,961(2,61)***	0,815 (2,20)**	-0,050 (0,21)	-0,017 (-0,07)
Tertiary	2,065 (4,28)***	1,936 (3,98)***	0,805 (1,97)**	0,673 (1,64)	-1,760 (-4,98)***	-0,182 (-5,13)***
Fertility	0,558 (2,15)**	0,491 (1,88)*	0,325 (1,39)	0,307 (1,25)	0,536 (2,57)***	0,507 (2,47)**
Health Status						
Sub-Health	0,476 (3,72)***	---	0,414 (4,14)***	---	0,195 (2,37)**	---
Disability	--	-1,774 (-3,30)***	---	-1,903 (-4,20)***	--	-0,884 (-2,46)**
Religion						
Muslim	-1,055 (-,92)*	-0,826 (-1,52)	-0,700 (-1,65)*	-0,511 (-1,22)	-0,245 (-0,73)	-0,156 (-0,47)
Catholic	-0,332 (-1,29)	-0,328 (-1,28)	-0,212 (-0,99)	-0,228 (-1,07)	-0,058 (-0,31)	-0,066 (-0,35)
Protestant	-0,416 (-1,53)	-0,432 (-1,58)	-0,083 (-0,37)	-0,136 (-0,59)	-0,274 (-1,35)	-0,299 (-1,47)
Province						
North	-0,322 (-0,68)	-0,349 (-0,73)	-1,67 (-3,52)***	-1,712 (-3,60)***	-1,499 (-3,70)***	-1,506 (-3,72)***
Centre	-0,306 (-1,34)	-0,219 (-0,96)	-0,573 (-3,01)***	-0,485 (-2,56)**	-0,091 (-0,51)	-0,044 (-0,25)
South	0,326 (1,33)	0,379 (1,52)	-0,544 (-2,38)**	-0,498 (-2,19)**	-0,108 (-0,50)	-0,084 (-0,39)
West	-0,376 (-1,61)	-0,330 (-1,42)	-0,136 (-0,75)	-0,086 (-0,48)	0,317 (1,82)*	0,345 (1,98)**
Constant	-11,722 (-8,03)***	-11,66 (-7,62)***	-6,518 (-5,66)***	-6,062 (-5,14)***	-2,731 (-2,93)***	-2,566 (-2,72)***

(1): Observations= 2096/ Wald Chi2(45)= 452,96/ Prob >Chi2= 0,0000/ Pseudo R2= 0,1085/ Log Pseudolikelihood= -2394,1194

(2): Observations= 2096/ Wald Chi2(45)= 451,72/ Prob >Chi2= 0,0000/ Pseudo R2= 0,1082/ Log Pseudolikelihood= -2395,0825

Dependent variable: **Participation**; (1) is estimated using *Sub-Health* as the health indicator*;* (2) is estimated using *Disabled* as the health indicator. Variables *Married, No-education, Other religions, Littoral,* are base outcomes for marital status, education, religion, and province. Values within parentheses under estimators represent *t*-Student. ***(**){*} significant at 0,000(0,005) {0,01}.

Table 7 (continued): Marginal Effects

	Public Sector		***Formal Private Sector***		***Informal Sector***	
Variables	(1)	(2)	(1)	(2)	(1)	(2)
Age	0,024 (4,73)***	0,024 (4,55)***	0,031 (3,36)***	0,291 (3,06)***	0,002 (0,21)	0,002 (0,20)
Age²/100	-0,024 (-3,74)***	-0,023 (-3,52)***	-0,039 (-3,43)***	-0,035 (-3,02)***	-0,009 (-0,89)	-0,009 (-0,81)
Single	0,008 (0,65)	0,008 (0,68)	0,049 (2,13)**	0,053 (2,27)**	0,073 (2,87)***	0,073 (2,84)***
Education						
Primary	-0,033 (-1,28)	-0,037 (-1,49)	0,025 (0,41)	0,008 (0,15)	0,037 (0,74)	0,035 (0,69)
Secondary	0,072 (2,89)***	0,067 (2,65)***	0,117 (2,53)**	0,102 (2,15)**	-0,058 (-1,31)	-0,063 (-1,39)
Tertiary	0,270 (2,98)***	0,258 (2,89)***	0,117 (1,48)	0,103 (1,33)	-0,285 (-12,12)***	-0,286 (-12,02)***
Fertility	0,024 (1,47)	0,020 (1,22)	0,017 (0,51)	0,151 (0,44)	0,075 (2,09)**	0,072 (2,02)**
Health Status						
Sub-Health	0,024 (2,76)***	---	0,047 (3,31)***	---	0,007 (0,53)	---
Disability	-----	-0,081 (-2,22)**	---	-0,222 (-3,46)***	---	-0,041 (-0,64)
Religion						
Muslim	-0,045 (-2,33)**	-0,038 (-1,74)*	-0,072 (-1,66)*	-0,055 (-1,16)	-0,004 (-0,06)	0,004 (0,08)
Catholic	-0,019 (-1,10)	-0,018 (61,07)	-0,025 (-0,89)	-0,027 (-0,90)	0,006 (0,18)	0,005 (0,16)
Protestant	-0,217 (-1,33)	-0,022 (-1,31)	0,006 (0,19)	-0,007 (-0,02)	-0,039 (-1,17)	-0,042 (-1,22)
Province						
North	0,014 (0,38)	0,012 (0,33)	-0,137 (-4,82)***	-0,139 (-5,00)***	-0,170 (-4,63)	-0,170 (-4,64)***
Centre	-0,012 (-0,83)	-0,007 (-0,54)	-0,074 (-3,16)***	-0,065 (-2,75)***	0,140 (0,45)	0,018 (0,56)
South	0,036 (1,71)*	0,041 (1,85)*	-0,074 (-3,01)***	-0,069 (-2,82)**	-0,005 (-0,14)	-0,004 (0,11)
West	-0,029 (-2,13)	-0,027 (-2,00)**	-0,031 (-1,29)	-0,026 (-1,67)	0,076 (2,38)**	0,079 (2,45)**
Probabilities	0,076	0,077	0,189	0,189	0,258	0,258

Dependent variable: **Participation**; (1) is estimated using *Sub-Health* as the health indicator*;* (2) is estimated using *Disabled* as the health indicator. Variables *Married, No-education, Other religions, Littoral,* are base outcomes for marital status, education, religion, and province. Values within parentheses next to estimators represent *t*-Student. ***(**){*} significant at 0,000(0,005) {0,01}.

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Table 8: First stage maximum likelihood estimates of Fertility equation.

	Coefficients (t-student)	
	(1)	(2)
Variables		
Age	0,139(12,67)***	0,139(12,72)***
Age²/100	-0,141(-9,70)***	-0,142(-9,81)***
Single	-0,289(-9,89)***	-0,291(-9,93)***
Education		
Primary	0,052(0,92)	0,045(0,81)
Secondary	-0,078(-1,50)	-0,083(-1,61)
Tertiary	-0,389(-6,32)***	-0,395(-6,06)***
Child-not in-charge	0,089(6,32)***	0,088(6,33)***
Deaths	0,216(10,18)***	0,218(10,28)***
Relatives	0,092(16,24)***	0,092(16,30)***
Religion		
Muslim	0,101(1,34)	0,105(1,38)
Catholic	-0,102 (-0,27)	-0,007(-0,17)
Protestant	0,036(0,77)	0,039(0,83)
Health Limitations		
Walking	0,028(0,84)	
Seeing	-0,020(-0,76)	
Understanding	-0,037(-0,94)	
Problem (14 days)	-0,0008(-0,03)	-0,001(-0,58)
Long-term disease	-0,017(-0,53)	-0,018(-0,58)
Province		
North	0,226(3,10)***	0,217(2,93)***
Centre	0,050(1,30)	0,049(1,28)
South	0,009(0,21)	0,012(0,27)
West	0,005(0,14)	0,004(0,13)
Constante	-2,364(-11,11)***	2,379(-11,21)***
lnalpha	-18,524 (0,213)	-16,880 (0,185)
alpha	9,01e-09 (1,92e-09)	4,64e-08 (8,62e-09)
Observations =	2064	2064
Wald chi2 (21)[(18)]=	2685,66	2679,27
Prob > chi2 =	0,0000	0,0000
Log pseudolikelihood =	-3369,632	-3370,481

Dependent variable: **Fertility**; (1) is estimated using *Sub-Health* as the health indicator*;* (2) is estimated using *Disabled* as the health indicator. Variables*, Married, No-education, Other religions, Littoral,* are base outcomes for marital status, education, religion, and province. Values within parentheses next to the estimators are *t* - Student. ***(**){*} significant at 0,000(0,005) {0,01}.

Table 9 : First stage maximum likelihood estimates of Health equations.

	Coefficients (t-student)	
Variables	***Sub-health***	***Disabled***
Age	0,00015 (0,01)	-0,021(-0,86)
$Age^2/100$	-0,015(-0,64)	0,058(1,80)*
Single	0,0221(0,43)	0,062(0,84)
Education		
Primary	0,116(0,96)	-0,336(-2,12)**
Secondary	0,128(1,18)	-0,346(-2,41)**
Tertiary	0,143(1,16)	-0,312(-1,87)*
Child-non-charge	-0,029(-1,18)	0,034(1,04)
Deaths	-0,048(-1,53)	0,077(1,85)*
Relatives	-0,017(-1,55)	-0,012(-0,82)
Religion		
Muslim	0,383(2,61)***	0,097(0,49)
Catholic	0,128(1,60)	-0,169(-1,54)
Protestant	0,180(2,12)**	-0,33(-2,78)***
Health Limitations		
Walking	-0,319(-4,37)***	
Seeing	-0,106(-2,06)**	
Understanding	-0,229(-2,87)***	
Problem (14 days)	-0,861(-15,51)***	0,698(9,59)***
Long-term disease	-0,761(-12,04)***	0,809(10,56)***
Province		
North	0,076(0,50)	-0,222(-0,99)
Centre	0,117(1,57)	0,083(0,76)
South	0,178(2,02)	-0,104(-0,78)
West	0,085(1,16)	0,038(0,36)
Ancyllary Parameters		
μ_1	-2,33	
μ_2	-0,737	
μ_3	0,323	
Constant		-1,008(-2,19)**
Observations =	2096	2096
LR chi2(21) / (18) =	799,42	459,21
Prob > chi2 =	0,0000	0,0000
Log likelihood =	-2291,96	-810,58
Pseudo R2 =	0,1485	0,2207

Dependent variable: **Health Status**; Variables*, Married, No-education, Other religions, Littoral,* are base outcomes for marital status, education, religion, and province. Values within parentheses next to the estimators are *t* - Student. ***(**){*} significant at 0,000(0,005) {0,01}.

Table 10: First stage maximum likelihood estimates of participation equations.

Variables	*Specification* (1)		
	Public Sector	***Formal Private Sector***	***Informal Sector***
Age	0,486(6,83)***	0,327(6,28)***	0,197(4,86)***
Age²/100	-0,508(-5,41)***	-0,411(-5,72)***	-0,263(-4,74)***
Single	0,346(2,01)**	0,483(3,54)***	0,438(3,62)***
Education			
Primary	-0,445(-0,85)	0,222(0,55)	0,230(0,91)
Secondary	1,190(2,72)***	0,945(2,57)***	0,021(0,09)
Tertiary	1,71(3,72)***	0,681(1,74)*	-1,94(-5,71)
Child-non-charge	-0,155(-1,42)	-0,0047(-0,06)	0,078(1,44)
Deaths	-0,053(-0,53)	-0,018(-0,21)	0,0078(0,11)
Relatives	0,095(2,92)***	0,048(1,68)*	0,064(2,49)**
Religion			
Muslim	-0,762(-1,46)	-0,494(-1,14)	-0,134(-0,40)
Catholic	-0,298(-1,17)	-0,169(-0,80)	-0,059(-0,32)
Protestant	-0,309(-1,15)	0,0041(0,02)	-0,241(-1,22)
Health Limitations			
Walking	-0,202(-0,86)	-0,174(-0,87)	-0,069(-0,42)
Seeing	-0,158(-0,95)	-0,0047(-0,04)	-0,239(-1,96)**
Understanding	-0,271(-0,97)	-0,068(-0,32)	-0,172(-0,93)
Problem (14 days)	-0,243(-1,39)	-0,317(-2,20)**	-0,118(-0,94)
Long-term disease	-0,486(-2,39)**	-0,376(-2,18)**	-0,083(-0,59)
Province			
North	-0,227(-0,50)	-1,59(-3,18)***	-1,37(-3,44)***
Centre	-0,235(-1,01)	-0,516(-2,74)***	-0,047(-0,26)
South	0,427(1,71)*	-0,464(-2,04)**	-0,080(-0,37)
West	-0,374(-1,55)	-0,116(-0,65)	0,317(1,82)*
Constant	-12,41(-9,15)***	-7,21(-7,54)***	-3,85(-5,12)****
Observations =		2096	
LR chi2(51) =		603,08	
Prob > chi2 =		0,0000	
Log likelihood =		-2384,0972	
Pseudo R2 =		0,1123	

Dependent variable: **Participation Status**; (1) is estimated using *Sub-Health* as the health indicator*;* Variables*, Married, No-education, Other religions, Littoral,* are base outcomes for marital status, education, religion, and province. Values within parentheses next to the estimators are *t* -Student. ***(**){*} significant at 0,000(0,005){0,01}.

Table 10 (continued): First stage maximum likelihood estimates of participation equations.

Variables	*Specification* (2)		
	Public Sector	***Public Sector***	***Public Sector***
Age	0,488(7,18)***	0,326(6,28)***	0,204(5,03)***
Age²/100	-0,52(-5,93)***	-0,411(-5,75)***	-0,277(-5,00)***
Single	0,329(1,97)**	0,476(3,49)***	0,419(3,48)***
Education			
Primary	-0,434(-0,83)	0,238(0,59)	0,234(0,93)
Secondary	1,21(2,77)***	0,956(2,62)***	0,018(0,08)
Tertiary	1,73(3,74)***	0,703(1,80)*	-1,95(-5,77)***
Child-non-charge	-0,154(-1,59)	-0,0049(-0,07)	0,081(1,49)
Deaths	-0,047(-0,46)	-0,019(-0,22)	0,012(0,17)
Relatives	0,097(2,97)***	0,049(1,68)*	0,066(2,58)***
Religion			
Muslim	-0,754(-1,45)	-0,498(-1,16)	-0,111(-0,33)
Catholic	-0,268(-1,05)	-0,156(-0,74)	-0,033(-0,18)
Protestant	-0,268(-1,00)	0,018(0,08)	-0,216(-1,10)
Health Limitations			
Problem (14 days)	-0,294(-1,70)*	-0,344(-2,41)**	-0,163(-1,32)
Long-term disease	-0,55(-2,66)***	-0,408(-2,43)**	-0,140(-1,02)
Province			
North	-0,218(-0,48)	-1,57(-3,15)***	-1,37(-3,46)***
Centre	-0,247(-1,07)	-0,513(-2,73)***	-0,050(-0,28)
South	0,432(1,73)*	-0,457(-2,02)**	-0,068(-0,32)
West	-0,384(-1,60)	-0,114(-0,63)	0,316(1,82)*
Constant	-12,51(-9,3)***	-7,23(-7,43)***	-4,03(-5,38)***
Observations		2096	
LR chi2(51)		593,58	
Prob > chi2		0,0000	
Log likelihood		-2388,8444	
Pseudo R2		0,1105	

Dependent variable: **Participation Status**; (2) is estimated using *Disabled* as the health indicator*;* Variables*, Married, No-education, Other religions, Littoral,* are base outcomes for marital status, education, religion, and province. Values within parentheses next to the estimators are *t* -Student. ***(**){*} significant at 0,000(0,005) {0,01}.

Table 11 : Relative Risk Ratios

Variables	***Public Sector***	***Formal Private Sector***	***Informal Sector***
Fertility	1,747(2,10)**	1,39(1,38)	1,710(2,62)***
Sub-Health	1,611(3,82)	1,513(4,11)***	1,21(2,34)***
Disabled	0,169(-3,42)***	0,149(-4,19)***	0,412(-2,46)**

Source :Authors estimates. Non-participation is used as the base outcome