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Keys Determinants of Food Insecurity in Sub-Saharan Africa

Fabrice Belmondo TCHIMEUTCHEU*, Jean Marie ABEGA NGONO

University of Yaoundé II-Soa, Cameroon

*Corresponding Author
Fabrice Belmondo TCHIMEUTCHEU, University of Yaoundé II-Soa, Cameroon

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Abstract

This paper identifies the factors that contributed to the persistence of food insecurity (FI) in sub-saharan Africa (SSA) between 1990 and 2019. The sample consists of 29 countries with data obtained from the Food and Agricultural Organisation 2021, World Development Indicators 2021, International Country Risk Guide 2021 and Polity IV 2021 databases. We use the principal component analysis (PCA) to construct the composite food insecurity index. We then employ the average bayesian model (ABM) and the general to specific (GETS) approach for robustness to identify the main determinants of food insecurity in SSA. The PCA result reveals that FI in SSA results from the dimensions of food availability, food utilization and food stability. As for the ABM, results confirmed by the robustness of the GETS approach, indicated that income level, Arable land, demography and lack of democracy are the main determinants that favour FI in SSA. In contrast, rural population and education reduce FI. There is an urgent need in strengthening agricultural strategies and an inclusive distribution of national wealth followed by political accountability in other to fight against FI.

Keywords: Food Insecurity, Principal Component Analysis, Average Bayesian Model, General to Specific, Sub-Saharan Africa.
JEL: C11 C38 Q18.

1. Introduction

Since 1990, reports identify sub-saharan Africa (SSA) as a region where food insecurity (FI) persists [1]. Indeed, SSA is the region where the prevalence of undernourishment remains the highest with an alarming rate [2]. In 2014, the zone managed to achieve a good hunger index and continues to suffer from severe hunger, making it the poorest zone in the world [3,4]. In 2018, Africa sheltered up to 31% of the number of food-deficient people in the world, compared to 21% in 2005. SSA had the highest proportion of underfed people at 22.8%, unchanged since 2016. Despite a decline of 11% in hunger between 2016 and 2018, the absolute number of hunger victims increased from 218.5 to 239.1 million [5]. Consequently, SSA did not achieve the international goals for poverty and hunger.

FI is a limited availability of adequate food and inaccessible, unusable and unstable of this one leading to an abnormal human development [6,7]. People have insufficient food and face the possibility of an inadequate diet in the future [8]. Indeed, the Global report on food crises 2020 indicates that five of the ten worse food crises in the world were in SSA [9]. So, the eradication of FI is one of the great global challenges of humanity [10]. Food items that people need must be available, accessible in quantities, qualities and diversities favourably usable and of permanent manner [11]. Indeed, FI is a global public health challenge [12].

However, drought conditions and other anomalies related to climatic changes caused severe damage to agricultural livelihoods generating a FI in Eastern and Southern African countries and thus its severity worsened in 2017 [11]. On the basis of classification at Phase 3 (This is the phase where, even with food aid, households suffer from food deficits and acute malnutrition at higher than normal rates) of food crisis of strongly affected countries, these include Africa-horn, Central and Eastern Africa [11]. FI has also worsened in Southern Africa, where crisis has been averted by stronger national capacities to respond to shocks [11]. In 2019, acute FI arose due to political crises, severe droughts, economic shocks, intensified conflict and the displacement of people within countries. According to, this resulted in a Phase 3 of the food crisis [13].

Yet, it is a fundamental right of all people to have sufficient, safe,

and nutritious food, to satisfy their food deprivation [14, 16]. FI affects welfare values, leading to poverty, hunger, malnutrition and diseases [10]. These limit physical and mental development of individuals, rendering them unable to consolidate growth and development favorable to the countries [12]. At macro level, it affects countries' development efforts [17]. On the micro level, it causes food deficits and malnutrition sufferings at households, making them unable to cover their minimum food needs by depleting their livelihood and assets [11]. It develops a spiral of rising poverty constraining them to live with the spectre of misery. Hence, the majority of people in African countries live in extreme poverty and are perpetually in a state of FI [18].

Some empirical works have focused on the causes of FI in households in SSA, analysing the persistence of FI in SSA, and examining the increasing FI in Africa [10,12,18-21]. However, no study has focused on determining the major factors contributing to the persistence of FI. This study identifies factors that contribute to the persistence of FI in SSA. Hence the main question is: what factors have a significant effect on FI in SSA? This paper contributes to the literature on FI and with the analytical and econometric tools used, draws out key dimensions of FI and identify in order the FI causes of importance. The rest of the article is as follows section 2 presents literature review, section 3 methodology, section 4 results and section 5 the conclusion.

2. Literature Review

The economic literature on FI suggests different causes namely, socio-economic, political 22 and natural causes [19, 23, 24]. Concerning natural causes, there are explanations of demographic and climatic theories. For the Demographic theories, there are two schools of thought namely the Malthusian and neo-Malthusian schools. For these, population expansion leads to an increase in pressure on agricultural resources, which adversely affects agricultural yields and food production [25]. FI is an imbalance between the population and productive capacity. For neo-Malthusians, the rural exodus is the consequence of FI. It creates a great imbalance between the productive capacity of the environment and the needs of the populations in that environment. This theory focuses on the potential consequences of hunger inducing rapid and strong population growth beyond the limits of global food production [26]. For climate theories, FI is caused by climatic conditions unfavourable to agriculture and the deserts encroachment on previously arable land reducing cultivable space [27, 29].

According to socio-economic causes, FI results from defects in social and economic systems [30, 31]. It is explained by the market failure approach and limited access defects. The market failure approach states that the market determines distribution of endowments, as the price structure resulting from exogenous shocks causes food crises. It focuses on the food market issue by highlighting the causes of food crises, which may be due to poor spatial integration of food markets, high transport costs, lack of road or rail infrastructure preventing the transfer of food surpluses to deficit regions, a shock to rural labour market, and low incomes during crisis leading to weak credit markets [32-34]. As for the access deficit approach formalised by, it proposes an analytical framework that aims to interpret FI as consequence of problems of accessibility and availability of safe and nutritious foodstuffs [35]. As well, certain social groups are affected by hunger even in a context of sufficient offerings due to blaze (? price inflation) of prices or losses of rights [36, 37].

Concerning political causes and according to, people starve because food services do not guarantee a sufficient level of nutrition [38]. Yet, the political cause is an important factor to the consolidation of food security at national level [22]. Countries that respect democratic rules are afflicted less with situations of FI [39, 40]. Thus, political and civil rights contribute to the protection of economic and social rights, including the right to feeding. However, lack of respect for institutional rules, political and civic rights can be a source of conflict which seems to have a direct influence on unavailability and inaccessibility of aliments [22]. Armed conflicts disrupt food security dimensions and have a detrimental effect on it [41-43]. The presence of any conflict causes FI [44-48]. Indeed, conflict and FI are closely related, each one supports and reinforce the other [4]. According to, generally, weak institutions cause FI [49, 50]. They believe that the men who embody them can use their power to impose FI on more vulnerable groups whose interests are insufficiently represented. In this case, FI can be akin to a political crime against the people.

3. Methodological Approach

3.1. Data Source

This study covers 29 countries (in Annex 1) in SSA and conduct in these between 1990-2019, period reflecting the availability of data and putting the accent on the phenomenon of FI in SSA. Data is collected from the Food and Agricultural Organisation 2021, World Development Indicators 2021, International Country Risk Guide 2021 and Polity IV 2021 sources.

3.2. Presentation of Variables

FI is the explained variable obtained by the FI Index (FI_I) constructed from the principal component analysis (PCA) approach by examining eight (8) variables grouped around four (4) dimensions of food security: *(i)* food availability obtained by food energy availability and share of energy supply coming from roots, tubers and cereals; *(ii)* food accessibility obtained by the prevalence of undernourishment as a percentage of the population; *(iii)* food utilization obtained by the prevalence of anaemia in under five children, the prevalence of anaemia in women of childbearing age as a percentage of women aged 15 to 45, and the prevalence of malnutrition; and *(iv)* food stability approximated by the variability of food availability. The construction of our index is based on three reasons:

- The relevance of indicator variables selected to approximate FI;
- The fight against FI implies the need for food availability followed by its accessibility which favours its use and in a context of food stability;
- Taking into account all dimensions of food security.

This index is preferable to "prevalence of malnutrition" used in the literature to obtain FI. This latter variable does not explain the complexity and multi-dimensional nature of FI [4]. It is better than the IFPRI's composite indicator, the Global Hunger Index, which incorporates, according to four components: *(i)* prevalence of malnutrition; *(ii)* percentage of wasting among children under five; *(iii)* percentage of stunted children under five; *(iv)* mortality rate of children under five years old [51, 52].

We use a set of potential explanatory variables for FI. First, there are variables related to socio-economic factors: *(i)* Income level is captured by the logarithm of GDP per capita (ln(*Lev_Inc*)). High income not only decreases FI via the importation of foodstuffs in the international markets, it is also one of the key factors influencing hunger; *(ii)* Agricultural production is captured by the logarithm of agricultural production (ln(*Agri_Prod*)) [12]. It is one of the most important determinants of FI; *(iii)* Education is measured by the logarithm of the total rate of educated adults aged 15 and over in a country (ln(*Educa*)) [40]. Education improves agricultural production by reducing FI; *(iv)* [53]. The level of investment is measured by the logarithm of fixed capital shares as a percentage of GDP ((ln(*Lev_Invest*)). It increases agricultural production through investment in agricultural infrastructure and R&D (suggest in full); *(v)* The quality of infrastructure (*Quality_Infra*s) is measured by the index of the quality of the country's infrastructures ranging from 1 to 5, with 1 very low, 2 moderate, 3 medium, 4 high and 5 very high. Low density and quality of infrastructures hinder the access of agricultural products to the markets; *(vi)* Inflation is captured by the logarithm of the GDP deflator (ln(*Infla*)). Food prices increase FI due to low household purchasing power.

Then, variables related to political factors are: *(vii)* Local conflicts (*Conf_Loc*) with civil war, political violence and civil disorder as components. Internal conflicts, especially in SSA, are one of the most important sources of FI; *(viii)* Democracy (Democracy) is captured by a democracy score ranging from -10 for weakly democratic countries to 10 for strongly democratic ones [18, 54]. Political systems hostile to the normal functioning of markets are one of the most important sources of FI; *(ix*) Legal system (*Legal_Sys*) is a binary variable with 1 for common law countries and 0 if not [18,54]. Common law countries are predisposed to reduce FI compared to other legal systems.

Finally, variables related to natural factors are: *(x)* Demography is captured by the logarithm of the total population of the country (ln(*Demogra*)). According to, population expansion reduces land availability and agricultural production and therefore increases FI; *(xi)* Rural population is expressed as the logarithm of the population of the country's rural zone ((ln(*Rural_Pop*)) [25]. High rural population density decreases FI because most rural workers are engaged in agriculture as their main activity. This increases the supply of agricultural commodities; *(xii)* Climatic change is captured by change in temperature in degrees Celsius. The increase in temperature has negative effects on agriculture production [55]. This lead to the reduction in the agricultural yields and indirectly increases the FI ; *(xiii)* Arable land is captured by the logarithm of the area of arable land (ln(*Arable_Land*)) as the percentage of the country's land area. According to, the scarcity of arable land is at the centre of FI problem in SSA; *(ivx*) Agricultural land is captured by the logarithm of agricultural land area (ln(*Agri_Land*)) as the percentage of the country's total land area [18]. The expansion of agricultural land leads to an increase of production 19. This has a negative effect on FI.

3.3 Construction of Food Insecurity Index and Estimation Technique

The identification of factors that contribute to FI in SSA is based on a two stage methodology. Firstly, we use principal component analysis (PCA) to construct the composite food insecurity index. Secondly, we identify the principal causes of food insecurity in SSA by, on the one hand the average Bayesian model (ABM), and on the other hand, the General-to-Specific (GETS) approach for the robustness.

3.3.1. Construction of the Food Insecurity Index: Principal Component Analysis Approach

The Principal Component Analysis is an analytical technique in multidimensional descriptive statistics that deals with variables simultaneously. Its objective is to obtain a space of reduced dimension with the least possible distortion of reality 56, 57. It will enable us to summarise FI variables in a relevant way in order to construct a composite indicator called FI Index calculated through-aggregation of the following steps: - obtaining of data of indicator variables; - normalisation of each of indicator variables, i.e. centred-reduced following the formula:

$$V_{it}^{n} = (V_{it} - \mu_i)/\sigma_i \quad (1)$$

V_{it}^{n} and V_{it} respectively stand for standardised value and value of an indicator i variable at a period t; μ_i and σ_i; the mean and standard deviation respectively of variable i the assignment of weights to variables using PCA, i.e. :

$$W_i = \sum_{j=1}^{q} |L_{ij}|E_j \quad (2)$$

With W_i weight i^{th} of variable ; E_j eigenvalue of the j^{th} principal axis ; L_{ij} coordinate of the i^{th} indicator variable on the j^{th} component, i=1,2,.,n indicator variables and j=1,2,.,q; with q number of components that provide at least 75% of available information that is approximately necessary to explain FI and; - the formation of FI index namely:

$$FI\_I = \frac{\sum X_i W_i}{\sum W_i} (3) \quad (3)$$

FI_I is FI index of each year of observation in a country and X_i the normalised vector of the i^{th} variable.

3.3.2. Estimation Technique

To identify the principal causes of FI, we use the Average Bayesian Model (ABM) technique. This is a technique traditionally used to

select economic growth modelling among the millions of specifications considered in the empirical studies [58, 60]. It enables us to avoid the problem of degrees of freedom caused by the determinant multiples used in previous studies. In addition, it enables us to consider not only the traditional determinants of FI but also those less known being able to be specific to each country. It also avoids the arbitrary choice of the specification of the model. For robustness, we use the General-To-Specific (GETS) approach. To the best of our knowledge, no study has yet used this method to assess the determinants of food insecurity and especially in the context of SSA.

3.3.2.1 The average Bayesian Model (ABM)

The empirical relationships between FI and its key determinants can't be examined by a single model. The majority of empirical work operate arbitrary choices on the models of specification. The subjective choice of model can lead to a potential bias in view of the specification of a model possible in the empirical literature that can be ignored. This bias is present in the work of developing countries because in addition to the traditional determinants of FI, other potential determinants can be added to the specification. We opt for the econometric approach based on an uncertainty model through the Average Bayesian Model technique. This technique is used to identify the determinants of FI by considering uncertainty on the specification of a model in the presence of several potential determinants. Its advantages concern the unavailability of data and multiple explanatory variables for which models of classical regression can't be effective (? or applied). The simplified version of the model is:

$$Y_{it} = \alpha_\gamma + \beta_\gamma X_{it} + \varepsilon_{it} \quad \text{with} \quad \varepsilon \sim N(0, \sigma^2 I) \qquad (4)$$

Where, Y_{it} is FI, X_{it} matrix of potential explanatory variables, α_γ constant, β_γ coefficients and ε_{it} error term.

The ABM addresses the issue of uncertainty in relation to model specification by estimating the model for all combinations of X_{it} explanatory variables and constructs an average weight. Supposing that X_{it} contains K potential explanatory variables, this leads to the estimation of 2^K combinations of variables and thus 2^K models, each having a certain probability of being the "true" model. Also, supposing that θ is quantity of interest, such that coefficients β, the posterior distribution associated with data is :

$$P(M_\gamma/D) = \sum_{\gamma=1}^{2^K} p(\theta/M_\gamma, D) p(M_\gamma/D) \qquad (5)$$

The posterior distribution of θ is an average of the posterior distribution under each of the models considered, giving a weight by the probability of the posterior model. For a model M_γ, the ptosterior probability of the model is obtained by the following Bayes' theorem:

$$p(M_\gamma/D) = \frac{p(D/M_\gamma)p(M_\gamma)}{\sum_{l=1}^{2^K} p(D/M_l)p(M_l)} \qquad (6)$$

$p(D/M_\gamma) = \int p(D/\theta_\gamma, M_\gamma) p(\theta_\gamma/M_\gamma) d\theta_\gamma$ is the integrated likelihood of model M_γ,θ_γ is the vector of model parameters M_γ, $p(\theta_\gamma/M_\gamma)$, θ_γ is the preliminary density under the model M_γ, is the $p(D/\theta_\gamma, M_\gamma)$ likelihood and $p(M_\gamma)$ is the prior density that M_γ is the true model. For this purpose, we choose a uniform prior probability which means a common prior probability model as [59], i.e $p(D/M_\gamma)=2^{-K}$. This is the most wide-spread way representing the absence of prior knowledge. Hence, implication of prior probability by including the regressors is 1/2 independently of the other regressors included in the model. According to [61], the prior average and variance are respectively given through:

$$E(\theta/D) = \sum_{\gamma=0}^{2^K} \Delta_\gamma p\left(\frac{M_\gamma}{D}\right) \quad \text{with} \quad \Delta_\gamma = E(\theta/D, M_\gamma) \qquad (7)$$

$$V(\theta/D) = \sum_{\gamma=0}^{2^K} (V(\theta/D, M_\gamma) + \Delta_\gamma^2) p(M_\gamma/D) - E(\theta/D)^2 \qquad (8)$$

3.3.2. GETS approach

This approach is alternative to the ABM to answer to problems of uncertainty of model. Indeed, this approach is one of the most influential econometric and statistical approaches to answer the problems of model uncertainty 62. Unlike ABM, which solves the problem of uncertainty of model by estimating the model for all possible combinations of explanatory variables, leading to thousands and even millions of regressions. The GETS approach answer this worry by leaning on a lone model called the General Unrestricted Model (GUM). The GUM containing the potential explanatory variables, goes through a series of stepwise statistical tests [63], resulting a withdrawal of empirically less important variables.

4. Results

4.1. Presentation and interpretation of PCA results

Table 1 indicates that the total dispersions of clouds of points explained by components 1, 2 and 3 are 78.54%, therefore more than three quarters of available information, giving a sufficient and satisfactory approximation to determine the leading dimensions to explain FI. Among the eight indicator variables that enter the construction of the FI Index, those with high contributions for formation of each of three components contribute most to the explanation of FI in SSA.

Component	Eigenvalue	Difference	Proportion	Cumulative
Component1	3.38471	1.51914	0.4231	0.4231
Component2	1.86557	0.832839	0.2332	0.6563
Component3	1.03273	0.394166	0.1291	0.7854
Component4	0.638566	0.104296	0.0798	0.8652
Component5	0.53427	0.200452	0.0668	0.9320
Component6	0.333818	0.203793	0.0417	0.9737
Component7	0.130025	0.0497196	0.0163	0.9900
Component8	0.0803056		0.0100	1.0000
Number of observations = 435 Principal component / correlation Number of components = 8 Trace = 8 rho = 1.0000 Rotation: (unrotated = main)				

Source : *Authors from stata 14.*

Table 1: Eigenvalues (PCA)

Table 2 shows the quality of representation of variables on the principal axis retained. Indeed, the availability of energy food and average protein supply variables contribute strongly to the formation of the first main axis. It results from the strong presence of food availability dimension. The variables, prevalence of anaemia in women of childbearing age as percentage of women aged between 15 to 45 and the prevalence of anaemia in children of less than 5 years of age contribute in the majority to formation of second main axis. It results from the strong presence of the food use dimension. The variable, variability of food availability contributes in the majority to the formation of third main axis. This is due to the strong presence of food stability dimension.

Variables	Factor1	Factor2	Factor 3
Prevalence of anaemia in children of less than 5 years of age (Focused and Reduced)	-0.2723	0.5806	0.2312
Share of energy supply (Centred and Reduced)	-0.3241	0.0817	-0.4270
Prevalence of malnutrition (Focused and Reduced)	0.4142	-0.0894	-0.0874
Prevalence of undernourishment (Focused and Reduced)	-0.4465	-0.2976	-0.0102
Prevalence of anaemia in women of childbearing age as % of women aged of 15-45 (Focused and Reduced)	-0.2219	0.5897	0.2275
Availability of energy foods (Centred and Reduced)	0.4621	0.3035	-0.0078
Variability of food availability (Centred and Reduced)	0.0691	-0.2605	0.8321
Average protein supply g/cap/day (Centred and Reduced)	0.4269	0.2280	-0.1104

Source: *Authors from stata 14.*

Table 2: Matrix of principal components (factors)

4.2. Presentation and Interpretation of Results of the Descriptive Statistics

Table 3 shows that in SSA between 1990 and 2019, the FI index varies between -0.957 and 0.647 with an average of -0.720 (FI index lies between - 1 and 1. In a preoccupation with an interpretation, we distribute it in the following way : [1, 0.5[situation of very weak FI, [0.5, 0[situation of moderated FI, [0, - 0.5[situation of high FI and [-0.5, - 1[situation of very high FI). So, there is over the period of study a situation of very high FI. The average income level in SSA is $1962.31/capita based on 2010 U.S Dollars making it a zone at intermediate income of lower tranche. On average, 60% of adult population in SSA countries is educated. The average level of investments is 21% below the 30% level recommended by international organisations. Average prices of products including food have increased in SSA of 23.33% over the period 1990-2019. On average, the rural population in SSA countries is 1.8 times larger than the urban population. The average surface of agricultural land in relation to total land surface in SSA countries is 49.40%. This demonstrates proof that in general, there is an intensification of agricultural activities in SSA countries. Arable land occupies an average surface of 14.89% of the total land surface of the countries. Overall, quality of infrastructures in SSA countries is at an average level, i.e. 2.28. This lack of infrastructures limits the access to arable lands for the needs of production as well as the cir-

culation of the little food available inside the SSA countries even between the countries causing the FI. The democracy index in SSA is on average 1.7 indicating this system of governance is the least practised in SSA. As for temperature variation in degrees Celsius, it varies on an average of 0.83% per year. This may help explain the droughts observed in SSA.

Variables	Observation	Average	Std.dev	Min	Max	Data source
FI_I	435	-.720205	.2962682	-.9577755	.6470488	Authors
Lev_Inc	849	1962.31	2390.514	164.3366	11949.28	WDI, 2021
Agri_Prod	435	160.5149	58.10198	64	285	FAO, 2021
Educa	136	59.61802	22.93998	10.89465	94.36792	WDI, 2021
Lev_Invest	758	20.84841	8.558637	-2.424358	93.54746	WDI, 2021
Inflation	845	23.22221	196.3179	-29.17246	4800.532	WDI, 2021
Demogra	870	1.82e+07	2.94e+07	119209	2.01e+08	WDI, 2021
Rural_Pop	870	1.15e+07	1.86e+07	56779	9.82e+07	WDI, 2021
Agri_Land	780	49.40535	18.01283	16.87345	80.92054	FAO, 2021
Arable_Land	780	14.89667	13.24729	.3783836	48.72219	FAO, 2021
Quali_infras	149	2.284483	.3811557	1.53	3.79	WDI, 2021
Loc_Confl	587	8.183757	1.908536	.25	12	ICRG, 2021
Democra	813	1.706027	5.621556	-9	10	Polity IV
Temperature	847	.8383117	.4215227	-.326	2.45	FAO, 2021
Legal_Syst	870	.4137931	.4927956	0	1	Laporta et al. (1998)

Source: *Authors from stata 14*

Table 3: Descriptive statistics on outcome indicators and FI Index

4.3. Presentation and Interpretation of Results of Average Bayesian Model

The results in Table 4 are obtained from our sample and based on 14 potential determinants. A variable is relevant to FI explanation if its probability of inclusion posterior (PIP) is greater than or equal to 50%. The columns Post Coefficients and Post Standard Deviation represent the coefficient and the post standard deviation of parameter β of variables. According to the results, the negative signs associated with education and rural population means that these variables reduce FI. This said, countries with more educated people are less exposed to FI, because they are more aware of the scourge and choose creditable agricultural practices. As for the rural population, its high density leads to a decrease in FI because most of the rural working population is engaged in agriculture as their main activity.

In contrast, the level of income in the absence of a legal system favours FI. According to 4, Africa has the lowest per capita income. In the developing countries, the weak purchasing power is one of the causes of FI 64. Arable lands are identified as an important cause of FI in SSA. Contrary to their study, 65 finds that the arable lands increases the food production in the countries and indirectly reduced the FI. Indeed, the majority of households farmer in SSA own little arable land and work intensively on same (or small?) spaces to feed their families 4. This involves soil degradation, low yields and poor quality. By specifying the legal systems of countries, it emerges that poor quality of institutions approximated by democracy favours FI because the functioning of a poor democracy hinders the fight against FI. Political systems hostile to the normal functioning of markets are one of the important sources of FI 54, 18. Demography is favourable to FI in SSA. This confirms the Malthusian theory that population expansion leads to increased pressure on agricultural resources, which in turn affects agricultural yields. As a result, existing food production is unavailable and / or disproportionate to the population, regularly exposing them to chronic FI.

Variables	PIP	Post Coefs	Post Sd	PIP	Post Coefs	Post Sd
ln(Inc_Lev)	0.50	0.110	0.129	0.36	0.0741	0.117
ln(Agri_Prod)	0.36	0.110	0.176	0.25	0.0733	0.158
ln(Educa)	0.97	-0.833	0.244	0.98	-0.815	0.215
ln(Lev_Invest)	0.48	-0.323	0.420	0.38	-0.209	0.372

Quali_infras	0.15	0.0221	0.0822	0.12	0.0121	0.0687
ln(Inflation)	0.22	-0.175	0.469	0.16	-0.121	0.407
Loc_Confl	0.21	0.0140	0.0359	0.46	0.0445	0.0563
Democra	0.26	0.00547	0.0116	0.51	0.0269	0.0312
ln(Demogra)	0.60	0.327	0.326	0.72	0.452	0.329
ln(Rural_Pop)	0.67	-0.356	0.315	0.78	-0.476	0.315
Chang_Tempera	0.14	0.0247	0.0975	0.11	0.0153	0.0795
ln(Arable_Land)	0.45	0.0978	0.129	0.63	0.193	0.172
ln(Agri_Land)	0.20	0.0353	0.104	0.15	0.0228	0.0863
Legal_Syst				0.43	-0.158	0.236
Constant	1.00	3.265	2.535	1.00	2.514	2.375

Notes: *For each simulation, we use a uniform prior model. Statistics in bold are those for which the posterior inclusion probabilities are greater than or equal to 50%.*

Source: *Authors based on data*

Table 4: Determinants of food insecurity

The results from the ABM clearly show that there are peculiarities related to the legal systems of countries that should be considered when conducting an analysis on the determinants of FI. The ABM is therefore not sufficient to identify variables that may be decisive for specific diagnoses.

4.4. Robustness Analysis: the GETS Approach, an Alternative to ABM

The results of ABM are submitted to an analysis of the robustness by using GETS approach and with FI Index as explained variable. This approach deals with the model uncertainty and identifies the most appropriate determinants of FI. Indeed, GETS like ABM, is one of the influential econometric and statistical approaches for handling model uncertainty62. The results obtained in table 5 lead to specific models GETS 1 and GETS 2. The determinants retained in the GETS approach models are exactly those with PIPs (Table 4) greater than or equal to 50%. This confirms veracity and evidence that the above results are robust to the chosen estimation method. So, in SSA, education and rural population have a negative and significant effect on FI while income level, demography, democracy and Arable land are favourable to FI.

	(1)	(2)
Variables	GETS 1	GETS 2
ln(Educa)	-0.768***	-0.695***
	(0.0790)	(0.0717)
Democra	0.0123**	0.0161***
	(0.00529)	(0.00503)
ln(Demogra)	0.456***	0.547***
	(0.0988)	(0.0896)
ln(Rural_Pop)	-0.488***	-0.587***
	(0.101)	(0.0895)
ln(Agri_Land)	0.271***	0.274***
	(0.0756)	(0.0771)
ln(Inc_Lev)	0.0729**	
	(0.0365)	
Constant	1.653***	1.944***
	(0.412)	(0.393)

Notes : *** and *** significant at the 5% and 1% level respectively*

Source : *Authors based on data*

Table 5: Specific model of food insecurity using the GETS approach

5. Conclusion

As in some other parts of the world, FI is a systematic problem of concern in SSA. In this light, the fight against FI has been included in one of the target Objectives of Millennium of Development and Sustainable Development Goals. However, in spite of progress achieved to improve food security, SSA is experiencing evidence of difficulties to reduce the FI. In this regard, this paper identifies factors that contribute to the persistence of FI in SSA of 1990 to 2019. The data are obtained from Food and Agricultural Organisation 2021, of World Development Indicators 2021, of International Country Risk Guide 2021 and of Polity IV 2021. We use principal component analysis (PCA) to construct the composite food insecurity index. In order to identify the principal causes of food insecurity in SSA, we use on the one hand the average Bayesian model (ABM), and on the other hand, the General-to-Specific (GETS) approach for the robustness. The PCA results reveal that FI in SSA results from the dimensions of food availability, food utilization and food stability. As for the ABM results confirmed by the robustness of the GETS approach, income level, arable land, demography and democracy are principal causes of FI persistence in SSA. In contrast, rural population and education have a negative effect. There is an emergency in reinforcement of agricultural strategies and in inclusive distribution of national wealth followed by political responsibility in struggle against food insecurity.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data Availability Statement

Data supporting this research are available on request from the author at the email : btchimeutcheu10@yahoo.fr

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Annex 1 List of Countries of the Study

Angola, Benin, Burkina Faso, Cabo Verde, Cameroon, Chad, Cote d'Ivoire, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, South Africa, Togo.