



# Household size and food consumption spending in cameroon. is there evidence of economies of size?

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## Abstract

This paper investigates the effects of household size on food consumption spending in Cameroon. This paper extracts secondary data from the Cameroon household consumption survey conducted in 2014 by the government's statistics office. The residual inclusion version of the two-stage least squares method is used to investigate the effect of household size on household consumption spending. We find that non-self-cluster fertility, non-self-cluster mortality and cluster-level household size are relevant instrumental variables for household size. We also find evidence of a U-shaped relationship between household size and food expenditure. Specifically, with household size below 7 members, any additional member decreases consumption spending, but above this threshold, any additional member increases consumption spending per adult equivalent. These findings present evidence of economies of scale in food consumption spending. Other variables that correlate positively with consumption spending include access to credit, urban residency, primary education, secondary education and tertiary education. Meanwhile, general price level correlates negatively with household food spending. These results have policy implications for the optimal household size in predominantly agricultural/rural settings.

**Keywords** Household size · Food consumption spending · Economies of size · Two-stage least squares · Cameroon

**JEL Classification** D6 · D11

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## Introduction

Household spending plays a significant role as far as aggregate demand is concerned and by extension, also plays an important role in the economic growth of a nation. According to Jainxu et al. (2018), household spending contributes towards dampening private consumption and thus aggregates demand and economic growth. OECD (2013) has indicated that household final consumption spending is typically the greatest component of the final uses of GDP, representing about 60% of GDP. Household spending is therefore an important component for the economic analysis of demand, as it allocates individual consumption expenditures of general governments and those that directly benefit households; thus providing an important measure for cross-country comparisons and comparisons of wellbeing in particular (OECD 2013).

Food stands tall as a vital component in many important dimensions of welfare such as food security, nutrition and health. In this way, food makes up the greatest share of total household expenditure in low-income countries to the tune of about 50% of the average household budget, making it a pivot for consumption and poverty analysis (The Inter-Agency and Expert Group on Food Security 2018). For Ebru and Melek (2012), food expenditure is a mandatory element of household total expenditure, hence can be used to determine the level of household economic welfare. Wirba et al. (2013) posited that food consumption expenditure in total household expenditure can be regarded as an important criterion for assessing welfare levels. According to Deaton (1997) food consumption has a fundamental role to play in determining the welfare of households since it often represents the largest portion of the household total expenditure in developing countries especially among low-income countries of which Cameroon is one. In a like manner, Haq et al. (2008) underlined that the low-income households spend practically three-quarters or more of their total budget on food.

The consumer demand theory holds that household food consumption is key element of social behaviour which is perceived to be affected by household income, price level of goods and household preferences which vary across households. In tandem with this consumer demand theory, the household rationally picks an optimal food consumption basket to optimise the household utility function subject to her budget constraint (Wirba et al. 2016). Empirically, the Engel Law lends support to the consumer demand theory as it posits that low-income households usually have higher income coefficients, whereas high-income households have lower income coefficients showing their relative level of income and economic wellbeing. Leaning on Engel (1857), for a necessary good like food, the expenditure of an average household is expected to increase less than proportionately as its money income increases; thus, the Engel curve for food is upward sloping. Based on this law, food share is inversely related to the logarithm of income or total expenditure of a household. According to Deaton and Paxson (1998), if per capita resources are held constant, food consumption per head in the household should increase with household size. This implies that the larger the household size, the greater the proportion of its total expenditure that must be devoted to the provision of food.

The average household size is not same for developed and developing countries and also varies by residence and educational level of household head. For instance, in the United State of America, the average household size is 2.6 persons compared to 3.7 in the 1960s (Duffin 2019). In Germany the average household size is about 2.0 people per household (Bauer 2019). Leaning on the summary estimates of household sizes and composition of the newly compiled United Nations Database on Household Size and Composition (2017), small average household sizes of fewer than 3.0 persons per household were found in most countries of Europe and Northern America (United Nations 2017). Larger average household sizes of more than 5.0 persons per household were found in most countries of Africa and Middle East. Worthy of note, the largest household sizes were observed in Senegal and Oman, averaging 9.0 and 8.0 persons per household, respectively (United Nations 2017).

In 2001, the average household size for Cameroon stood at 5.1 with 4.8 for urban areas and 5.5 for rural areas. The Far North region had the largest average household size of 6.2 and the South region registered the lowest with 4.1. The national average household size of 5.1 has only changed slightly from 1987 value of 5.2. While the average household size witnessed an increase from 5.3 to 5.5 in rural areas within the period, the urban areas instead recorded a decrease from 5.0 to 4.8. The average size for households headed by males (6.2) is significantly higher than that of households headed by females (4.1). Unlike with level of education, the average household size increase with the age of the household head before reducing after 59 years (Mbarga 2005). Leaning on the 2014 recent Cameroon household consumption survey, we observed that the average household size for Cameroon stands at 4.5 (compared to 5.1 in 2001), with the rural areas having a slightly higher average household size (4.8) than the urban areas (4.2). The households headed by males registered a higher average household size (3.2) compared to those headed by females (2.7). It is observable that the average household size for Cameroon has been declining steadily since 2001.

Cameroon has the problem of low food consumption, standard of living and welfare which is evident in the fact that she fights to reduce hunger and food insecurity in line with the Sustainable Development Goals. A decline has been observed on the aggregate food supply which has led to a reduction in the quantity and quality of food among households (Ninno and Tamiru 2012). Overall, more than 1 in 5 households (22%) in Cameroon are estimated to suffer the problem of inadequate food consumption, with 17.7% of them consuming borderline diet and 4.3% of them consuming poor diet (WFP 2017). Compared to 2011 WFP report on Comprehensive Food Security and Vulnerability Analysis (CFSVA), the situation has worsened with a 35% increase between 2011 (20%) and 2017 (27%) of rural households consuming inadequate diets. Based on the 2017 food consumption score of the WFP, a higher percentage of households in rural areas (27%) suffer poor food consumption (that is, inadequate diets) compared to those in major cities like Yaoundé and Douala (19.3%) and in other urban areas (17.2%).

The rural–urban dichotomy in poor food consumption is also reflected across the sources of livelihood. Specifically, poor diets are more widespread among households depending on small trade (9.9% in rural areas and 4.5% in the urban areas). For the households depending on farming, we have 6.1% of rural households consuming

poor diets against 4.4% in urban areas, and for those depending on small businesses, we have 6.4% of rural households consuming poor diets compared to 3.3% in urban areas. For households in the livestock sector (5.5% for rural against 2.7% for urban), and those depending on aid/credit (5.5% for rural against 4.1% for urban), we have the least consumption of poor diets among households who are employed in the public and private sectors (2.3% for rural and about 1% for urban). It is undeniably that poor food consumption is a signal of food insecurity.

According to the WFP (2017), about 16% of households are considered to be food insecure (corresponding to 3.9 million people), with 1% that are considered severely food insecure (about 211,000 people). Like with poor food consumption, the rural households suffer relatively more food insecurity (22%) compared to the urban households (10.5%). The northern regions that have traditionally been experiencing problems related to food availability, access and utilisation are ranked the most food insecure, with the Far North toping the rank with 33.7%, followed by Adamawa with 15.4% and North with 15.3%. The North West and West regions also registered high rates of food insecurity, 18.1% and 18% of households, respectively, which might be as a result of the Anglophone crisis that is plaguing the North West region since 2016 and has also affected the neighbouring regions, particularly the West region (WFP 2017).

Evidently, poverty and large household sizes partly accounts for food insecurity in Cameroonian households. Poverty incidence is normally noted to be higher among households with larger sizes (Epo and Baye 2012). In the same line, Jenkins and Rigg (2001) posited that household size and composition can have an important impact on the incidence of income poverty. Again, poverty literature holds that “people living in larger and generally younger households are usually poorer” (Lanjouw and Ravallion 1995 in Fusco and Islam, 2017). These evidences suggest a negative association between household food poverty/consumption and household size. Worthy of note, additional children in the household naturally increase the risk of being poor, which is explained by a lower amount of resources per capita and a higher dependency ratio, while additional adults typically reduce the risk (Kuepie and Saidou 2013 in Fusco and Islam, 2017). In a nutshell, the presence of children may also bring about poverty through reduced labour supply or human capital investment of the mother who now dedicates more time to bring up the child than in income-generating activities (Datta and Dubey 2006 in Fusco and Islam, 2017).

In general, although overall income rises slightly with household size, a rise in household size appears to have a negative bearing on the household’s standard of living. Larger households dedicate a majority of their income to necessities and less to luxuries (Espenshade et al.1983). This indicates that household size has an inverted relationship with accumulated wealth which is measured by consumer goods acquired, savings and housing quality. Due to the challenges resulting from larger household sizes and their pressure on natural resources, many nations have taking major steps to reduce household sizes. Bradbury (2014) pointed out that household sizes declined in 28 countries and territories, some of which include Australia, Bahrain, Belgium, Brazil, Canada, China, Denmark, Mexico and United States. Cameroon too in promoting birth control measures has witnessed a steady decrease in household size since 2001. It is true that household size has a relationship with food

expenditure and consumption, income and exerts pressure on natural resources, but evidence on whether or not there is evidence of economies of scale/size in the relationship between household size and food consumption spending is still absent in Cameroon. Such evidence is vital in shaping policy efforts aimed at promoting birth control measures and fighting food poverty in the country.

## **An overview of the Cameroon economy and food expenditure**

Cameroon until the second half of the 1980s had enjoyed a steady growth for more than two decades. This steady growth was strongly associated to the growth of agricultural output, agricultural exports (oil, coffee, cocoa and cotton being the principal exports) and the exploitation of the country's petroleum reserves from the latter half of the 1970s. High economic growth rate enjoyed by the country in the period 1978—1985 was sustained by oil, with agriculture's share in GDP decreasing to less than 28% in the late 1970s and oil skipping to 17% of GDP. For the period 1980—1985, the economy of Cameroon witnessed a growth rate of 8% propelled by the oil sector, with oil export reaching about two-thirds of the total exports by 1984. The investment growth rate stood at 7%, export at 16% and consumption grew by 3.3%, and Cameroon had a high per capita income (Cameroon 1989, 1991 and Amin 1998). The export boom of the late 1970s and the 1980s provided Cameroon with considerable foreign earnings.

This enviable period of positive economic performance collapsed with the coming of the economic crisis from the second half of the 1980s. This collapse involved both oil and other exports. Retreat in economic activity accelerated in 1986/87 with a negative growth rate of 4.5% (MINPLAT-DSCN 1993). Between 1985 and 1988, the terms of trade deteriorated by 60%, resulting in a loss of 15.7% of real output in 1987, and this went up to about 18% in 1994 (IFS 1998). As explained by Baye and Fambon (2001), this collapse is because of the rapid decrease in world prices and the inability of oil revenue to finance the long-term development planning system pursued since independence.

In an attempt to reverse this ill economic situation, Cameroon, from 1988, adopted the Structural Adjustment Program (SAP) of the Bretton Woods institutions (the World Bank and IMF). The putting in place of the SAP involved the following: liquidating non-profit making and privatising some marginal profit making public enterprises; reducing public expenditure; freezing salary increment of the public sector workers; decreasing public and semi-public sector workers from early 1990 and implementing salary cuts in January and November 1993 (Baye, 2005). The effect of SAP on the economy of Cameroon was not enough to root out the severe economic malaise. Economic indicators deteriorated continuously and incomes fell steadily, leading to a 40% decrease in per capita consumption between 1992 and 1993. The echo of this rather insufficient respond pushed Cameroon in 1994 to join members of the Franc Zone to devalue the FCFA by 50% against the French Franc. This devaluation registered significant improvements in exports and in fiscal revenue. Devaluation equally led to the reallocation of resources from non-tradable sectors to tradable sectors. Since the devaluation, the economy of Cameroon witnessed

a renewed growth of between 4 and 5 per cent a year, with GDP per capita growth rate of between 1.5 and 2.7 per cent. Since the mid-1990s, food crop production enjoyed good weather, resulting in good harvests and a steady annual growth in food production of between 3 and 8 per cent since 1995.

Food production and food access are the key goals enshrined in one of the country's current policy document, the 2009 Growth and Employment Strategic (GESp) document. This policy document has as main goal to enhance agricultural production in the country and increase access to food. Food consumption still occupies a large share of total budget of households. The second and third Cameroon household consumption surveys (CHCS III-2007 and CHCS IV-2014) underline that food consumption expenditure takes a higher share of the total budget of households, over time in both urban and rural areas. However, according to these surveys, there is a rural–urban dichotomy in the share of food consumption expenditure, with the food consumption share in rural areas higher than that in urban areas. The share of food consumption expenditure stood at 42.7% in 2014 (with 38.7% in urban versus 47.1% in rural), compared to 40.5% in 2007 (with 33.7% in urban versus 51.1% in rural). The observation is that the share of food consumption in the total budget of households has grown by 5.4% between 2007 and 2014. Food consumption expenditure taking a larger share of household budgets has implications on the ability of households to provide for other pressing household needs. Besides the increasing share of food consumption in the household budget, the average household size in Cameroon has been declining steadily since 2001 as intimated above, suggesting a relationship which is yet to be established empirically.

This paper makes three (3) major contributions to knowledge: (1) The above figures on the share of food consumption spending and average household size point to a possible relationship between food consumption spending and household size in Cameroon. Unfortunately, robust empirical evidence to illuminate this relationship using Cameroon data is yet to emerge. This paper fills this empirical gap. (2) Many studies have underlined the presence of economies of scale by indicating that there exists a positive relationship between the number of members in a household and the level of its expenditures on food (Nelson 1988, Garcia and Grandle, 2010; Heien et al 1989; Jacobson et al 2010; Jae et al 2000; Manrique and Jensen 1998; Mihalopoulos and Demoussis 2000; Nayga 1995; Neulinger and Simon, 2011; Ricciuto et al., 2006; Sabates et al 2001; Teklou, 1996; Thiele and Weiss 2003, Vernon 2004, Goungetas and Johnson 1992, Jacobson et al. 2010, Munirwan et al. 2019, and Omotoso et al. 2022). Some others have established a negative relationship between the number of members in a household and the level of its expenditures on food (Kuepie and Saidou 2013; Datta and Dubey 2006 in Fusco and Islam, 2017). These studies undeniably have their place in the growth of knowledge, but these studies have ignored the potential endogeneity of household size in the food expenditure function, given that household size is affected by other variables and correlated with the error term. This paper fills this gap, by internalising the endogeneity of household size in the food expenditure function before investigating the evidence of economies of size. Again, robust evidence that controls for the potential endogeneity of household size and test the presence of economies of size in household food consumption is completely absent in Cameroon and Africa. This paper will employ Cameroon

data to advance literature on this aspect and fill this literature gap in Africa. (3) This paper employs knowledge of differential calculus to obtain the turning point-critical household size at which households start enjoying economies of scale in Cameroon.

In this way, this paper aims at answering the main research question: To what extent does household size affect food consumption spending in Cameroon? Specifically, (1) what are the determinants of household size in Cameroon? (2) To what extent does household size influence food consumption spending? (3) Do economies of scale exist on food spending as household size increases? Our main objective is therefore to investigate the extent to which household size affects food consumption spending in Cameroon. The specific objectives are (1) to examine the determinants of household size in Cameroon, (2) to assess the extent to which household size influences food consumption spending in Cameroon and (3) to find out whether economies of scale exist on food consumption spending as household size increases. The rest of this paper is organised in five sections. “[Literature Review](#)” gives a review of the literature, “[Methodology](#)” dwells on the methods and procedures, data and the variables of interest, “[Empirical results](#)” presents the empirical results and “[Conclusion and policy implications](#)” concludes this paper and offers policy direction.

## Literature review

### Theoretical literature

#### Engel law

Ernest Engel in 1857 conducted an empirical study based on family budget data which constituted the first empirical family budget study. Engel (1857) highlighted that “The poorer a family, the greater the proportion of its total expenditure that must be devoted to the provision of food”. The law was then lengthened to whole countries by arguing that the richer a country, the smaller the food share (Stingler, 1954). This later came to be referred to as the “Engel’s Law” which enjoys increasing status due to the empirical support that it attracted. The growing application of Engel’s Law gives it an almost unique position in Economics.

The Engel’s Law has numerous implications for the structure of all consumption expenditure. The first being that, food takes a larger portion of the poor’s budget, this tendency to specialise implies that their budgets are less diversified than those of more affluent consumers. According to Engel, the very poor are likely to spend as much as one-half of their income on food; hence, their budgets can be deemed to be food intensive or specialised. In a like manner, within the food budget, less expensive and more-starchy foods such as rice, potatoes and bread are expected to be predominant for the poor bringing about less nutritious, less diversified diets (Clements et al. 2017).

The second application of the Engel’s Law is its relationship with quality. The Engel’s Law underlined a distinction between the luxury and necessary goods leaning on elasticity. For elasticity greater than one the goods are luxuries and

for elasticity less than one the goods are necessities. As the budget share of luxuries increases significantly, relatively more is spent on these goods and they can be deemed to be preferred, or of higher quality, in the eyes of the consumer. The reverse is true for necessities which are deemed to be of lower quality (Clements et al. 2017). According to Theil (1975, 1976) and extended by Clements and Gao (2012), high-quality goods are intensively consumed by the rich. The fact that the budgets of the poor are intensive in low-quality goods, especially food, offers a link between Engel's Law and the measurement of quality.

### **The second engel law**

The Second Engel Law is relevant to our topic. This Second Law states that the Engel curve for food moves out as household size increases, thus implying a decrease in welfare. This Law repudiates the presence of economies of scale which is our concern in this paper using Cameroon data. What is still unsettled is that this regularity does not hold for equivalent income functions expressed in per capita terms. Deaton and Paxson (1998) underlined that holding total household expenditure per capita constant, expenditure per head on food decreases with the number of heads. According to them, larger households are expected to have higher per capita consumption of private goods such as food, provided that they do not substitute too much towards the effectively cheaper public goods. Deaton and Paxson's empirical evidence from developed and developing countries seems to refute the claim of the Second Engel's Law. The most conceivable source of economies of scale is the presence of household public goods that can be shared and serve their function without needing to be replicated in relation to the number of household members. If we assume bringing together two previously separate adults while retaining their original incomes, so that per capita income in the partnership is the same as it was for the average of the two separate units; when public goods are present, the couple is now better off. This is because they can do everything as before, but new options are available. Particularly, the resources released by the partnership allow more to be spent on everything, public and private goods all together. There will probably be substitution effect towards the shared goods, which now will be less expensive for members of the larger household. For private goods that are not shared, income and substitution effects will take place but in different directions.

## **Empirical literature**

### **The determinants of household size**

Burch (1970) assessed the effect of demographic variables such as, mortality, fertility, age of marriage and life expectancy on average household size under different family systems. His study revealed that under all family systems, average household size is positively correlated with fertility, life expectancy and average age of marriage. Importantly, he indicated that households under nuclear and stem family systems do not exceed 10 persons on average. On the contrary, with households under



extended family systems, when mortality is low and fertility is high, the average household size goes up to 25 persons per household.

Libois and Somville (2014) focused their work on the relationship between the number of children and household size. They found that households with more children hold less non-nuclear relatives and do not hold more relatives in the long run. They underlined that births push the household size to increase and only to decrease it after some time. Like Libois and Somville (2014), Moore (1997) indicated that the declining birth rate has resulted in smaller families in Britain. Blaney (1980) in his study highlighted that high fertility rates have historically been strongly related with poverty, high childhood mortality rates, low status and educational level of women, defects in reproductive health services and deficient availability and acceptance of contraceptives. Moore (1997) on his part identified a linkage between household size and ethnic groups and posited that there is a difference between household size of the Asians and the Blacks in Britain. He identified the culture of the country from which they come from, the age and sex distribution as factors that explain the varying household size.

### **The effect of household size on food consumption spending**

Studies on food demand have underlined that household size has a significant and positive impact on total food expenditure (Davis et al. 1982; Neenan and Davis 1979; and Smallwood and Blaylock, 1979). Household size and composition have also been found to have a significant and positive impact on total household expenditures in Indonesia (Rikhana 1991; and Sundrum 1973). In his study of Indonesian households using 1964–65 and 1967 SUSENAS, Sundrum (1973) revealed that household size is positively related to total household expenditures in both rural and urban areas. Similarly, Rikhana (1991) in her study of the 1991 SUSENAS in the province of East Java indicated that the coefficient of household size is positive and significant on total household expenditures in urban and rural areas. Their findings are in line with Majunder (1988), Smallwood and Blaylock (1986), and Volker et al. (1983). Most of these studies have ignored the potential endogeneity of household size in the food expenditure function, given that household size is affected by other variables and correlated with the error term. This paper fills this gap, by internalising the endogeneity of household size in the food expenditure function before investigating the evidence of economies of size.

In a study on the impact of household size and age–sex composition on food consumption in the United States employing the 1977–78 Nation Food Consumption Survey, Goungetas and Johnson (1992) underlined that all individual age–sex categories had a positive and significant impact on household food consumption. Their work indicated adult males had the largest impact, while children (age 10 and under) had the smallest impact. Many other studies have indicated that there exists a positive relationship between the number of members in a household and the level of its expenditures on food (Garcia and Grandle 2010; Heien et al 1989; Jacobson et al 2010; Jae et al 2000; Manrique and Jensen 1998; Mihalopoulos and Demoussis 2000; Nayga 1995; Neulinger and Simon, 2011; Ricciuto et al., 2006; Sabates et al

2001; Teklou, 1996; Thiele and Weiss 2003, Vernon 2004, Jacobson et al. 2010, Munirwan et al. (2019), Omotoso et al. 2022).

### **Economies of scale on food spending and household size**

The work of Davis et al. (1982) revealed evidence of economies of size for food expenditure. Like Davis et al. (1982), Deaton and Paxson (1988) found that at any given household expenditure per capita, expenditure per head on food decreases as the household size increases in seven countries including USA, Great Britain, France, Thailand, Pakistan and South Africa. Lanjouw and Ravallion (1995) investigated whether the presence of economies of scale can invalidate the contention that larger households tend to be poorer, and recognised that demographic compositional effects can be more reasonably attributed to economies of scale. Their model estimated the parameter associated with size effect of the household size while detaching the compositional effect in the demographic variables, such as the number of proportion of members in the various age groups, outside the equivalent income function. Although their model was not coherent with an integral specification model, it apprehended economies of scale as measured by the horizontal distance between adjacent Engel curves specific to the household types of interest corresponding to an increasing or decreasing cost of a child. Nelson (1988) posited that larger households may benefit from economies of scale in consumption when the cost per person of maintaining a given material standard of living decreases as household size increases.

Nguyen and Duong (2018) researched whether there were economies of scale for Vietnam household electricity consumption between 2010 and 2014. Their study employed the OLS model and indicated that, in general, economies of scale do exist for household electricity consumption in Vietnam. Like Nguyen and Duong (2018), Nelson (1988) found substantial and statistically significant economies of scale for five classes of goods and services including food, shelter, household furnishing/operation, clothing and transportation in US data during 1960/61 and 1972/73. Daley, Garner Phipps & Sierminska (2020) looked at differences across countries and time in household expenditure patterns with implications for the estimation of equivalent scales. They questioned whether it is appropriate to use a common equivalent scale when comparing economic wellbeing across countries and/or time if consumption patterns differ? Using the Engel methodology, they estimated equivalent scales for a set of countries in different time periods. They found considerable differences in economies of scale across countries as well as increases over time. They also underlined that economies of scale are larger than those implied by the widely accepted square root of household size equivalent scale. Their results reveal that using a common equivalent scale to compare economic wellbeing across countries and/or time may be misleading. To add value to these studies, this paper first accounts for the endogeneity of household size before assessing the presence of economies of size and leans on the knowledge of differential calculus to obtain the turning point-critical household size at which households start enjoying economies of scale in Cameroon.

## Methodology

In brief, we specified the food expenditure model which is the outcome model and the reduced-form models for household size and household size squared to enable us to inter-nalise the potential endogeneity problem posed by household size.

## Model specification

Following Goungetas and Johnson (1992) and Garcia and Grandle (2010), the food expenditure production function is specified as follows:

$$\text{LnFS}_i = \alpha_0 + \alpha_1 \text{HS}_i + \alpha_2 \text{HS}_i^2 + \sum_{k=3}^m \alpha_k X_{ik} + \varepsilon_{1i}, \tag{1}$$

where LnFS denotes log of household food spending; we took the log transformation of FS because the model without the log yielded highly skewed predicted residuals, defying the normality assumption (see Histogram at Online Appendix).  $\text{HS}_i$  is household size for the  $i$ th household,  $\text{HS}_i^2$  is the square of the household size and  $X$  represents the vector of the other household characteristics that correlate with household food spending.  $\varepsilon_i$  is the error term and  $\alpha_k$  represent the parameters to be estimated. Since household size is likely to exhibit economies of scale, we expect  $\alpha_1 < 0$  and  $\alpha_2 > 0$ , indicating that food spending is likely to first decrease with increase in household size before it starts increasing.

Household size and household size squared that enter the food expenditure function are potentially endogenous since they are possibly correlated with the error term. This is mainly from the idea that some unobservable factors (such as commitment to family planning) may influence the household size. Another reason for the possible correlation between household size and the error term is the presence of measurement errors. In this way, ignoring the potential endogeneity of household size in the estimation technique may lead to biased and inconsistent parameter estimates. The present study uses the non-self-cluster mean of fertility (Burch, 1970) and its squared as instruments, and the cluster-level household size. Leaning on Burch (1970), the reduced forms of household size and household size squared can take the following forms:

$$\text{HS}_i = \pi_0 + \sum_{k=1}^3 \pi_k Z_{ik} + \sum_{k=4}^n \pi_k X_{ik} + \varepsilon_{2i}, \tag{2}$$

$$\text{HS}_i^2 = \theta_0 + \sum_{k=1}^2 \theta_k Z_{ik} + \sum_{k=2}^n \theta_k X_{ik} + \varepsilon_{3i}, \tag{3}$$

where  $HS$  is the household size,  $X$  is a vector of exogenous variables of the food expenditure function (outcome equation) and  $Z$  is the set of instrumental variables which are assumed to affect the endogenous inputs  $HS$  and  $HS_i^2$  but have no direct

influence on the food expenditure-generating function unless through these endogenous inputs.

Following the two steps approach, the residuals are predicted from the reduced-form equations (Eqs. 2 and 3) and included as additional exogenous variables in the food expenditure-generating function. The augmented version of Eq. (1) is given as

$$\text{LnFS}_i = \beta_0 + \beta_1 \text{HS}_i + \beta_2 \text{HS}_i^2 + \sum_{k=3}^m \beta_k X_{ik} + \delta_1 \hat{\varepsilon}_2 + \delta_2 \hat{\varepsilon}_3 + v_i, \quad (4)$$

where  $\hat{\varepsilon}_2$  and  $\hat{\varepsilon}_3$  are the predicted residuals of the endogenous inputs derived from the reduced-form models (Equations 2 and 3). The residuals serve as the control for unobservable variables that correlate with endogenous inputs (household size and household size squared).

The critical household size, where households are expected to start enjoying economies of scale, is computed as follows:

$$\frac{\partial \text{LnFS}_i}{\partial \text{HS}_i} = \beta_1 + 2\beta_2 \text{HS}_i = 0. \quad (5)$$

Equation (5) marks the first order condition (FOC) to obtain extreme values or turning points which states that the first derivative with respect to the input under consideration (which is HS is our case) should equal zero.

The turning point is obtained by making HS the subject from the FOC:

$$\text{HS}^* = -\frac{\beta_1}{2\beta_2}, \quad (6)$$

where  $\text{HS}^*$  is the turning point-critical household size at which households start enjoying economies of scale in terms of food spending.

## Data and variables of interest

This paper made use of data from the fourth national household surveys conducted in 2014 (ECAM 4) by the National Institute of Statistics. The Fourth Cameroon Household Survey (ECAM 4) is the current household consumption survey after those of 1996, 2001 and 2007. It is part of the process to update the poverty profile, the monitoring and evaluation of the national strategy for growth and employment and the progress towards achieving the Millennium Development Goals (MDG). Given the great time gap between the end of the data collection and the dissemination of the results, and the opportunity deadline reduction in data collection that new technologies offer, the National Institute of Statistics (NIS) chose to collect ECAM 4 data through the Computer-Assisted Personal Interviewing (CAPI) method. The main objective of the Fourth Cameroon Household Survey (ECAM 4) was to provide indicators on living conditions of populations and to update the poverty profile. The survey targeted a sample of 12,897 households which was broken down into 10,303 clusters. The questions were addressed to household heads referring here to

the primary provider of income and food in the household which could be either the father or mother of the household or a senior male or female ( $\geq 18$  years) in the household.

Based on data collected from ECAM 4, the following variables were selected. Food expenditure was the dependent variable which depended on household size, household size squared and other control variables, such as credits, cost price index, level of education of the household heads (primary, secondary and tertiary), household residence and the gender of the household heads.

Consumer price index (CPI), fertility (total births per woman) and mortality rates (infant dead per 1000 live births) were captured per region for all the ten regions of Cameroon. The general CPI data for 2014 were sourced from the National Institute of Statistics. The fertility and mortality data per region were sourced from the Demographic Health Survey (DHS) 2014. The description/meaning of the variables used is presented at Online Appendix.

## Empirical results

### Descriptive statistics

Table 1 shows the summary statistics describing the variables used in the empirical analysis.

From Table 1, on average, household size stands at about 7 persons with the smallest household size having 1 person and the largest household size having around 30 persons. The size squared of the household on average stands at about 59 persons where the smallest household size squared has 1 person and the largest

**Table 1** Descriptive statistics

Variable	Observation	Weight	Mean	Standard deviation	Minimum	Maximum
Log food expense	10,303	2,157,474.5	13.5134	0.7223	9.4698	16.2684
Size	10,303	2,157,474.5	6.6497	3.8270	1	30
Size <sup>2</sup>	10,303	2,157,474.5	58.8628	76.5710	1	900
CPI	10,303	2,157,474.5	29.6631	6.8517	17.6	40.1
Credit	10,303	2,157,474.5	0.0223	0.1475	0	1
Urban	10,303	2,157,474.5	0.4034	0.4906	0	1
Primary education	10,303	2,157,474.5	0.3253	0.4685	0	1
Secondary education	10,303	2,157,474.5	0.3274	0.4693	0	1
Tertiary education	10,303	2,157,474.5	0.0819	0.2743	0	1
Female	10,303	2,157,474.5	0.2356	0.4244	0	1
Fertility	10,303	2,157,474.5	5.0914	1.3169	3.2	6.8
Mortality	10,303	2,157,474.5	6.1305	2.1734	3.2	10
Size_residual	10,303	2,157,474.5	1.20e-09	3.3700	- 12.1572	23.1457

*Source:* Compiled by Authors from 2014 Cameroon Household Survey (ECAM 4), price and household components

household size squared has about 900 persons. Averagely, consumer price index stands at about 29.66 with the smallest price index being 17.6 and the largest price index about 40.1. Close to 2.23% of the household heads obtained credit as opposed to a huge majority of about 97.77% who never had access to credit. More than 40% of the households in our sample are urban dwellers as opposed to about 60% who are rural dwellers.

Averagely, only about 32.53% of household heads have primary education as opposed to 67.47% who do not have primary education. Close to 32.74% of household heads have reached secondary level of education, whereas 67.26% have not reached secondary level. On average, only about 8.2% of household heads have attended higher education as opposed to a huge majority of 91.8% who have not reached that level of education. The mean mortality (per 1,000 live births) and fertility (births per woman) rates in 2014 are 6.13 and 5.09, respectively. The minimum mortality and fertility rates are same (3.2) and the maximum fertility is 6.8 and the maximum mortality is 10 per 1000 live births.

## Regression analysis

### Reduced-form estimates: pooled sample results

Table 2 submits the reduced-form estimates of the endogenous variable, household size. Non-self-fertility (*fertility\_nsmpsu*) relates positively and significantly with household size, indicating that it is an important determinant of household size. The coefficient of non-self-mortality (*mortality\_nsmpsu*) is negative and significant, depicting that non-self-mortality rate negatively affects the household size. It is also evident from the table that the cluster level of household size (*size\_nsmpsu*) has a positive and significant effect on household size. The instruments (that is, *fertility\_nsmpsu*, *mortality\_nsmpsu* and *size\_nsmpsu*) are all significant in explaining household size, indicating that they are reliable. The instrumental variables were all captured at the cluster level to dissociate them from the influence of individual households, making them more valid.

Table 3 presents the reduced-form estimates of the endogenous variable size squared. Non-self-fertility (*fertility\_nsmpsu*) has a positive and significant relationship with the endogenous variable size squared showing. Non-self-mortality (*mortality\_nsmpsu*) relates negatively and significantly with size squared. The results also reveal that the cluster level of size (*size\_nsmpsu*) has a positive and significant effect on size squared. These instruments are all significant in the size squared function, making them reliable instruments.

### Effect of household size on food expenditure: pooled sample results

Table 4 hosts the effects of household size on food consumption spending in Cameroon, internalising for the potential endogeneity of household size and size squared.

**Table 2** Reduced-form equation of the determinants of household size

Size Coefficient	Coefficient	Standard error	<i>t</i> value	<i>P</i> >   <i>T</i>
Fertility_nsm <sub>psu</sub>	0.1178	0.0335	3.552	0.000
Mortality_nsm <sub>psu</sub>	- 0.1823	0.0510	- 3.58	0.000
Size_m <sub>psu</sub>	1.2674	0.0308	41.13	0.000
C <sub>pi</sub>	- 0.0173	0.0080	- 2.17	0.030
Credit	1.1297	0.2362	4.99	0.000
Urban	0.1398	0.0876	1.60	0.110
Primary education	- 0.4626	0.0920	- 5.03	0.000
Secondary education	- 0.7124	0.0920	- 7.27	0.000
Tertiary education	- 1.3946	0.1462	- 9.54	0.000
Female	- 1.0729	0.8.6233	- 13.31	0.000
Constant	1.9460	0.2716	7.16	0.000
Number of observation	10,303			
F(10,10,292)	298.02			
Prob > F	0.0000			
R-squared	0.2245			
Adj R-squared	0.2238			
Root MSE	3.3717			

*Source:* Computed by Authors using ECAM 4  
*nsm<sub>psu</sub>* non-self-cluster mean; *mps<sub>u</sub>* cluster-level mean

**Table 3** Reduced-form equation of size squared (size<sup>2</sup>)

Size <sup>2</sup>	Coefficient	Stand error	<i>t</i> value	<i>P</i> >   <i>T</i>
Fertility_m <sub>psu</sub>	4.9417	0.6844	7.22	0.000
Mortality_m <sub>psu</sub>	- 6.7694	1.0427	- 6.49	0.000
Size_m <sub>psu</sub>	23.0886	0.6304	36.63	0.000
C <sub>pi</sub>	- 0.5276	0.1630	- 3.24	0.001
Credit	12.3965	4.6281	2.68	0.007
Urban	1.4902	1.7918	0.83	0.406
Primary education	- 12.8181	1.8827	- 6.81	0.000
Secondary education	- 15.9982	2.0042	- 7.98	0.000
Tertiary education	- 22.7296	2.9910	- 7.60	0.000
Female	- 14.9390	1.6494	- 9.06	0.000
Constant	- 18.4006	5.5566	- 3.31	0.001
Number of observations	10,303			
F (10, 10,292)	240.34			
Prob > F	0.0000			
R-squared	0.1893			
Adj. R-squared	0.1885			
Root MSE	68.977			

*Source:* Computed by Authors using ECAM 4

**Table 4** Effects of household size on food expenditure: pooled sample

Log food expense	Coefficient	Standard error	<i>t</i> value	<i>P</i> >   <i>T</i>	[95% CI: Lower]	[95% CI: Upper]
Size	- 0.1937	0.0374	- 5.17	0.000	- 0.2671	- 0.1203
Size <sup>2</sup>	0.0141	0.0020	7.03	0.000	0.0102	0.0181
CPI	- 0.0052	0.0001	- 4.94	0.000	- 0.0072	- 0.0031
Credit	0.2807	0.4344	6.46	0.000	0.1956	0.3659
Urban	0.4611	0.0141	32.67	0.000	0.4334	0.4888
Primary education	0.1955	0.0181	10.82	0.000	0.1601	0.2309
Secondary education	0.3163	0.0184	17.21	0.000	0.2802	0.3523
Tertiary education	0.4457	0.0274	16.27	0.000	0.3920	0.4994
Female	- 0.1333	0.0175	- 7.62	0.000	- 0.1675	- 0.0991
Size_residual	0.3238	0.0377	8.59	0.000	0.2499	0.3978
Size <sup>2</sup> _residual	- 0.0167	0.0020	- 8.26	0.000	- 0.0207	- 0.0127
Constant	13.7588	0.1349	101.97	0.000	13.4943	14.0233
Number of observations	10,303					
F(11,10,291)	476.26					
Prob > F	0.0000					
R-squared	0.3373					
Adj R-squared	0.3366					
Root MSE	0.5883					

Source: computed by authors using ECAM 4

The F-statistics of 476.26 with the p-value of 0.0000 indicates that our model is globally significant at 1%, thus fit for policy implications. An R-squared of 0.3373 indicates that the independent variables specified in the model explained 33.73% of the variability in the independent variable, food expenditure. The regression results reveal that size relates negatively with food expenditure, while size squared relates positively with food expenditure. This implies that an increase in size is expected to reduce food expenditure. Size squared is positive implying a U-shaped relationship. These results are all statistically significant at 1%. Precisely, a unit increase in household size will lead to a 0.1937 log points reduction in food expenditure and beyond a certain point (that is, 7 members) will increase food expenditure by 0.0141 log points. This is indication of economies of size beyond 7 members in the household; this turning point is further expressed below:

For the national sample, the turning point-critical household size ( $HS^*$ ) at which households start enjoying economies of scale in terms of food spending is

$$HS^* = \frac{0.1937}{2(0.0141)} = 6.87 \cong 7 \text{ members.}$$

Results also indicate that the coefficient of consumer price index is negative and significant in explaining household food expenditure. This depicts that an increase in price will induce a negative effect on food expenditure. Precisely, a one-unit increase in price (CPI) is expected to reduce food consumption by 0.0052 log points,



all other variables held constant. The coefficient of microcredit (credit) is positive and significant in the household food expenditure production function. This shows that a household that has access to microcredit, as opposed to those who do not, is expected to enjoy an increase in food expenditure. Precisely, the result points that a household that has access to credit is expected to increase food expenditure by 0.2807 log points.

The coefficient of urban households is positive and significant in explaining household food expenditure. This shows that living in the urban area, as opposed to the rural areas, increases food expenditure. Concerning level of education, we observe that a progression from primary to secondary and to tertiary education improves food expenditure in households. The results also depict that being in a household headed by a woman reduces food expenditure compared to households headed by men. The predicted and fitted residuals (Size\_residual and Size<sup>2</sup>\_residual) are all statistically significant (at 1%) in the food expenditure production function, indicating that the potentially endogeneity of household size and size squared have been handled.

### **Sensitivity analysis of economies of size by residence**

It is noted that the reduced forms for the sub-sample results in Tables 5, 6 are in Online Appendix. In Table 5, the result reveals that the coefficient of size in the urban area is negative and size squared is also negative. This implies that there is a negative relationship between household size and food consumption spending. As household size increases, food consumption falls and continues to fall even when size doubles. This results point to the absence of economies of size in the urban areas in Cameroon.

Results in Table 5 indicate that the coefficient of size is negative and that of size squared is positive, showing a U-shaped relationship between size and food consumption spending in the rural areas. This shows evidence of economies of size in food expenditure as household size increases to a certain household-size threshold (6.3 members), beyond which food expenditure starts increasing. The fall in food spending as household size increases is as a result of increase in returns from household-based farm production in rural areas. The discussion of results below provides more insights on this.

### **Discussion of key results**

Our regression result reveals that an increase in household size is expected to reduce food expenditure only below the threshold of 7 members, and that an increase in household size beyond this threshold increases food expenditure which may lead to an increase in the quantity and quality of food, hence high standard of living and welfare of the household members due to economies of scale.

The indication is that an increase in household size by one person in a household with less than 7 persons reduces household spending by about 0.1937 log

**Table 5** Effects of household size on food expenditure: urban sub-sample

Lnfoodexp	Coefficient	St. Error	<i>t</i> value	<i>p</i> value	[95% CI: Lower]	[95%CI: Upper]	Sig
size	- 4.528	0.403	- 11.24	0.000	- 5.318	- 3.738	***
size2	- 0.005	0	- 15.24	0.000	- 0.006	- 0.004	***
CPI	- 0.055	0.004	- 12.88	0.000	- 0.063	- 0.047	***
Obtained credit	1.407	0.117	12.07	0.000	1.178	1.635	***
Primary education	1.242	0.094	13.24	0.000	1.058	1.425	***
Secondary education	1.347	0.085	15.93	0.000	1.181	1.512	***
Tertiary education	0.891	0.036	24.63	0.000	0.82	0.962	***
Female	0.075	0.017	4.30	0.000	0.041	0.109	***
Residual_urban	4.703	0.403	11.66	0.000	3.912	5.493	***
Residual_urban2	0.391	0.034	11.55	0.000	0.324	0.457	***
Constant	22.801	0.857	26.61	0.000	21.122	24.481	***
Mean-dependent var			13.393	SD-dependent var		0.727	
R squared			0.283	Number of obs		10,303	
F test			406.289	Prob > F		0.000	
Akaike crit. (AIC)			19,269.765	Bayesian crit. (BIC)		19,349.407	

\*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$

**Table 6** Effects of household size on food expenditure: rural sub-sample

Lnfoodexp	Coef	St. error	<i>t</i> value	<i>P</i> value	[95% CI: Lower]	[95% CI: Upper]	Sig
size	- 0.403	0.049	- 8.16	0.000	- 0.5	- 0.306	***
size2	0.032	0.003	9.43	0.000	0.026	0.039	***
CPI	- 0.003	0.001	- 2.34	0.019	- 0.005	0	**
Obtained credit	0.302	0.047	6.41	0.000	0.209	0.394	***
Primary education	0.332	0.022	14.93	0.000	0.289	0.376	***
Secondary education	0.471	0.019	24.76	0.000	0.434	0.508	***
Tertiary education	0.457	0.029	15.82	0.000	0.401	0.514	***
Female	- 0.158	0.018	- 9.03	0.000	- 0.193	- 0.124	***
Residual rural	0.577	0.05	11.66	0.000	0.48	0.674	***
Residual_rural2	- 0.037	0.003	- 10.85	0.000	- 0.044	- 0.03	***
Constant	14.007	0.111	125.92	0.000	13.789	14.225	***
Mean-dependent var			13.393	SD-dependent var		0.727	
R squared			0.282	Number of obs		10,303	
F test			404.135	Prob > F		0.000	
Akaike crit. (AIC)			19,285.236	Bayesian crit. (BIC)		19,364.879	

\*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$

points, whereas, in a household with more than 7 members, any additional person registers an increase in household spending in the order of about 0.0141 log points, other things being equal. This is evidence of economies of size in food consumption. The threshold level of 7 members is, however, greater than the national average household size (4.5) in 2014. Nevertheless, policy makers determining the optimal household size in predominantly agricultural settings should note that there are benefits in terms of food spending when household size increases beyond 7 members. This is a critical input for policy discussions centred on the optimum household size in developing country settings.

Like with the national sample, economies of size lie beyond 6.3 members in rural areas, and no evidence of economies of size in food consumption was registered in the urban areas. The increase in food consumption as household size increases is as a result of increase in returns from agricultural production activities in the rural areas. The main activity in rural areas is agriculture and larger household implies much labour available, which leads to larger outputs and more food for consumption. Given the fact that much agriculture in the rural area is for consumption and only the excess is taken to the market, larger households will entail greater labour available to carry out agricultural activities, hence high agricultural productivity. The demand for labour in the agricultural sector is the reason most couples in the rural areas give birth to many children and end up with large family sizes. These results are in line with Uzeh et al (2008) and Bose-rup (1965)'s hypothesis which holds that population growth leads to increase in agricultural intensification. The results are also in tandem with Mortimore (1993) and Eboh (1994) who found that population pressure in the family level is a significant determinant of agricultural land use patterns in Nigeria.

However, we acknowledge that purchase-based, not size-based, economies of scale may also occur in urban settings. Many households in the urban areas are made up of workers who are able to put their resources together and purchase in large quantities. Larger family buys large quantities and may likely take advantage of bulk discount in purchasing. Such households may be able to buy "economy size" products or take advantage of promotional discounts like "two for one" sales. This is in line with Nelson (1988) and Robin (1985) who provided evidence that is consistent with the fact that larger households may benefit from buying in bulk and thus paying less per unit; hence, expenditure falls even when quantities are rising. This acknowledgment also gains support from Prais and Hauthakker (1971) who found out that economies of scale occur in the purchasing, storage and preparation of food and that there may be straight forward discounts for purchasing larger quantities.

The negative coefficient of household size and the positive coefficient of size squared in the pool and rural sub-samples are in conformity with the Second Engel Law from the point where food expenditure increases as household size increases, but differs with it at the initial stage when food consumption spending falls as household size increases. The Second Engel Law states that the Engel Curve for food moves out as household size increases, showing a decrease in welfare which disagrees with the initial part of our findings, and later confirms our result when food expenditure starts rising.

## Conclusions and policy recommendations

This paper set to find out the determinants of household size, the effects of household size on food expenditure and the household size beyond which economies of size occurs in Cameroon. From this study we found out that non-self-fertility, non-self-mortality and cluster level of household size are important determinants of household size. The results indicated that an increase in non-self-fertility will increase household size. Non-self-mortality was found to be negatively related with household size, implying that an increase in non-self-mortality brings about a decrease in household size. The results showed that the cluster level of household size relates positively to household size. This study also investigated the effects of household size on food consumption in Cameroon and results revealed that there is a U-shaped relationship between household size and food consumption. The results revealed that an increase in household size will lead to a decrease in household food consumption, and indicated that size squared affects household food consumption positively, pointing to the presence of economies of scale. This paper uncovered evidence of economies of size in household food consumption beyond 7 members in the household, for the national and rural samples and not in urban settings.

There is need for policy makers to reduce household size in urban settings in order to reduce the pressure on household budget and expenditure so as to increase standard of living and welfare. This can be realised through continuous provision and sensitisation on the use of contraceptives, encouraging female education by giving scholarships to outstanding female students and placing more women in higher positions in the government which will serve as motivation for others. Agrarian or rural settings while taking advantage of the observed economies of size in food consumption should bear in mind that though larger household sizes imply much labour available which leads to larger outputs and more food for consumption, the optimal household size should always be sought given the resources available for the household. In this way, our results have policy implications for the optimal household size in predominantly agricultural/rural settings. Policy makers should work on boosting food consumption in order to increase standards of living and welfare in Cameroon by promoting education, providing credit facilities to farmers, encouraging production and consumption of domestic products and by keeping prices of basic food items stable.

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**Data availability** All original research must include a data availability statement. Data availability statements should include information on where data supporting the results reported in the article can be found, if applicable. Statements should include, where applicable, hyperlinks to publicly archived datasets analysed or generated during this study. For the purposes of the data availability statement, “data” are defined as the minimal dataset that would be necessary to interpret, replicate and build upon the findings reported in the article. When it is not possible to share research data publicly, for instance, when individual privacy could be compromised, data availability should still be stated in the manuscript along with any conditions for access. Please refer to “Data availability” in “Instructions for authors” for more information on how to complete this section. This study made use of data collected from secondary sources. In this study use was made of the fourth national household surveys undertaken in 2014 (ECAM 4) by the National Institute of Statistics Cameroon. <https://www.google.com/url?sa=t&source=web&rct=j&url=http://slmp-550-104.sl.c.westdc.net/~stat54/nada/index.php/catalog/114&ved=2ahUKewjKhPbm-Yf9AhWDO-wKHWp2DuYQFnoECAgQAQ&usg=AOvVaw2kihMP9lqchUnLvhuKQ4dx>

## Declarations

**Conflict of interest** The authors are required to disclose financial or non-financial interests that are directly or indirectly related to the work submitted for publication. Please refer to “Competing Interests and Funding” in “Instructions for authors” for more information on how to complete this section. On behalf of all authors, the corresponding author states that there is no conflict of interest.

**Ethical approval** The study is not based on repeated trials. Thus, only secondary data were used to carry out this study. Ethical approval: If applicable include the following details Full name of the committee that approved the research.

**Human and animal rights** This article does not contain any studies with human participants performed by any of the authors. Confirmation that all research was performed in accordance with relevant guidelines/regulations applicable when human participants are involved (e.g. Declaration of Helsinki, or similar). This article does not contain any studies with human participants performed by any of the authors. This article does not contain any studies with human participants performed by any of the authors.

**Informed consent** In this section, please confirm whether, and if so, informed consent was obtained from all participants and/or their legal guardians for participation in this study. If consent was deemed not necessary, please state so and why. This article does not contain any studies with human participants performed by any of the authors. It relied entirely on secondary data; thus, no informed consent is required.

## References

- Amendola A, Boccia M, Mele G, Luca S (2016) Financial access and household welfare. World bank group. Macroeconomic and fiscal management global practice group. Policy, 2233. Research working paper.
- Amin A (1998) Cameroon’s fiscal policy and economic growth, The African Economic Research Consortium, RP85, November 1998. <https://aercafrica.org/old-website/wp-content/uploads/2018/07/RP85.pdf>
- Bauer M (2019) Average household size in Germany by country, province, district and municipality. ArcGIS
- Baye MF, Fambon S. (2001). “The Impact of Macro and Sectorial Policies on the extent of Poverty in Cameroon. In Globalisation and Poverty: The Role of Rural institutions in Cameroon”. Background paper submitted to FASID, Tokyo, Japan
- Becker G (1964) Higher learning, greater good. The private and social benefits of higher education (the private and social benefits of higher education). Baltimore, The John Hopkins University Press.
- Boserup E (1965) The conditions of agricultural growth: the economics of agricultural change under population pressure. Aillen and Unwin, London

- Cameron (1991). The Vth Five Year Economic, Social and Cultural Development Plan (1986–199 1). Ministry of Plan and Regional Development, Yaounde
- Cameron. (1989). Statement of Development Strategy and Economic Recovery, Yaounde. Cameroon.
- Clements KW, Jiawei S (2017) Engel's law, Diet diversity, and the quality of food consumption. Oxford University Press on behalf of the Agricultural and Applied Economics Association.
- Daley T, Garner S, Phipps, Sierminska E (2020). Differences across Countries and Time in Household Expenditure Patterns: Implications for the estimation of Equivalence Scale. Discussion Paper Series, IZA DP No. 13246
- Datta GN, Dubey H (2006) Fertility and the household's economic status. *J Dev Stud* 42:110–138
- Davis C, Moussie M, Dinning S, Christakis G (1983) Socioeconomic determinants of food expenditure patterns among racially different low-income households: An empirical analysis. *West J Agric Econ* 8:183–196
- Deaton A (1997) The analysis of household surveys: a micro-econometric approach to development policy. The World Bank, Washington DC
- Deaton A, Paxson C (1998) Economies of Scale, Household Size, and the Demand for Food, *The Journal of Political Economy*, 106 (5), pp. 897–930 Discussion paper, 1404
- Duffin E (2019) Average size of a family in the US 1960–2019. Statista. Retrieved June 25 2020, from <https://www.Statista.com/Statistics/183657/Average-Size-of-a-family-in-the-us/>
- Duncan GJ, Brooks-Gunn J (1997) Consequences of Growing up poor. New-York: Russell Sage.
- Eboh EC (1994) Sustainable agricultural population: Eastern Nigeria. *Productivity* 35:518–523
- Ebru C, Melek A (2012) Micro-economic analysis of household consumption determinants for both rural and urban areas in Turkey. *Am Int J Contemp Res* 2:2
- Epo BN, Baye FM (2012) Decomposing poverty-inequality linkages by non-
- Espenshade TJ, Bouvier LF, Arthur WB (1982) Immigration and the stable population model. *Demography*, 19, 125–133. *Economics Online* (2019). Household spending [www.economicsonline.co.uk/managing\\_the\\_economy/Household\\_Spending.html](http://www.economicsonline.co.uk/managing_the_economy/Household_Spending.html), expenditures: a cross-country comparison, food policy, 26, 571–586.
- Frazao E (1992) Food spending by female-headed households. Community economics division, Economic research service, U.S. department of agriculture. Technical bulletin, 1806.
- Gao G (2012) World food demand. *Am J Agr Econ* 94(1):25–51
- Garcia I, Grande I (2010) Determinants of food expenditure patterns among older consumers. *Spanish Case Appetite* 24:62–70
- Goungetas B, Jacobson SR (1992) The impact of household size and composition on food consumption. An analysis of the food stamp program parameters using the nationwide food consumption survey 1977–78. Centre of Agricultural and Rural Development Monograph. Ames: Iowa state university press.
- Hagan JJ, Berning JP (2012) Estimating the relationship between education and food purchases among food insecure households. Selected paper prepared for presentation at the Agricultural and Applied Economics Asssocation's 2012 AAEA Annual Meeting, Seattle, Washington, 2012
- Haq Z, Nazli H, Meilke K (2008) Implications of high food prices for poverty in Pakistan. *J Agric Econ* 39:477–484
- Heien D, Janis S, Perali F (1989) Food consumption in Mexico: Demographic and Economic Affairs, food policy, 14:167–180.
- Household Income to Employment Vulnerability in Cameroon. *EuEconomica*, 1, 32: ISSN 1582–8859.
- IFS (1998) International Financial Statistic Year Book, 1998. income source in Cameroon. In: Paper presented at the CSAE 2012 conference. University of Oxford, on 18th to 20th 2012
- Jacobson D, Mavrikiou P, Minas C (2010) Household size, income and expenditure on food: the case of Cyprus. *J Socio Econ* 39:319–328
- Jae MK, Ryu JS, Ghany MA (2000) Family characteristics and convenience food expenditure in urban Korea. *J Consumer Home Econ* 24:252–256
- Jenkins SP, Rigg J (2001) The dynamic of poverty in Britain. Department for work and pension. Research report, 157, UK
- Jianxu L, Duangthip S, Songsak S, Xie J (2018) Analysis of household consumption behaviour and indebted self-selection effects. Case Study Thailand. <https://doi.org/10.1155/2018/5486185>
- Kuepie M, Saidou H (2013) The impact of fertility on household economic status in Cameroon. Mali and Senegal, PS/INSTEAD working paper, 2013–20. Esch Sur Alzette
- Mahjabeen R (2008) “Microfinancing in Bangladesh: Impact on households, consumption and welfare. *J Policy Model* 30(6):1083–1092

- Majundar D (1988) An analysis of the impacts of household size and composition on food expenditure in Haiti. Retrospective thesis and dissertations. 8868 available on <https://lib.dr.iastate.edu/rtd/8868>.
- Manrique J, Jensen H (1998) Spanish household demand for Seafood products. *Am Agricult Econ Associat* 1:718–736
- Mbarga B (Undated) Socioeconomic- demographic situation of ordinary households.
- Mihalopoulos V, Demoussis M (2001) Greek household consumption of food away from home: a micro-economic approach. *Eur Rev Agric Econ* 28:421–432
- MINPLAT-DSCN (1993) Ministère de Plan et de l'Aménagement du Territoire : Direction de la Statistique et de la Comptabilité Nationale (DSCN). *Comptes Nationaux Du Cameroun*. Juin, 1993, Yaoundé
- Mortimore MJ (1993) Northern Nigeria: Land Transformation under Agricultural Intensification. In *Population and land-use in Developing Countries* pp 42–48
- Munirwan Z, Haji S, Sukmawati A, Daud L, Lukman Y (2019) Determinants of Household Food Expenditure in a Cassava Growing Village in Southeast Sulawesi. *Academic Journal of Interdisciplinary Studies*, 8, 3 Nov 2019, <https://www.richtmann.org/journal/index.php/ajis/article/view/10585/10210>
- Nayga RC (1995) Determinants of US household expenditures on fruit and vegetables: a note and update. *J Agricult Appl Econ* 27:588–597
- Neenan PH, Davis CG (1979) Impacts of the food stamp program on low income household food consumption in rural Florida. *Southern Journal of Agricultural Economics*
- Nelson JA (1988) Household economies of scale in consumption: theory and evidence. *Econometrica. Journal of the Econometric Society*, 1301–1314
- Nguyen HS, Ha-Duong M (2017) Family size, increasing block tariff and economies of scale of household electricity consumption in Vietnam from 2010 to 2014. *External Economics Review/ Tap Chi Kinh tế Doi ngoai, Foreign Trade. University, Hanoi, Vietnam*, 2017, (101), 1–11. Hal-01714899
- Ninno CD, Tamini K (2012) Cameroon social safety nets. *The World Bank*
- Obayelu AE, Okoruwa VO, Ajani OIY (2010) Analysis of differences in rural- urban household's food expenditure share in Kwara and Kogi States of Nigeria. *Global journal of Agricultural Sciences*, 10, 1, 2011:1–18. Bachudo Science Co.Ltd printed in Nigeria ISSN 1596–2903
- OECD (2020) Household spending (indicator). Doi:10.1787/ b5f46047-en (Acceded 08 Sep 2020)
- OECD/AFDB (2002) African Economic Outlook – Cameroon, <https://www.oecd.org/countries/cameroon/1823923.pdf>
- Okafor FC, Onokerhoraye AO (1986) *Rural Systems and planning*. University of Benin, Benin
- Omotoso AB, Ajibade AJ, Ayodele MA, Popoola O M and Adejumo D R (2022) Rural Households Food Expenditure Pattern and Food Security Status in Nigeria, *Biomedical journal of Scientific and Technical Research*, 43, 4, 34900–30909, <https://biomedres.us/fulltexts/BJSTR.MS.ID.006946.php>
- Oygar L (2000) Studying food tastes among young adults using Bourdieu's theory *Consumer Studies and Home. Economics* 24:160–169
- Population facts (2017) Household size and composition around the world. United nations department of Economics and social affairs
- Psacharopoulos G, Woodhall M (1997) *Education for development*. New York Oxford University Press, An Analysis of Investment Choice
- Rikhana M (1991) The effect of Agricultural season on total household expenditures among rural and urban households. In: *Evidence from the national socioeconomic survey (SUSENAS) in East Java, Indonesia*. Unpublished master's thesis, Iowa State University, Ames, Iowa
- Sabates B, Gould B, Villareal H (2001) Household composition and food
- Smallwood D, Blaylock JR (1981) Impact of household size and income on food spending patterns. *Economics and statistics service, US department of agriculture. Technical bulletin*, 1650.
- Smallwood DM, Blaylock JR (1986) United State demand for food: Household expenditure demographic and projection (Technical Bulletin 1713), Washington D.C, US Department of agriculture, economics and statistics service
- South African Government (2016). *Statistics South Africa on community Survey 2016 results*. Retrieved July 2020, from [www.gov.za](http://www.gov.za)
- Sundrum RM (1973) Consumer expenditure pattern: an analysis of the socioeconomic survey. *Bull Indones Econ Stud* 9(1):86–106
- The World Bank [www.worldbank.org/en/country/Cameroon/overview](http://www.worldbank.org/en/country/Cameroon/overview) 2019.
- Thiele S, Weiss C (2003) Consumer demand for food diversity: evidence for Germany. *Food Policy* 28:99–115

- United Nations, Department of Economic and Social Affairs, Population Division (2017) Household size and composition around the world 2017- Data Booklet (ST/ESA/SER.A/405).
- United Nations, Department of Economic and Social Affairs, Population Division (2019). Patterns and trends in household size and composition: Evidence from a United Nations dataset. ST/ESA/SER.A/433
- Uzeh C, Uba C, Orebiyi J, Omege S (2008) Effect of population density on agricultural land use and productivity in the nsukka agricultural zone of unugu state. *Int J Tropical Agri* 2(384):157–162
- Vernon V (2004) Food Expenditure, Food Preparation Time and Household Economies of Scale, University of Texas at Austin, December 2004, <https://econwpa.ub.uni-muenchen.de/econ-wp/lab/papers/0412/0412005.pdf>
- Volker BC, Winter M, Beutler IF (1983) Household production of food: expenditure, norms and satisfactory. *J Cons Res* 10:281–291
- WFP (2017), Cameroon - Comprehensive Food Security and Vulnerability Analysis (CFSVA) (2017) World Food Programme-WFP, [https://reliefweb.int/report/cameroon/cameroon-comprehensive-food-security-and-vulnerability-analysis-cfsva-december-2017?gclid=CjwKCAiA0cyfBhBREiwAAtStHK7uM5dDEaFJIYKadI8ZUPDprJdrOS-8kRuw0b5uCcUQDJDBmgVocRoCiVoQAvD\\_BwE](https://reliefweb.int/report/cameroon/cameroon-comprehensive-food-security-and-vulnerability-analysis-cfsva-december-2017?gclid=CjwKCAiA0cyfBhBREiwAAtStHK7uM5dDEaFJIYKadI8ZUPDprJdrOS-8kRuw0b5uCcUQDJDBmgVocRoCiVoQAvD_BwE)
- Wirba EL, Baye FM (2016) Accounting for urban -rural food expenditure differentials in Cameroon; a quantile regression-based decomposition. *EuroEconomica* 11:1582–8859
- Wirba EL, Epo BN, Baye FM (2013) Explaining growth in house hold real food consumption expenditure in Cameroon 2001–2007. *Tanz Eco Rev* 13(1):26–29
- World Bank (2012) The World Bank Annual report 2012, 1. Main report. World bank Report; Washington DC © World bank. Available on <https://openknowledge.worldbank.org/handle/10986/11844> license:cc BY 3.01GO

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