Journal of Economic Cooperation and Development, **41**, 2 (2020), 47-66

Problem of Food Needs Coverage by Availabilities in Niger: An Error-Correction Model Analysis

Mamane Tarno[1] and Musa Talba Jibir[2]

To move from risk to the food crisis, the actors, through their behavior, must provide the alibi. This idea is modeled in the form of an econometric equation in which the indicator of food crises, measured by the rate of food needs coverage by availability, is regressed on variables controlled by the behaviors of three actors: the populations, the government and the international community. The equation is estimated using an error correction model (ECM) on time series of Niger covering the period 1968-2014. Short and long-term results indicate that crises persist due to adverse agro-climatic, economic and political conditions, the government's inability to implement audacious policies that have a positive impact on incomes and producer prices, and the lack of willingness of the international community to provide timely an adequate food aid. Thus, the main surprising result is that populations have almost no influence on food crises that keep them on the threshold of survival.

Key words: Food crises, food security actors, cointegration, MCE.

1. Introduction

According to FAO et *al.*, (2014), Niger is one of the few countries in sub-Saharan Africa to reach the first target of the MDGs. It's surprising for all those who know that the initiative to which this achievement is attributed, namely "The Nigeriens Feed the Nigeriens", fished during its implementation by a slowness striking (GRAP Policy Brief, 2013). This slowness is the sign of public policies failure, which are powerless to curb unemployment and poverty. It is in the 2000s that public policies have shown the most inability to curb these diseases and that the international community has decided to fight through the MDGs and policies specifically geared towards poverty reduction. In eight years, from 2000

[1] Faculty of Economics and Management (FSEG), University ABDOU MOUMOUNI Niamey, Niger.
[2] Department of Economics, University of Maiduguri

to 2007, the poverty rate fell by only 0.1% on average per year, a quasi-insignificant drop compared to population growth of 3.3%. This high level of poverty is due to a weak productive apparatus and sharp inequalities in the redistribution of wealth.

According to GRAP Policy Brief, (2013), it is sustained by the recurrence of food crises, with each episode translating into a decapitalization that makes poor households, poor and vulnerable, and households already poor, even poorer. From the 1960s to the 1980s, the interval separating two consecutive episodes of crisis has narrowed considerably: it is hardly more than two years old today. In an account of the food crisis in the Sahel, Gado et al. (2006) noted this trend: three surplus years were recorded in the 1990s, compared to only two in the 2000s. Over the past decade, this trend has become more pronounced. Compared to the 1970s and 1980s, where only two episodes of crisis have been experienced, it is clear that the situation has taken a new turn. The crisis is no longer this temporary epiphenomenon, but indeed a chronic structural problem. It mortgages development by destroying precious resources for growth; and because of climate change, it prevents their re-establishment (Knaepen and *al.*, 2015).

The literature on food and nutrition security in the Sahel is a fairly well-documented topic. It focuses mainly on the determinants of food security using a macro-prudential approach, thus paying little attention to the behavior of actors and their strategic choices. Another characteristic or limit of this literature is the neglect of livelihoods as a variable in modeling food crises. Nor did it consider how the choice of government and the intervention of the international community affected the recurrence of food crises in a country.

Insofar as the behavior of the actors is not well understood, food crises will continue to plague and jeopardize economic development. Understanding the choice and behavior of actors will help control food crises in Niger as well as in other Sahelian countries. Having experienced several episodes since the early seventies, Niger can serve as a laboratory.

Taking these dimensions into account, this paper will not only help to bridge the gap, but also to explain how improving people's livelihoods influences the emergence and recurrence of food crises in this particularly fragile area. It will also explain how the behaviors of different actors are

linked and interconnected. To the best of our knowledge, no paper analyses the choice and behavior of the actors in explaining food crisis in Niger. This paper adds to the strand of literature on two-fold: first, it incorporates the food security actors in modelling food crisis and second, analyses the response of food crisis to livelihoods improvement and resilience.

The paper documents that building rural resilience of the population is *sine qua non* condition to controlling food crisis in Niger. It intends to evaluate empirically the impact of the behaviors of food security actors on recurrence of food crisis in Niger. For this purpose, we used an error correction model estimated on long series of Niger from 1968 to 2014. This country is an interesting case as it has been characterized by a changing macroeconomic and climatic environment which has presented opportunity for food crisis especially in the seventies. The study adds another dimension which has not been studied extensively, which is the econometric investigation of the choice, behaviors and decisions of actors in explaining recurrent food crisis. To put an end to this scourge, it is clear that the best way is to identify its causes. Thanks to the prevention mechanism, the warning signs of the crises are known, but it is not known until now why the crises persist despite the multiple interventions of the State and its external partners. To put an end to it, should we advocate more interventions? Is it not reasonable to act on the actors and their behavior? Does government choice and economic and commercial policies affect livelihoods and food and nutrition security status of population in Niger? What role do donor agencies and other international community play in food security and livelihoods? Does improvement in population resilience affect positively food security status and livelihoods of the population?

Targeting the government, the international community and the population, this study aims to answer these various questions. It is structured into three sections: the first deals with the literature review, the second one with the methodology and the third with the results and discussions.

2. Literature Review

A food crisis arises from a shock that is either a natural disaster or a political instability or an epidemic as was the case of malaria, AIDS and

recently the Ebola virus in sub-Saharan Africa have done and continue to wreak havoc. Sick or afraid of being infected, many workers have no choice but to abandon their activities or put them on the back burner, thus exposing themselves to hunger and poverty. Disasters are not the only causes of food crises, they also arise from unfavorable changes in certain variables or structural determinants: price spikes due to speculation on certain agricultural products; disruptions in the production and trade channels, most often resulting either from inappropriate decisions by economic agents or from insufficient investment, or from declining soil fertility and yields in the case of agriculture, or from population growth ; impossibility for certain social categories due to custom, tradition or politics, to access means of production such as land, credit, etc. and conversely, the ease that private foreign investors have in obtaining land in sub-Saharan Africa (Inter-réseaux, 2015 p.2, Destrait, 2014 p.3). In addition, we have land reforms that are inappropriate or badly thought out, as was the case in Zimbabwe where the reform led to the spontaneous and massive departure of the white producers, thus causing the collapse of the corn sector. The deficiency in transport, energy and communication infrastructures would have the same effects; as is family farming, the small size of farms being a brake on mechanization (Byerlee et *al.*, see Inter-réseaux, 2015 p.1).

Some of the factors listed are endogenous in that their origins lie in population poverty, market failures, or anomalies in the food system (Charrasse and Gouteyron, 2005). There are many publications devoted to these typical questions of the food system. On the other hand, it is rare to see analyzes that attribute the origin of food crises to the behaviors of actors other than those related to "resilience". The debates on this topic theme are articulated, for some on its definition, for the others on its relationship with vulnerability, and for others on its relationship with the aid and assistance provided to persons or countries in distress.

First of all, with regard to the definition, chronological evolution shows that the meanings given to resilience have evolved both by widening and improving. According to Inter-réseaux, (2013 p.2), originally it was a concept of the physics of materials used to designate the ability of the latter to return to their original form after a shock. Subsequently, it was extended to psychology, the traumas created by the Second World War have raised questions about the ability of individuals to recover from serious trauma. Then, by analogy, it was introduced in Disaster Risk

Reduction (DRR) to describe the response of populations and adaptation mechanisms caused by natural disasters. Following these expansions, a consensus definition was formulated by UNISDR in 2009: "The capacity of a system, a community or society exposed to the risks of resisting, absorbing, hosting and to correct the effects of a hazard in a timely and effective manner, including the preservation and restoration of its essential structures and functions". Speaking of systems, this definition shows that resilience is not reducible to individuals, it also applies to the State and beyond, to any multilateral organization. This idea is echoed in DFID's definition: "Disaster resilience is the ability of countries, communities and households to adapt to change by conserving or transforming their standard of living (living standards) in the face of shocks or stress - such as an earthquake, drought or conflict - without compromising their long-term prospects "(DFID, 2011 p.20). It is therefore not wrong to speak of government resilience, the resilience of the international community, which can be their ability to adapt to changing circumstances. A government would be said to be non-resilient if it fails to adopt its economic policies to the changing national and international food context. Its resilience, if it exists, will depend on the concrete effects that its interventions will have on people's lives. Similarly, the international community would not be considered resilient if its interventions do not take into account the context of the country it is supposed to assist and assist. Its resilience will be appreciated given the concrete effects of the aid it provides, including official development assistance. With regard to the latter, the very numerous analyzes - the question being sensitive - are controversial. For some, aid weakens the resilience of the beneficiary countries, while for others, it is essential to overcome the economic, food and nutritional crisis. Admitting that the government and the international community can be resilient, it would not be superfluous to ask how, individually or jointly, their resilience would affect that of the populations.

But whatever the meaning of resilience, most authors consider it to be "mirror" with the notion of vulnerability (Inter-Réseaux, 2013). This means that a population, a household, a vulnerable individual is not resilient; conversely, a population, a household, a resilient individual is not vulnerable (Grünewald and Warner, 2012). The notion of resilience is more "positive" insofar as it insists on the capacities of the populations; it goes hand in hand with the notion of empowerment, according to which people must be given the opportunity to withstand prolonged shocks or

stresses by themselves. It is also a dynamic notion, it addresses a changing context, which requires constant adaptations, without necessarily requiring a return to the initial state. In contrast, vulnerability refers primarily to a state (Inter-networks, 2013). For Frauke de Weijer (see Inter-Réseaux, 2013 p.3), resilience comes in multiple manifestations that vary according to the populations considered, the context and many other parameters. Thus, taken in the sense of empowerment, the resilience for nomadic pastoralists would be mobility while for sedentary farmers, it would be rather the existence of grain reserves or a diversification of activities. Notwithstanding this, some experts believe that resilience is a concept without positive or negative connotations. One can respond to an external shock or stress simply by lowering one's expectations downwards, a so-called "adaptive preference" phenomenon developed by Sen (1981). This is the case of a household that adjusts its expenses and lifestyle to changes in its economic conditions such as job loss. An example of the same kind, seeing the price of an agricultural product increase, a farmer reacts by increasing the share of this product in his crops. But if the market turns around and the price of this product falls, it will inevitably find itself in a situation of vulnerability.

Resilience is sought through different channels such as Linking Relief, Rehabilitation and Development (LRRD) approaches, security, etc. This is achieved by acting on two dimensions: the temporal dimension, anticipating crises not to prevent them, but to bring international organizations to help victims, through alert and capacity building mechanisms, to recover an unforeseeable shock; and the sectoral dimension where food security is linked to health, education, the environment, and so on, the belief that vulnerability is systemic. For a long time, food security policies were focused on increasing agricultural productivity. Their failure has increased the need for a holistic approach addressing all aspects (economic, social, climatic, etc.) of vulnerability. Focusing on political factors (Sen, 1981; Drèze and Sen, 1989; Messer and *al.*, 1998 and 2001; Sen, 2000; Teodosijevic, 2003; Wiesmann, 2006 etc.), economic (Pritchett and Summers, 1996; Smith and Haddad, 2000; Wiesmann, 2006; Ravallion, 1995; Dollar and Kraay 2002 etc.), demographics (Birdsall and Sinding, 2001), climate (Carloni, 2001; Knaepen and *al.*, (2015) many empirical studies have been part of this logic. Thus, the determinants resulting from these studies established the properties of resilience not individual but global, macroeconomic or even systemic. On a smaller scale, particularly at the household stage, similar

analyzes have led to the definition of microeconomic or individual determinants. In the latter case, the origin of resilience is understood as a phenomenon intimately linked to the preferences of agents who, on a daily basis, act to satisfy their needs. These preferences are materialized by choices and activities whose intensity and vigor allow each individual to have a certain level of food security. Thus, in order to maximize its usefulness (which amounts to maximizing its working time versus leisure time), the individual decides what activities to undertake (his choice being a function of the expected utilities of each alternative). To take only this example of agriculture, a crucial activity for food security, the individual will decide on the areas to be embedded, the inputs to be used, the assets to be used, and so on. For a given cereal, he will decide the quantities to be produced, the shares of the product to be consumed and sold, and so on, as well as quantities of other goods to be acquired on the market. Likewise, it will decide on the claims to be held on its partners and the debts to be contracted, the investments to be made and the sectors to receive these investments, and so on.

This reasoning leads to postulating that food crises arise because, based on their preferences (rational or non-rational), agents do not choose strategies and solutions to protect them from food insecurity. They do not choose, either for lack of capacity or lack of will, anomalies that are explained by cognitive, emotional, individual or collective (mimicry of group or crowd) or by tares belonging to pure automatics (reflexes, habits).

3. Methodological approach

The relations between preferences, choices and utilities are conceptualized by the theory of behavioral economics and its corollary, the theory of decision. A choice assumes that one has in front two or more alternatives and preferences. The notion of utility emerges, for its part, from the fact that in order to prefer one alternative over another, it will be necessary to compare their respective aptitudes to satisfy specific needs. By combining these concepts, one can thus elucidate many economic phenomena such as food crises that, unless considered as inevitable, are the result of alternative combinations between availabilities (revealed utilities) with decisions supposed to involve them, sovereign choices of individual agents. There are several models to specify this complex problem. We can indeed use the expected utility model (Samuelson,

1937), but the drawback of this model is to underestimate the sources of utility, notably the choices and decisions of agents. Moreover, time is the only dominant variable, the analysis being placed in an intertemporal framework. It is more recommended in game theory for the study of repeated games. It is true that food crises are also repetitive, but their repetition is of a different kind. The quasi-hyperbolic discount model, more appropriate in the study of phenomena of addiction or procrastination, is also not suitable. On the other hand, depending on whether the environment is risky or uncertain, one can use the expected utility model (Kahneman and Tversky, 1979), the utility expectancy theory, the prospect theory, the utility expected subjective theory, etc.

Unfortunately, all these models have the fault of not revealing the activities that materialize the choices of the actors and which give form and meaning to the structuring elements of the problematic of food security. In the absence of a standard model suitable for our case, we adopt the simple econometric specification which consists of directly relating the food situation to the variables materializing the choices and decisions of the economic actors.

3.1. Choice of model variables

Food crises are variously measured in the literature. For example, Mulubay, (2007) used caloric or protein consumption per capita per day, Clément, (2009) Global Hunger Index and FAO, (2008) the intensity of food and nutrition shortage and of the hunger measured by the ratio "Food Deficiency (DA)" or "Food Severity (GA)". The both measure the gap between an individual's daily energy needs (BEA) and energy availability (DEA) average to which he can theoretically claim.

To all these indicators, we prefer the rate of coverage of food needs by availability that is easy not only to calculate but also to interpret.
As in the case of Mulubay, (2007) and Clément, (2009), we consider the following variables as representative of the food choices and decisions of the agents in Niger. Food aid and foreign-funded investments reflecting the will of the international community.
Investment financed from budgetary resources, cereal prices and per capita income reflecting agricultural and trade policies and the will of the government; the area sown to cereal crops and the productivity of agricultural assets to capture population choices; and finally, rainfall and

political stability, control variables assumed to described the agro-climatic conditions and the political environment.

3.2. Model specification

The functional form of our model is:

TC = F (AIDALIM, INVESTEQPT, PRICE, GNWH, SUPERF, XVIT, PLM, INSTABPO) where TC is the rate of coverage of Food needs by availability;
AIDALIM: Food aid;
INVESTEQPT: Investment in Equipment and infrastructure;
PRICES: Food prices;
GNP: per capita income;
SUPERF: areas sown to cereal crops;
XVIT: Productivity of agricultural assets;
PLM: Rain height;
INSTABPO: Political instability.

Inspired by Mulubay, (2007), we assume that the function is linear with the variables cited above. The latter are not exhaustive, and we add to the deterministic model a random variable that takes into account the other factors. Thus, the stochastic model to estimate is as follows :

$$TC_t = \alpha_0 + \alpha_1 AIDALIM_t + \alpha_2 INVESTEQPT_t + \alpha_3 PRIX_t + \alpha_4 PIBNH_t + \alpha_5 SUPERF_t + \alpha_6 XVIT_t + \alpha_7 PLM_t + \alpha_8 INSTABPO_t + \varepsilon_t$$

The coefficients of food and prices are expected to be negative and those of the other variables positive.

3.3. Description of the variables of the model

Food aid (AIDALIM): this is the food granted in the form of donations. Niger currently receives between 20,000 and 30,000 tons against an annual average of 50,000 tons in the past. Local purchases, which are difficult to control, are on the rise: 40% today compared with 5% in 1985-1986. It is the donors who determine the volume and the distribution of the aid. For distribution, we take into account the poverty threshold which is free for the poor and the sale at moderate prices for the less poor. As a

component of the availability, food aid increases the coverage rate. However, since aid could be diverted, distributed after leftover or sold where conditions suggest that it is distributed free of charge, its sign may be negative.

Investment in equipment and infrastructure of economic development assets (INVESTEQPT): they include the costs of agricultural construction, hydraulic works, development of crops sites, construction of roads and rural roads, purchases of machinery, public utilities, and so on. The funds come from the State, donors, populations, NGOs, etc. For purposes of the analysis, we distinguish between external expenditures and government expenditures. In principle, the coefficient of this variable is positive.

Food price (PRICES): a distinction is made between producer price and consumer price. They have the same economic function, but their induced effects are divergent. By increasing, the producer price allows the producer, with a smaller supply, to satisfy his liquidity needs. It is observed on the market just after harvest. The oligopsonic nature of the market makes the price at this period low, which benefits the traders who are the main buyers. The second price is set by traders during the welding where they are in a monopoly position. The variable is calculated by averaging the two prices. Since the second price includes the first, the variable will have a negative impact on the coverage rate.

Per capita income (GNP): it measures general welfare, wealth inequalities, economic performance, availability and access to cereal consumption goods (Pritchett and Summers, 1996; Smith and Haddad, 2000; Wiesmann, 2006; Ravallion, 2005; Bourguignon, 2004; Easterly, 2007). It is obtained by relating the national income to the total population. His sign is expected to be positive.

Areas sown for cereal crops (SUPERF): in a traditional agricultural system, the increase in agricultural production depends exclusively on the areas sown. It also depends on yields, productivity, and the impact of population pressure on the latter (Boserup, 1965; Birdsall and Sinding, 2001). In principle, the coefficient of this variable is positive. A negative sign cannot be ruled out; demographic pressure can impose decreasing returns to scale.

Productivity of agricultural assets (XVIT): this is the amount quantity of grain produced per farm worker. Its coefficient is positive, because if productivity increases, the availability increases due to the simultaneous increase in production and incomes.

Rainfall height (PLM): this is the rainfall recorded during a winter season. Cereals consumed in Niger are obtained from rain fed crops and rainfall is of critical importance for food security. There are two conditions for good harvests: the height of rain is sufficient or it is well distributed in time and space. Its coefficient is therefore either positive or negative.

Political instability (INSTABPO): it is a threat to the democratic framework. Problems that will arise (disputes, failure of the administration, etc.) will be obstacles to the economy, trade, investment, etc., which would seriously expose the country to all kinds of shocks. Its impact on food coverage will be negative.

3.4 Data sources

Data on population, cereal production, imports, exports, domestic supplies and uses come from FAOSTAT (Food and Agriculture Organization of United Nations statistics). Those on food aid are from the INS (National Institute of Statistics, Niger). We had to supplement the missing data by extrapolation by referring to the rates given by FAOSTAT (FAO, 2007-2014). Data on rainfall and prices are taken from the INS electronic file. Those for agricultural labor and real GDP per capita are from WEO (World economic indicators) of the IMF, (2014) and partly from Beyond 20/20 of UNCTAD, (2001).

3.5 Estimation technique

The cointegration theory introduced by Granger, (1981) requires before applying MCOs to “stationarize” non-stationary series by differentiating them. Since the differentiation procedure often masks the long-term properties, by analyzing the short-term dynamics, long-term stable relationships are jointly specified. Granger's representation theorem (1981) postulates that cointegrated series can be modeled as an error correction model (ECM). The ECM is written:

$$\Delta Y_t = \gamma \hat{z}_{t-1} + \sum_i \beta_i \Delta X_{t-i} + \sum_j \delta_j \Delta Y_{t-j} + d(L)\varepsilon_t \qquad (1)$$

Where ε_t is a white noise; $\hat{z}_t = Y_t - \hat{\beta} X_t$ is a residue of the estimate of the cointegration relation; d (L) is a finite polynomial in L. In practice, we often have d (L) = 1 and the MCE is written more simply as follows:

$$\Delta Y_t = \gamma \hat{z}_{t-1} + \sum_i \beta_i \Delta X_{t-i} + \sum_j \delta_j \Delta Y_{t-j} + \varepsilon_t \qquad (2)$$

The coefficient γ represents the speed force of adjustment of the error correction coefficients towards the long-term target. It must be significantly different from zero and negative. The MCE makes it possible to integrate short-term fluctuations around the long-term equilibrium given by the cointegration relationship.

4. Results and discussions

To prevent multicollinearity, a correlation test is performed on the explanatory variables. Similarly, post-estimation tests are performed to validate the results.

4.1. Statistical characteristics of the variables

The explanatory variables of the model satisfy the statistical characteristics. The position, dispersion and shape parameters do not call for any particular comment. However, the Jarque-Bera statistics indicate that the series "agricultural yields" and "productivity of the agricultural labor force" are not normal. The results (see table 1 in the appendix) show that the variables do not have the same order of integration. The correlation test reveals the existence of four correlation cases. Thus, the relation (2) is divided into six (6) distinct models.

4.2. Estimation results

The residue resulting from the estimation of the long-term relationship is subjected in each case to the unit root test according to the same procedure as above (see table 2 in the appendix).

Table: Result of regressions of long and short term relationships

	MOD.1	MOD.3	MOD.4	MOD.5	MOD.6
D(LTC(-1))	-0.552	-0.177	-0.747	0.005	-0.122
	(0.118)***	(0.047)***	(0.121)***	(0.046)	(0.032)***
LAIDALIM	0.251	0.034	0.138	0.017	0.017
	(0.106)**	(0.034)	(0.115)	(0.029)	(0.022)
D(LAIDALIM)	-0.001	-0.009	0.088	-0.001	0.010
	(0.125)	(0.037)	(0.137)	(0.036)	(0.029)
D(LAIDALIM(-1))	-0.497	-0.011	-0.440	-0.031	-0.026
	(0.200)**	(0.047)	(0.182)**	(0.039)	(0.042)
LINVESTEQPT	0.065		0.119		
	(0.081)		(0.088)		
D(LINVESTEQPT)	-0.377		-0.276		
	(0.122)***		(0.119)**		
D(LINVESTEQPT(-1))	-0.177		-0.357		
	(0.144)		(0.133)**		
LPIBNH	-0.359	0.014			
	(0.144)**	(0.043)			
D(LPIBNH)	-0.288	-0.036			
	(0.185)	(0.055)			
D(LPIBNH(-1))	0.418	0.038			
	(0.186)**	(0.057)			
LPLM	-0.654		-0.835		
	(0.145)***		(0.182)***		
LPLM(-1)	0.489		0.208		
	(0.156)***		(0.191)		
LREND	-0.203		-0.200		-0.011
	(0.117)		(0.104)*		(0.018)
LREND(-1)	0.029		0.038		-0.003
	(0.069)		(0.077)		(0.017)
LXVIT		-0.964		-0.956	-0.926
		(0.058)***		(0.070)***	(0.033)***
LXVIT(-1)		0.828		1.001	0.899
		(0.076)***		(0.051)***	(0.044)***
LSUPERF		0.019		-0.010	
		(0.026)		(0.019)	
D(LSUPERF)		0.050		0.007	
		(0.148)		(0.116)	
D(LSUPERF(-1))		-0.020		0.056	
		(0.155)		(0.127)	
LPRIX			-0.279	-0.007	-0.016
			(0.139)*	(0.019)	(0.014)
D(LPRIX)			0.398	-0.071	-0.038
			(0.179)**	(0.045)	(0.037)
D(LPRIX(-1))			-0.004	-0.004	-0.029
			(0.118)	(0.037)	(0.026)
INSTABPO	0.004	0.0003	0.002	0.0002	0.0001
	(0.002)*	(0.0007)	(0.002)	(0.001)	(0.0004)
INSTABPO (-1)	0.002	0.0003	0.002	0.001	0.001
	(0.002)	(0.0006)	(0.003)	(0.001)	(0.001)
CONSTANTE	3.084	0.178	5.311	-0.118	0.221
	(1.946)	(0.341)	(2.761)	(0.319)	(0.263)
Nombre d'obs.	34	34	37	43	43
R^2 ajusté	72.8%	97.4%	69.6%	96.9%	98.0%
F-statistique	6.529***	89.706***	6.145***	95.168***	161.287***
Autocorrélation : Breusch-Godfrey Test	Non	Oui	Non	Oui	Oui

(*), (**) and (***): coefficient respectively significant at the threshold of 10%, 5% and 1%. Figures in parentheses are standard deviations.

Since the residues are integrated in level in all models, the null hypothesis of nonstationary is rejected. Therefore, the variables are all cointegrated. We can therefore associate with each of them an error correction model. This result is globally confirmed by the Johansen test. Applied to models 1 to 6, two cointegration relationships appeared for models 1, 3, and 4; and one for models 5 and 6. Admitting no cointegration relationship, model 2 is a fallacious regression. The short and long term relationships for models 1, 3, 4, 5 and 6 are estimated in the same equation. The results are shown in the table above.

4.3. Validation conditions for models

To validate a model, the results must satisfy three conditions: economic, statistical and econometric. The first refers to the signs of the coefficients of the explanatory variables; they must conform to economic theory. The second is defined with respect to the coefficient of determination; it must be of a sufficient level. As for the last one, it refers to the sign of the coefficient of the delayed explained variable, to its stationarity and to the presence or not of the autocorrelation of the errors. In examining these conditions, it appears that:

(i) most of the explanatory variables bear the expected signs, leading to the conclusion that all models are validated economically;
(ii) in view of the coefficients of determination ranging from 69.6% to 98%, it is assumed that all models are statistically validated;
(iii) in all models, except for model 5, the coefficient of the lagged explained variable admits a negative sign and less than unity, thus justifying the existence of an automatic system adjustment mechanism as a result of 'a shock;
(iv) as the presence of the delayed explained variable among the explanatory variables invalidates the Durbin-Watson test, to detect the existence of error autocorrelation, the Breusch-Godfrey test is performed.
(v) The Fisher statistics calculated for models 1, 3, 4 and 6 are respectively 16.75%; 3.45%; 45.96% and 0.04%. With a probability greater than 5% (we accept the hypothesis H0 of absence of autocorrelation errors), models 1 and 4 are econometrically validated and models 3 and 6 invalidated.

Only models 1 and 4 fulfill the three conditions, so they are validated. We base our interpretations and discussions on their optimal estimators.

4.4. Discussion of results

Measuring the strategic behaviors of the three actors, the variables used in this analysis together explain between 70 and 73% of the variation of food crises in Niger. Six variables have significantly different elasticities of zero in the long run. There are so many in the short term. The presence of the delayed endogenous variable among the explanatory variables reveals an error correction mechanism (recall force) which at 55% (mod.1) and 75% (mod.4) automatically reduces the rate to the long-term equilibrium whenever disturbed by shock.

The individual impacts are analyzed bearing in mind the nature of the endogenous variable which is a ratio between two magnitudes. An increase in this ratio denotes a deterioration of food conditions and therefore a crisis, and a decline the opposite situation. In the long-term relationship, apart from food aid and political instability having negative effects on the ratio, all other variables (rainfall, average per capita income, agricultural yields, food prices) are an opposite sense. For food aid and the index of political instability, an increase of one per cent leads to an increase in the ratio of + 0.5% and + 0.01% respectively, thus attesting to their role as a brake. For the other variables, a one per cent increase leads to a decrease in the ratio, which indicates either the absence of a crisis or the exit from a crisis situation. With an elasticity between -0.7 and -0.8, the height of rain has the highest impact. Reflecting the commitment of public authorities and populations, with an elasticity of -0.7, average income per capita is the second shield against crises. "Food prices" come in third, with an elasticity of -0.3. Agricultural yields have the same impact, their elasticity being -0.2. The negative influence of the international community is measured by the elasticity of "food aid" which is +0.5. This is hardly surprising, because food aid creates addictive effects for beneficiaries who inhibit their ability to work and their resilience. Also exerting a negative influence on the ratio, the "political instability" hinders the increase of the availabilities and accentuates the tensions on the markets by stifling the energies and the creative initiatives of the populations. To reduce the risk of food crises, structural policies must target these variables and upstream of them, the actors whose behaviors have the ability to structure them.

On the other hand, in the short term, only two variables act as a brake on the coverage of food needs by availability: these are the "food prices" and the average income per inhabitant delayed. Their elasticities are all equal to +0.4. The positive sign of price elasticity can be explained by the fact that a rise in prices pushes producers to increase their offers on the market and therefore to reduce their availability, which, in the face of needs that are unchanged in the short term, leads automatically a rise in the ratio. A fall in prices will have the opposite effect, as producers refrain from increasing their offers and thus lowering their availability. For delayed income, a negative impact is difficult to predict unless one considers that income, being of agricultural origin, is precarious and that it is spent on the purchase of food during the lean season, where prices are particularly high. Apart from these variables, all the others, namely delayed food aid, equipment expenditures in current and delayed value and delayed rainfall, exert a positive influence on the ratio, their elasticities being negative and significant. Delayed food aid has an elasticity of -0.4 and -0.5, which contradicts the long-term effect. But this is understandable when you know that by giving immediate access to food to beneficiaries, emergency food aid helps to redress a crisis situation. This result is the opposite of what OXFAM thinks (2009). For delayed rainfall, an increase of 1 percent results in a 0.5 percent decrease in coverage, improving coverage, similar to the long-run effect. As regards investments in equipment, their long-term impact is insignificant; on the other hand, in the short term in current value and delayed, their impacts are negative. A one per cent increase in either variable results in a + 0.3% and + 0.4% decrease in the ratio, as increased spending increases the availability of cash, improving coverage, especially since short-term needs remain unchanged.

To put an end to repetitive food crises, short-term policies must target food aid, agricultural investments, income, rainfall and food prices, and especially those whose strategic behavior affects these variables.

In Niger, food crises persist due to adverse agro-climatic, economic and political conditions, the government's lack of willingness to implement policies that have a direct and positive impact on incomes and producer prices, the carelessness of the international community, which restricts aid and dispensation without considering the needs of the recipient countries. Contrary to popular belief, populations do not exert a significant influence on food crises, which depend more on the behavior of the government and the international community.

The results being mixed, how to reconcile the short-term and long-term requirements that in some respects do not converge? With regard to food prices, the conciliatory solution is the rehabilitation of the security stocks policy by authorizing the national office to buy during the harvest period, to build stocks in anticipation of crises, and to resell during the lean season at a moderate price. The purchase price must be sufficiently raised to allow producers to cover their expenses, which at the same time would maintain the incentives. And for sale, the concern for social protection must prevail over the imperatives of financial equilibrium, which means that in this sensitive sector, subsidies must be used. With regard to food aid, its short-term impact argues in favor of maintaining it, but the long-term results suggest that it should not be used systematically. Alternative solutions must be found, so that the aid is gradually abandoned. This is the role of economic, trade and social protection policies.

With regard to rainfall, the positive long-term impact (-0.7 to -0.8) is offset by the negative short-term impact (+0.5). This is the result of two extreme situations, optimal rainfall and drought. The solution must be sought in adaptation strategies (resilience), which gives agronomic research and policies of dissemination and popularization of new technologies a great importance. The results do not reflect two important variables: the "productivity of agricultural assets" and the "areas sown to cereal crops", the models to which they were associated having been invalidated.

5. Conclusion and perspectives

The purpose of this paper was to assess empirically the impact of the behavior of food security actors on the recurrence of food crises in Niger. We used an error correction model estimated on long series of Niger from 1968-2014. The results helped to understand that crises persist due to the unfavorable agro-climatic, economic and political context, the government's inability to implement policies that have a direct and positive impact on income and producer prices, and the lack of willingness of the international community to provide timely an adequate food aid. Population behavior does not seem to play a major role in crises. Improving their resilience has no effect on their livelihoods. This depends on the choices and decisions of the State through its economic and commercial policies; and the international community through food aid and investment in agricultural equipment and infrastructure. Does this mean that people are unable to be resilient, or would this result be dictated by the particularly hostile physical and climatic environment of Niger?

Bibliographical References

Charasse M. et Gouteyron A. (2005), Rapport d'information, au nom de la Commission des Finances, du contrôle budgétaire et des comptes économiques de la Nation sur la mission d'évaluation et de contrôle du soutien français au dispositif nigérien de gestion de la crise alimentaire, N° 512 Sénat Session extraordinaire de 2004- 2005.

Claquin P. et Chabane M. (2013), L'agriculture au cœur des stratégies de développement, les publications du service de la statistique et de la prospective- Centre d'Etudes et de la Prospective (CEP), n°8-septembre 2013.

Clément M. (2009), « Les déterminants socioéconomiques de la faim : une analyse macro-économétrique à partir de données de panel », GREThA, Université de Bordeaux.

Destrait F. (2014), « Financiarisation de l'agriculture, privatisation des territoires, déficit démocratique », Editorial, n° 119 - Bimestriel - juin, juillet 2014 défis sud.

FAO, FAOSTAT, L'agriculture en Afrique : enjeux et politiques publiques, Fiche 1 à 11. http://faostat.fao.org.

FAO, FIDA et PAM (2014), *L'État de l'insécurité alimentaire dans le monde 2014. Créer un environnement plus propice à la sécurité alimentaire et à la nutrition.* Rome, FAO.

Galbraith J. –K. (1980), Théorie de la pauvreté de masse, Gallimard, 1980, 1ère éd. 79.

Granger C W J (1981), "*Time Series Data and Econometric Model Specification",* Journal of Econometrics 16 (1981) 121-130, North-Holland Publishing Company

GRAP *Policy Brief*, (2013), « La sécurité alimentaire au Niger, quels défis pour la coopération belge? » #12, juin 2013

Grünewald F. et Warner J. (2012), « La résilience : concept porteur ou mot à la mode ? », Humanitaires en mouvement n°10, Octobre 2012

Inter-réseaux (2013), *La promotion de la résilience au Sahel : changement d'approche ou nouvelle mode?*, Bulletin de synthèse souveraineté alimentaire, N°8 Janvier 2013.

Inter-réseaux (2015), « Agricultures familiales en Afrique de l'Ouest : nuancer les affirmations pour faire avancer le débat », Bulletin de synthèse souveraineté alimentaire, SOS Faim, Février 2015.

Kahneman D. et Tversky A. (1979), « Prospect Theory: An Analysis of Decision under Risk », *Econometrica*, vol. 47, nº 2, mars 1979, p. 263-291

Knaepen H., Torres C. and Rampa F. (2015), "Making agriculture in Africa climate-smart from continental policies to local practices", *Briefing Note*, No.80-Nov. 2015, ECDPM

Mulubay F. T. (2007), « Politiques d'ajustement et sécurité alimentaire en Afrique *: Cas de la RDC »*, AAAE Conference proceedings (2007) 593-599, *Université de Kinshasa.*

Oxfam, (2009), « Aide à l'agriculture : des promesses aux réalités de terrain », Rapport, 13 novembre 2009, source : http://www.oxfamfrance.org/php/plan.

Oxfam, (2010), Millennium Development Goals update: Are we on target? www.oxfam.org.uk/education.

Samuelson P. A. (1937), « A Note on Measurement of Utility », *The Review of Economic Studies*, vol. 4, nº 2, février 1937, p. 155-161

Sanchez, Garrido et Celstino (2015) : « Protection sociale et sécurité alimentaire au Burkina Faso : les boutiques témoins ». Rapports de recherche OXFAM avril 2015.

Sen A. (1981), "Ingredients of Famine Analysis: Availability and Entitlements", in quarterly Journal of Economics 96, n°3, pp433-464.

Annex

Table 1: ADF Unit Root Tests

Variables	With trend (5%)	With constant (5%)	No constant No trend	Unit root test at the 5% threshold		Decision
				t-Statistic	Critical Value	
LTC	No	No	Yes	-2,16	- 1,95	I(1)
LAIDALIM	No	No	No	-5.95	-1.95	I(1)
LINVESTEQPT	No	No	No	-5.17	-1.95	I(1)
LPIBNH	No	No	No	-4.31	-1.95	I(1)
LPLM	No	Yes	Yes	-4.99	-2.93	I(0)
LPRIX	No	No	No	-6.68	-1.95	I(1)
LREND	Yes	-	-	-5.81	-4.17	I(0)
LSUPERF	No	No	No	3.06	-1.95	I(1)
LXVIT	No	Yes	-	-5.79	-2.93	I(0)
INSTABPO	No	No	Yes	-6.91	-1.95	I(0)

Table 2: Result of the test on the error term of the long-term relationship

	Significantly different from zero at the 5% threshold		Without constant or trend	Test of the unit root		Decision
	With trend	With constant		t-statistic	Critical Value (5%)	
Model 1	No	No	Yes	-6.34	-1.95	I(0)
Model 2	No	No	Yes	-5.31	-1.95	I(0)
Model 3	No	No	Yes	-6.25	-1.95	I(0)
Model 4	No	No	Yes	-6.21	-1.95	I(0)
Model 5	No	No	Yes	-6.81	-1.95	I(0)
Model 6	No	No	Yes	-5.74	-1.95	I(0)