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Cereal Crops Price's Instability and Food Security in Ségou Region

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Abstract

The objective of this work is to determine the levels of accessibility and availability of some main cereal crops (millet, sorghum, maize and rice) in Ségou region's markets. To do so, the analysis of price volatility and seasonal movements of flows was conducted. It specifically based on measurement of the level of consumer access to main crops (millet, sorghum, maize and rice) regarding macroeconomic indicators (inflation and economic growth), the analysis of price volatility by the Gaussian coefficient of variation method and the analysis of the dynamics of flows based on the extent of price seasonality. The best findings were that access to cereal crops in Ségou region is not related to the existence of a demand, as some economists' argue. But it is also a function of an equitable distribution of the benefits of growth that is the wealth created in the country. The analysis of the seasonality of prices shows indeed that the marketing circuits and their direction are drawn according to the differences of coefficients of seasonality across consumer markets. The most available cereal during normal marketing periods and during the lean season is rice. Our results also show that, in consumer markets, cereal prices (millet, sorghum, maize and rice) are less volatile.

Keywords: cereal crops, seasonality, price volatility and Gaussian variation coefficient.
JEL classifications: Q11, Q13, Q18

1. Introduction

Generally, national and global strategies to fight food insecurity were focused on increasing agricultural supply. The 1970s and 1980s were marked by a low agricultural supply on the world market following the consequences of the oil crisis of 1972, of the climate hazards (droughts and floods) and the exhaustion of the stocks of cereals, especially in China. The countries of Sub-Saharan Africa, especially in the Sahel based their policies to fight against food insecurity on increasing agricultural supply and the management of food stocks (Temple et Dury, 2003). However, those strategies have shown their limitations over time. The debates and the observations on the food self-sufficiency strategy of those countries have shown that it alone no longer ensures the accessibility of foodstuffs. One of the reasons for the failure of this strategy is the globalization of economies through the internalization of markets in the 1980s is pointed out (Temple et Dury, 2003). It took the food crisis of the years 2007/2008 which resulted in a surge in prices, to realize this was obvious. There has been a surge in the price of agricultural products in the global market marked by rising that demand due to changing consumption patterns in emerging countries and the competing use of cereals in biofuel production. The relationship between price fluctuations and access to food was then again evident.

Accessibility to food either through one's own means or through the market was previously highlighted and confirmed at the World Food Summits held in 1996 and 2002. Urban poor households spend a large part of their income in the purchasing of food products so that the price of food products determines their standard of living (Adanguidi, 2003).

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Today we are witnessing more and more an increase in the market supply of rural consumption. In Africa, peasant self-production accounts for less than half of consumption. Purchases account for between two-thirds and over 90% of consumption in Africa, depending on the country (Bricas et al., 2015). The market has become dominant as a source of food supply even in rural areas. The high market share of rural food consumption has a significant impact on their food security (Bricas et al., 2015). The food system is now largely monetarized. Such a situation shows that households have become very largely dependent on the price of food which has become an indicator of access to food for both rural and urban populations. Thus, instability or fluctuation in producer or consumer prices has a strong impact on household food security. The instability of agricultural commodity prices has both micro-economic and macro-economic consequences. At the micro-economic level, the producer tends to decrease his production and productive investments. In case of rising prices, the consumer will have difficulties in accessing food. At the macroeconomic level, instability is a source of chronic fiscal imbalance at the country level through increased subsidies to either production or consumption.

It is widely recognized that level fluctuations in the different price components (seasonality and random variation) can be the cause of food insecurity. In the light of this statement, this paper questions the impact of macroeconomic indicators, price volatility and seasonal movements of flows on the availability and accessibility of 4 staple cereals (millet, sorghum, maize and rice) in the food of the populations in the region of Ségou in Mali.

The global objective of this study is to analyze the instability of cereal crops' prices in Segou region in a context of food insecurity. Specifically, it will consist to:

- Analyze price instability and consumers' accessibility to main cereal crops (millet, sorghum, maize and rice) in Ségou region;
- And, analyze the seasonality of prices and the flow dynamics of cereal products in the Ségou region.

The other parts of the study are organized as follows: the second part deals with agricultural products prices instability's origin; the third part is based on the agricultural products prices seasonality and flows estimation's problem; in the fourth part, the contextual background exposed; the method and tools used are presented in the fifth part; then the sixth part concerns the results obtained and the discussion; finally, the last part presents the conclusion and the recommendations.

2. Origin of agricultural products price instability

Agricultural commodities' price instability is not a new phenomenon. It has long been the subject of sustained and contradictory debates among proponents and advocates of liberalized food trade. (Galiani 1770), in his dialogues on the wheat trade, opposed the liberalization of the wheat trade which for him was at the origin of the price surge followed by a subsistence crisis and an economic crisis (Larrere, 1992). According to the classical theoretical conception, the relation between supply and effective demand makes the market price gravitate around the natural price (Benetti, 1981). This conception of the formation of the prices of goods was corrected by the neoclassical thought that the price variation of a good is a direct result of the confrontation between supply and demand in a pure and perfect competition market.

Despite theoretical advances in the understanding of price instability, it has been relegated to the background by politicians in the resolution of contemporary food crises. It was not until the recent food crises of 2006-2008 that the question of instability returned to the heart of economic debate and was recognized as the central element of agricultural policies (Boussard, 2010).

In view of the harmful nature of price volatility, many economists have looked into this issue and have tried to explain it. First, they sought to understand the origin of agricultural price fluctuations and then propose solutions to mitigate their effects. The debate over the causes of price change is marked by sustained controversy. For some, the origin of agricultural price volatility is internal to the very functioning of the markets, while for others it is the result of the influence of external factors. This difference in interpretation has important consequences for the representation of this economic phenomenon and especially for the resulting prescriptions in terms of economic policy (Gérard et al., 2008). The exogenous theory of price volatility is explained by external market disturbances. In the case of agricultural markets, price instability is the result of random fluctuations in the volumes produced related to the effects and impacts of climatic hazards and other exogenous factors (attacks by pests, social conflicts and political instability, etc.).

These random fluctuations are aggravated by the rigidity of the demand specific to food products and which implies large price variations to balance the market following small variations in marketed agricultural products. On the other hand, the endogenous theory of fluctuations is based on a dynamic market analysis. It assumes that there is a certain amount of time before economic agents in the markets react to price changes. This process is accompanied by very often unfounded expectations of economic agents; sharp price fluctuations are observed with sudden returns to situations of unstable equilibrium.

The instability of agricultural prices creates a sub-optimal situation; it results in the disruption of agricultural production plans as well as consumption and marketing strategies (Galtier, 2009; Gérard et al., 2008; Géronimi et Maître d'Hôtel, 2012). Price instability results from a situation of short-term imbalances between supply and demand. Therefore, in order to measure price volatility, time series are generally used that are corrected for their long-term (or "deterred") trend (Galtier, 2009).

3. Agricultural products prices seasonality and flows estimation's problem

Seasonality is linked to economic activities of production and consumption. It is limited in time corresponding to phenomena or tasks normally called to be repeated each year at the same periods, according to the rhythm of the seasons or the collective way of life. In the agricultural sector, seasonality is a determining factor influencing on the one hand, the production and sales strategy of the farmer and on the other hand, the consumption strategy of both rural and urban households (Adanguidi, 2003). The effect of seasonality on agricultural markets is well known. It can increase the seasonal price gap well beyond expected levels in contexts where markets are functioning well.

Seasonality is a contributing factor to price volatility, prices of agricultural products vary from season to season with pre-harvest price spikes and the lowest price levels at the time of harvest. This seasonality can be measured by the average of the seasonal gap over several years, which is the difference between the highest pre-harvest price and the lowest price during the harvest period. Seasonal price differentials can be caused by trade restrictions in poorly integrated markets, market power in marketing channels, and the behavior of farm households subject to less liquidity and access constraints to credit. This can result in a situation of food insecurity that results in inadequate dietary intakes for households, lower purchasing power, and reduced budget ratios for food.

In estimating the extent of seasonality, various methods are used. These methods focus on the regression of dummy variables (monthly) on trend-adjusted prices, on the estimation of the average (monthly) price differential around a moving average trend and on trigonometric models based on the Stochastic approach. Empirical regression and moving average methods are based on assumptions that are not always justified. Nevertheless, their simplicity of application sometimes justifies their use before resorting to much more complete analyzes based on a stochastic approach and a sinusoidal trigonometric model of seasonality (Gilbert et al., 2017).

In Developing Countries, the availability of reliable statistics on flows between agricultural markets is lacking (Bonjean et Combes, 2010). Knowledge of flows and supply dynamics from one agricultural commodity market to another is a key concern of these countries in the development and implementation of food security strategies and policies. The issue of estimating flows on these marketing routes in the context of market integration has been the subject of numerous published researches. The first focuses on the direct measurement of cross-border trade by developing methods for estimating flows, while the second follows an indirect, more global approach based on the analysis of price behavior across a range of markets (Nkendah et al., 2011). This work is mainly based on these two empirical approaches.

In the direct measurement of flows, research has shown that the volume of informal and unregistered trade in agricultural products is enormous, and plays an extremely vital role, but without any formal recognition in the economies of countries. In addition, flows may experience a reversal of their direction according to supply and demand and a modification of the marketing axes along which they move. In Mali marketing routes that are not necessarily fixed from one year to the next, depend on the current production situation in the different localities, as well as the demand situation in the destination markets (Babre-Madhin et Diarra, 1990).

On the other hand, price statistics are the most available despite some imperfections in data collection methods. This justifies the use of the more global indirect approach, which is based on the analysis of price behavior. It is assumed that the price behavior analysis results from the aggregation of four components including trend, cyclical component, seasonal component and residual component.

The seasonal component that interests us here is assumed to be periodic. It differs from the fact that its period is generally dependent on our environment and despite its name this component is not always linked to the seasons (Coutrot et Droesbeke, 1984). The results of previous studies have shown that the first approach to direct flow estimation is difficult. These difficulties are linked to the reversal of flows according to supply and demand and the variability of marketing routes. Generally, the marketing routes vary according to the current situation of production and demand in the different localities. In West Africa, the determinants of the dynamics of trade in agricultural products are the complementarities of the production and consumption basins, including those of the agro-ecological zones between the Sahelian fringes, of the supply / demand regulation which sometimes induces reversals in terms of prices and differences in trade and fiscal policies (Dupaigre et al., 2008).

These difficulties are sometimes circumvented by resorting to the price behavior analysis approach, in which geographic information system software is used to map price indices and identify areas of high price or poor food availability (Donkin et al., 2000) and, tests of market non-cointegration are made (Badolo, 2011).

4. Contextual Background

In Mali, price instability results from a combination of factors that are both geographic (supply variability), geopolitical (emerging market strategies), demographic (increasing demand) and sociological (changing consumption patterns) and policies (national and regional regulations). These factors are expressed jointly at different scales, both spatial and temporal, which makes agricultural price volatility particularly complex (Maître d'Hôtel et al., 2012).To better understand instability and to analyze it, some works have addressed the question of its measurement. The most commonly used indicator in measuring agricultural price volatility is the coefficient of variation, which is calculated as the standard deviation from the mean. Oppositions to this idea, argue that the measurement of price fluctuations by this Gaussian method, only provide information on small variations in price around the average and not on the extreme values that normally express spectacular gains and losses for economic agents (Rama, 2009). For some authors, only the extreme values that can take the price up or down (Galtier, 2009; Géronimi et Maître d'Hôtel, 2012). For others, these extreme values serve only the anticipation needs of market players. They cannot bring any stabilizing effect of the market, to the contrary, expectations can in certain cases produce instability.

The controversy over the validity or otherwise of indicators for measuring instability and the role of Gaussian and Paretian models, opens up the prospects for a large research project.

5. Method and tools

To analyze the prices, we have chosen the decomposition model of time series. The choice of the decomposition model depends on the series to decompose (Temple et Dury, 2003). To be located on the decomposition model to choose, we have drawn the scatter plot representing the raw series between 2010 and 2017.

The observed form guided the choice of the multiplicative model. This model decomposes the fluctuations between the effects of trend, seasonality and instability. The chosen model is of linear type of the following form:

where

Yt: raw series;

Tt: trend;

St: seasonal component;

Ct: cyclical component;

Et: residual component.

The raw series is decomposed into several components: the trend; the seasonal component and the random variation composed of the cyclic component plus the residual component associated with the instability. The analysis of the time series of cereal prices consisted respectively of the calculation of the trend, the seasonal coefficients and the determination of the seasonally adjusted series. The trend (long trend) is determined by the linear method. The seasonal differences were calculated by the quotient between the raw series and the trend. Seasonal coefficients are obtained by performing the arithmetic mean of the seasonal coefficients of the given month. To characterize the level of accessibility to different cereals, we used the calculation of the price index based on an initial price equal to 100 %, the level of inflation characterizing the country's economy, and calculation of the Consumer Price Index on the basis of an initial price equal to 100. The level of accessibility of cereals was assessed through the analysis of GDP per capita and the comparative analysis of the evolution of the country's inflation rate to the price of cereals. The measure of cereal price inflation was based on the upward or downward growth of the Consumer Price Indices (CPI).

The analysis of the impact of seasonality on the food supply is made on the basis of the differences between seasonal price indices in the markets and between markets. The level of instability is measured by percent (%) weight of the variation coefficient (VC) of the random (irregular) series in the variation coefficient (VC) of the raw series of each cereal.

To the extent of instability, we deduce from the total series, the seasonal component and the trend. This allowed us to determine the random component (SI). Then we calculate the coefficient of variation on this component, which we compare with the variation coefficient of the total series. When the weight of the coefficient of variation of the random component corresponds to that the raw series's, the prices are then less unstable.

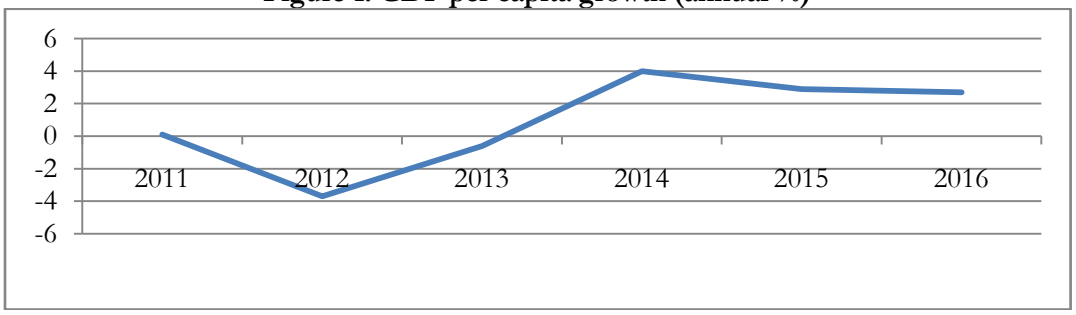
We chose to focus only on basic grains (millet, sorghum, maize and rice). Targeted markets were identified after secondary data mining. The data used in the analysis are time series of cereal prices (millet, sorghum, local rice, maize) in the main consumer markets in the region of Ségou. These data, which cover the period from January 2010 to July 2017, come from the data base of the Agricultural Market Observatory (AMO).

6. Results and discussions

6.1 Consumer accessibility to basic cereals

In Mali, there is a predominance of cereals food consumption. Cereals account for the bulk of food consumption, which is mainly provided by domestic production, with imports accounting for a relatively small share of cereal consumption (Géronimi et Maître d'Hôtel, 2012). Thus, food security is difficult to envisage in Mali without better access to cereals. In the Ségou region, millet, sorghum, maize and rice are the four most important staple cereals. Given the evolution of the Consumer Price Index (CPI) in this region, we can therefore make a first judgment on the accessibility of basic grains. Secondly, cereal accessibility levels are characterized by changes in macroeconomic indicators such as inflation and per capita economic growth. After a spectacular rise during the 2012 security crisis, consumer prices for grains in constant value (Consumer Price Index) fell sharply. They have remained at much lower levels with a slight upward or downward trend and variations in time and space. The table below represents the evolution of the Price Index to Consumption of cereals. The economic context has been marked by positive growth in GDP per inhabitant moving at a slower pace. It favors improving food accessibility only in conditions where the benefits of economic growth are equitably distributed.

Figure 1: GDP per capita growth (annual %)



The average inflation rate is 4.1%. It is higher than the average annual price growth of 1.2%. This indicates that at a global level, access to cereals is improved by the expression of sufficient demand in consumer markets. This global situation does not reflect the reality of access to cereals in the region. There are some pockets of grain price inflation spread over time and space. Agricultural risks and insecurity have led to insufficient cereal supplies in some markets.

Cereal price inflation in the run-up to the 2012 crisis was observed in the Monimpébougou market for millet and sorghum, in the Niono and Bla markets for maize and in the Niono market for rice. In 2012, inflation spread to all consumer markets in the region with much higher price levels.

In the post-crisis period, the observed price inflation was low in a number of markets, namely: the markets of Monimpébougou, Macina, San, Niono in 2014 and Macina in 2015 for millet; the markets of Monimpébougou in 2014 and Ségou center in 2016 for sorghum, the markets of Bla in 2015, San, Bla and Niono and Niono in 2016 for corn, the markets of Niono, Monimpébougou in 2014, in all markets except at San in 2015 and San in 2016 for rice.

It remains to be seen which of the macroeconomic indicators between price inflation and economic growth is significant in improving food accessibility? This question is answered in the argument advocated by Sen (1981) stating that famines are mainly due to insufficient demand rather than a scarcity of food supplies. Equitable redistribution of the fruits of growth avoids the expression of insufficient demand and will best guarantee consumers' access to basic foodstuffs.

Table 1: Evolution of the annual growth rate of the cereals price index

	2011	2012	2013	2014	2015	2016	Average annual growth rate
Millet							
Ségou Centre	5	60	-39	0	-13	1	2,3
San	-6	50	-31	2	-13	-2	0
Bla	2	67	-48	-9	-6	0	1
Macina		58	-63	-8	6	-6	-2,2
Monimpébougou	22	92	-87	11	-14	-10	2,3
Niono	10	65	-46	2	-4	-12	2,5
Average							**1**
Sorghum							
Ségou Centre	6	53	-39	-1	-8	3	2,3
San	1	47	-38	-2	-4	-1	0,5
Bla	12	62	-59	-6	0	-6	0,5
Monimpébougou	40	116	-110	13	-14	-13	5,3
Niono	11	52	-42	0	-1	-7	2,2
Moyenne							**2,2**
Corn							
Ségou Centre	7	39	-28	-1	-6	2	2,2
San	0	32	-22	-15	0	9	0,7
Bla	13	41	-47	-15	3	6	0,2
Niono	17	29	-30	-10	1	2	1,5
Moyenne(en anglais							**1,1**
Rice							
Ségou Centre	5	9	-16	-7	14	0	0,8
San	-2	14	-12	-2	2	2	0,3
Bla	7	10	-15	-3	9	-4	0,7
Macina		-7	-12	0	12	-2	-1,5
Monimpébougou	1	5	-12	2	16	-10	0,3
Niono	13	4	-15	2	14	-5	2,2
Average							**0,5**
Total average							1,2
Inflation rate	12,2	5,5	0,7	1,6	2,8	1,5	4,1

Source: Authors from OMA data 2010 – 2017

- **Seasonality and dynamics of cereal flows**

In Mali, and particularly in the Ségou region, food is based on grains such as millet, sorghum, maize and rice. The flow volumes of these cereals are characterized by informal exchanges and are poorly known in a context of liberalization of the cereals market started since the 80s. It is well known that the solution to this problem is not the distant goal and difficulties to achieve flow estimation from monitoring methods. Then, the cointegration methods for agricultural markets, price, availability of information and the method of analyzing seasonal coefficients' differences were used.

The method used to analyze seasonal variation in coefficients used in this article, as in previous work (Temple et Dury, 2003), deals with the problem of agricultural flows differently. Unlike previous research, which is generally concerned with the comparative analysis of cereals according to the seasonal effect on their price, we have chosen to test the method of analyzing seasonal coefficient differences in the identification of the periods over which movements from one zone to another one, and to complete it by determining the order of importance of the availabilities of the different products on the same market.

Given that seasonal variation in agricultural prices plays a key role in movements between markets and within markets, the method used to analyze seasonal differences in seasonal coefficients is based on the principle that agricultural commodity flows start from a zone of low seasonal coefficient towards a zone of higher seasonal coefficient. As for the order of importance of supplies, products with lower seasonal coefficients are the most available.

The use of this method of seasonal variations implies the determination of the marketing axes on which the product flows evolve. The areas on which the analyzes focused, are those identified in the region of Ségou following the results of the study of rapid recognition of the marketing axes realized in 2011 by the Commissariat for Food Security (CSA) thanks to the support of USAID. These four (4) areas marketing axis of millet: San-Bla-Ségou, Bla-Ségou-Niono, Monimpébougou-Ségou, Monimpébougou-Niono, that of sorghum: Bla-Ségou-Niono, that of corn: San-Bla-Ségou and that of rice: Niono-Ségou-San. Figure 2 illustrates the marketing routes for millet.

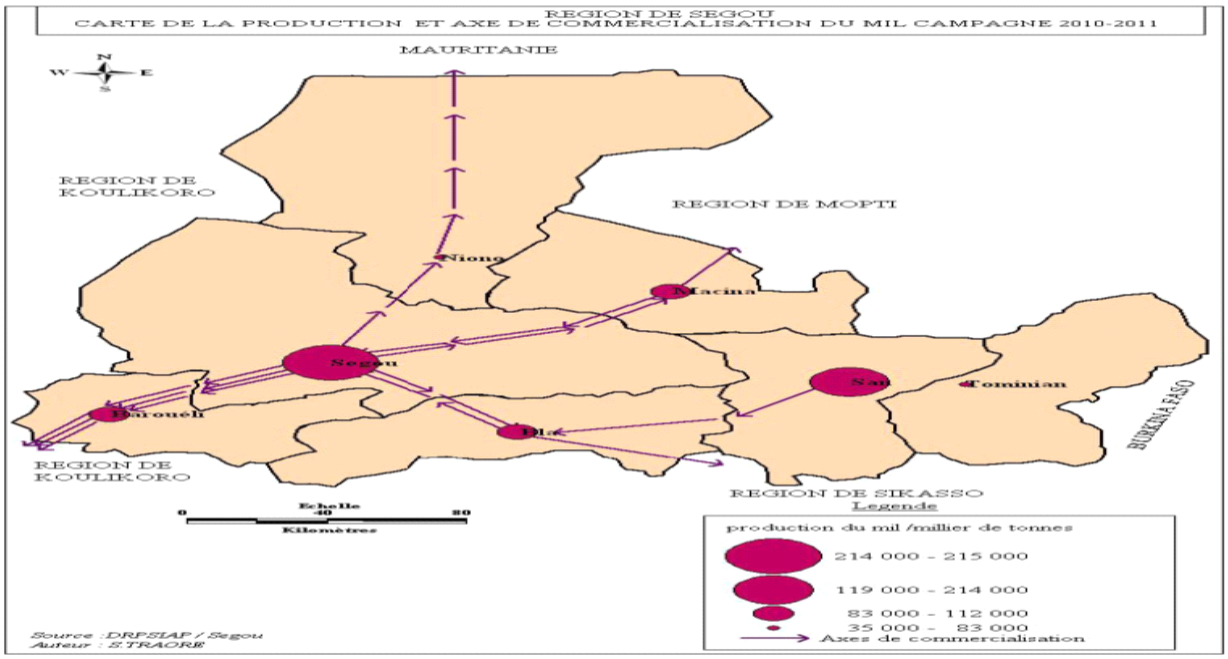


Figure 2: marketing routes for millet

Source: USAID-Mali, 2011

The extent of the seasonality of prices and its consequences on movements and the intensity of grain flows (millet, sorghum, maize, rice) in the Ségou region are examined on these marketing routes. The analyzed information is the monthly price series from the dataset of the Agricultural Market Observatory (AMO).

- **Seasonality of the price of millet**

Supply mainly from the millet market in the Ségou region is provided by the inter-river zone through the marketing routes San-Bla-Ségou, Bla-Ségou-Niono, Monimpébougou-Ségou and Monimpébougou-Niono. The price of millet begins its seasonal increase in January when its seasonal coefficient is at its lowest level. It peaks between the months of July and August. Seasonal differences in prices observed between markets located on these commercialization routes indicate the direction and periodicity of millet flows. The maximum variation in the seasonal coefficient of millet is 13%.

Figure 3: Evolution of the monthly seasonal gap in the price of millet: San-Bla-Ségou axis

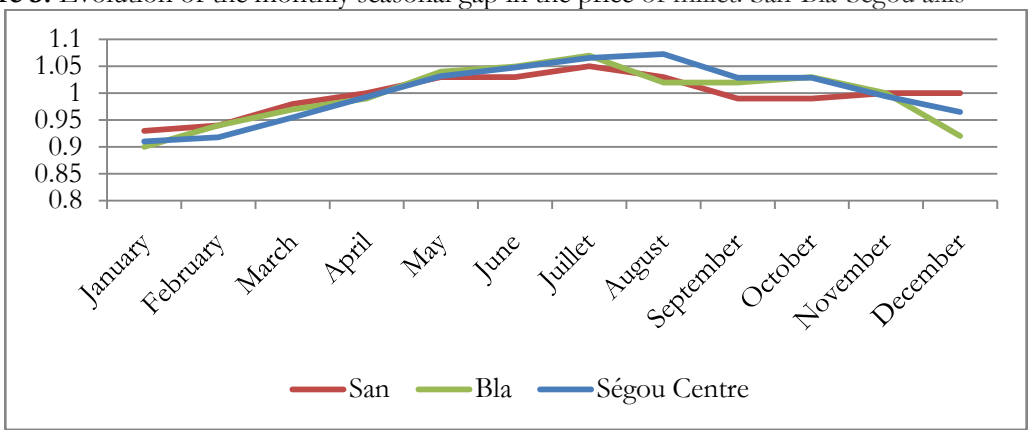


Figure 4: Evolution of the monthly seasonal gap in the price of millet: Bla-Ségou-Niono axis

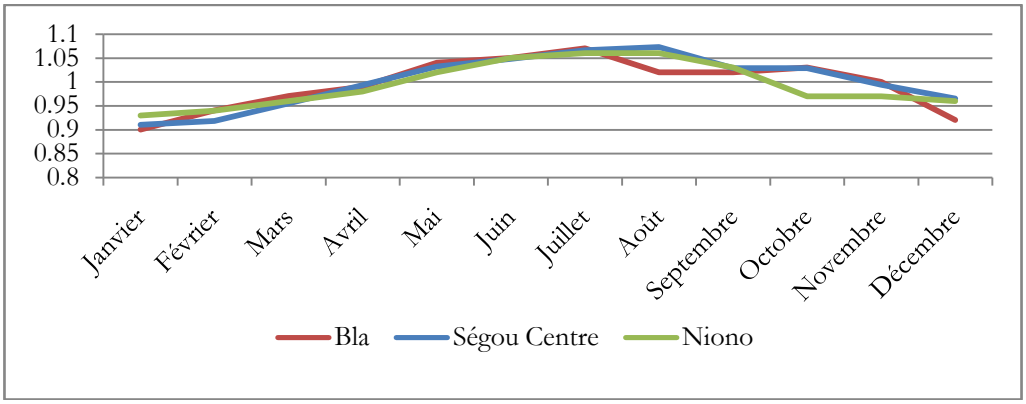


Figure 5: Evolution of the monthly seasonal gap in the price of millet: Monimpébougou-Ségou axis

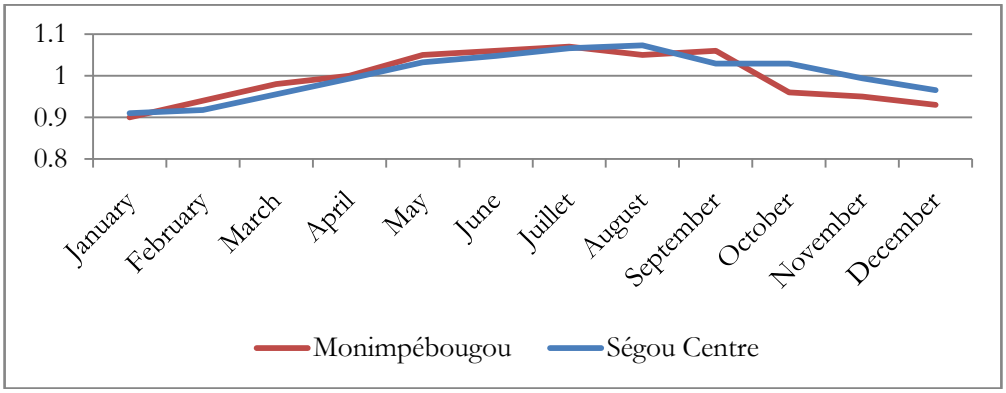
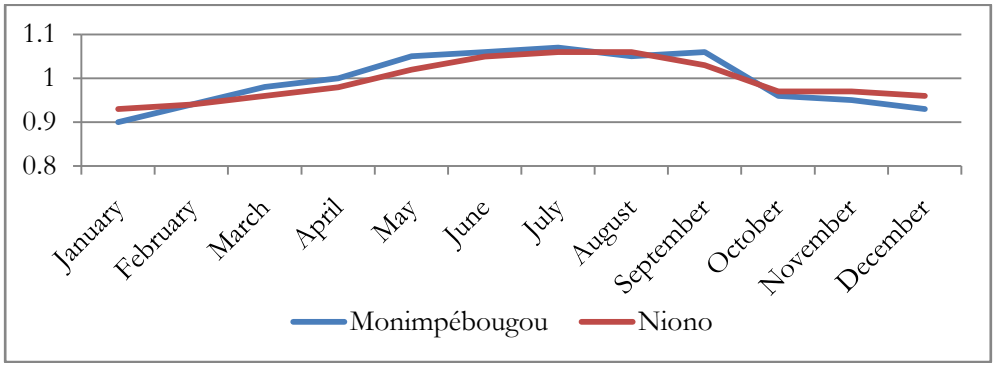


Figure 6: Evolution of the monthly seasonal gap in the price of millet: Monimpébougou-Niono axis



The seasonal coefficient on the San-Bla-Ségou axis has a minimum value of 0.91 and a maximum value of 1.073 or 16%. Seasonal price variations on this axis show a movement of marketed volumes of millet from the localities of San and Bla to the city of Ségou between the month of May and the month of November, from the locality of Bla to the city of Ségou between the month of July and the month of October.

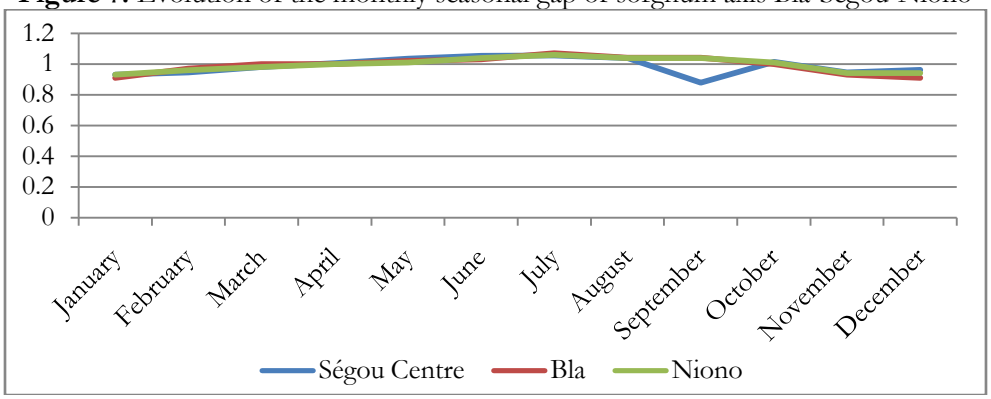
The seasonal coefficient on the Bla-Ségou-Niono axis has a minimum value of 0.9 and a maximum value of 1.073 or 17%. The seasonal variations result in a movement of marketed volumes of millet from the locality of Bla to the city of Ségou and the locality of Niono over the period between July and September and the period between the month November and January.

The seasonal coefficient is a minimum value of 0.9 and a maximum value of 1.07 or 17% on the Monimpébougou-Niono axis, a movement of marketed volumes of millet from Monimpébugou to the town of Niono in the period between October and February. On this axis, the amplitude of variation of the seasonal coefficient is a minimum value of 0.9 and a maximum value of 1.07 or 17%. The seasonal variations on the Monimpébougou-Ségou axis, result in a movement of marketed volumes of millet from the town of Monimpébugou to the city of Ségou between July and August and during the period between September and January.

- **Seasonality of the price of Sorghum**

The seasonal variations on the Bla-Ségou-Niono axis reflect a movement of marketed volumes of sorghum from Bla locality to the consumer markets of Ségou and Niono over the periods from October to January and from May to June. The seasonal coefficient has a minimum value of 0.88 and a maximum value of 1.04, with amplitude of 16%.

Figure 7: Evolution of the monthly seasonal gap of sorghum axis Bla-Ségou-Niono

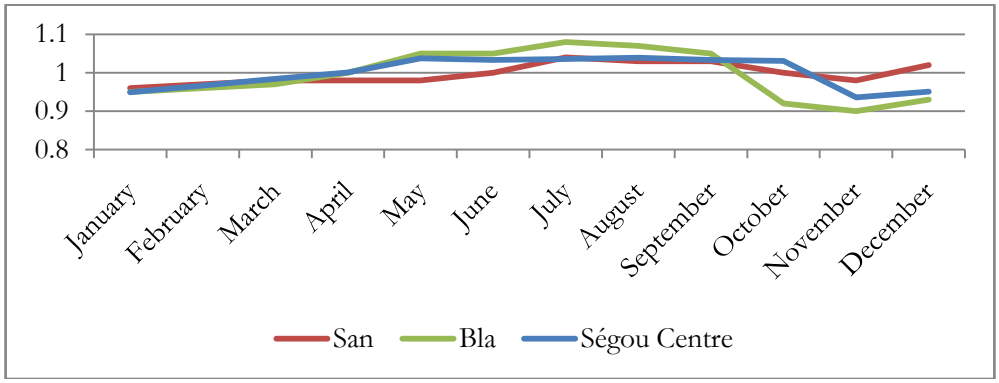


The above figures for millet and sorghum show that the seasonal coefficients of these two cereals on the markets located in the dry inter-river zone (San, Bla and Ségou) are lower during the lean season (June-September) and cereal harvest (September-February). Due to this relative weakness of the seasonal coefficient level, millet flows are moving towards the markets of irrigated crop areas (Ségou-Niono).

- **The seasonality of the price of maize**

Corn marketing takes place in the region of Ségou on the San-Bla-Ségou road. The seasonal coefficient hasa minimum value of 0.95 and a maximum value of 1.08 with a maximum amplitude of 13%.

Figure 8: Evolution of the monthly seasonal gap in the price of maize, San-Bla-Ségou axis



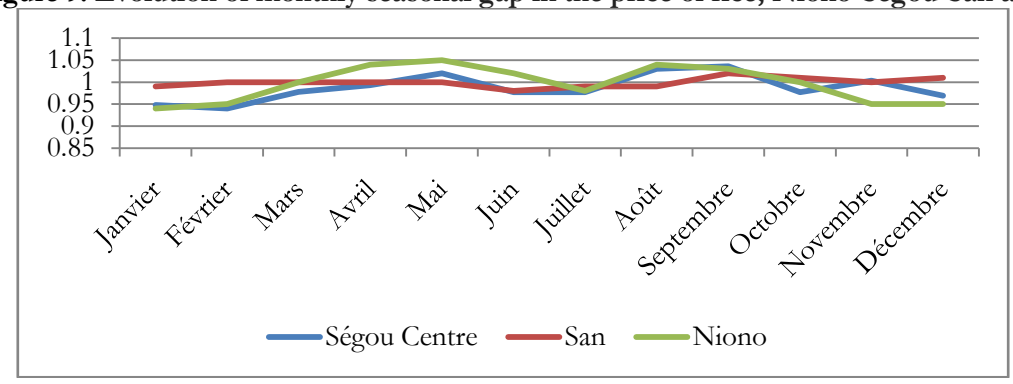
The observed seasonal price variations show that maize flows undergo a reversal depending on the production periods of cereals (September-March) and the welding period (March-September).

During the harvest period, the Bla market, located in the most important production area, has a lower seasonal coefficient, so it supplies the Ségou and San markets. During the lean season, the San market has a lower seasonality of maize and maize flows change direction and supply the Bla and Ségou markets. This inversion of maize flow is mainly linked to the evolution of supply and demand on the markets.

- **Seasonality of the price of rice**

The seasonal coefficient of rice is a minimum value of 0.5 and a maximum value of 0.94 or 11%. It is the weakest on the San market between April and June and between July and September, and on the Niono market between October and January. The Niono market supplies the Ségou market between October and January. It supplies that of San between the month of September and the month of March. There are two main marketing areas for rice, all of which originate in the production area of Office du Niger (Niono). One goes to the city of Ségou, the other goes to the city of San. Rice from Niono is re-exported to the northern areas of the country for the case of San and to Bamako for the case of Ségou.

Figure 9: Evolution of monthly seasonal gap in the price of rice, Niono-Ségou-San axis



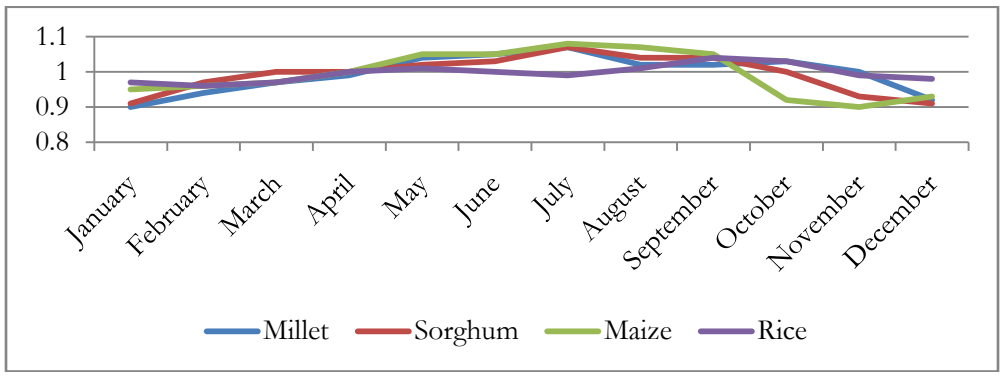
The results obtained indicate that grain flow movements are a function not only of the seasonality of production, but also of the relationship between supply and demand in the markets. They partially confirm the results of research on the seasonality of agricultural commodity prices in Africa, where the extent of cereal price seasonality is highest for maize (33.1 percent on average) and lowest for rice (16.6 percent) (Gilbert et al., 2017). In the Ségou region of Mali, millet is the cereal with the highest seasonal variation coefficient between markets at 17%. Millet is followed by sorghum with 16%, maize with 13% and rice with 11%. As for maize, contrary to the results of this research in Africa, the seasonal gap in its price ranks among the lowest compared to that of rice.

Two main reasons explain the small amplitude of variation of seasonal coefficients of maize and rice prices compared to other cereals in the region of Ségou. First, the seasonality of maize prices varies with the types and patterns of consumption of staple cereals in different localities on the African continent. Secondly, the national supply of rice from irrigated crop areas is reinforced by imports, off-season crops and the liberalization of peasant and commercial stocks at the beginning of the season, and corn by imports from neighboring countries.

The analysis of the two figures presented above shows that the regularity of cereal availability in almost all consumer markets in the Ségou region is mainly ensured by the flow of maize and rice. During the normal marketing period and the lean season (specifically between April and September), the availability of rice in the markets is the highest compared to the three other cereals (millet, sorghum and maize). This is due not only to increased availability of cereals through out-of-season rice harvests, but also to the release of rice stocks during the lean season when dry cereal stocks are depleted. This translates into a lower level of seasonal rice coefficient. In addition, between September and November, the lower level of seasonal maize coefficients means that market availability deficits for cereals are reinforced by the beginning corn harvests rather than those of other cereals. These corn harvests put an end to the lean season by filling the gaps in the availability of cereals on the markets. The case of the market of Bla, sufficiently illustrates the resolution of food deficits by the maize on all the markets of the region of Ségou. The regularity of cereal availability in almost all consumer markets in the Ségou region is mainly ensured by the flow of maize and rice.

During the normal marketing period and the lean season (specifically between April and September), the availability of rice on the markets is the largest compared to the three other cereals (millet, sorghum and maize). This is due not only to increased availability of cereals through out-of-season rice harvests, but also to the release of rice stocks during the lean season when dry cereal stocks are depleted. This results in a lower level of seasonal coefficient of rice price.

Figure 10: Seasonal gap in prices between cereals on the Bla market



6.2 Measurement of price instability in cereals

Table 2 analyzes the level of grain price instability, measured by the percentage weight (%) of the Variation Coefficient (VC) of the random component in that of the raw series.

Tableau 2: Coefficient of variation of millet price

Markets % VC Series Alea in VC Series Brute	**Ségou**	**San**	**Bla**	**Niono**	**Macina**	**Monimpebougou**
Millet	**0,95**	**0,94**	**0,95**	**1**	**0,83**	**0,97**
Sorghum	**1**	**0,94**	**0,91**	**0,95**	**-**	**0,97**
Maize	**0,93**	**0,93**	**0,86**	**1,06**	**-**	**-**
Rice	**0,1**	**1**	**1**	**0,89**	**0,89**	**0,9**

Source: Authors from OMA data 2010 - 2017

It appears that the differences between the instability of the total price series and the instability of the irregular price series are relatively small. That is, dry cereal (millet, sorghum and maize) and rice (irrigated) prices are generally less volatile in the Ségou region.

The results obtained do not contradict the fact that the results of previous work in Africa largely attribute the low levels of rice price volatility in Mali (7% to 8%) compared to maize in Zambia, less exposure to climatic hazards, the majority of rice production coming from water-control systems (Géronimi et Maître d'Hôtel, 2012). In fact, in the Ségou region of Mali, off-season rice stocks and harvests from irrigated areas (Office du Niger) and maize harvests in September, strengthen the availability of cereals on the markets by stabilizing prices of cereals. The exceptional instability of the price observed on the rice market in Ségou cannot be other than the result of strong speculations on the part of the actors.

7. Conclusion and recommendations

The objective of this paper is to analyze the instability of cereal crops' prices in the Ségou region in a context of food insecurity. Specifically, it focuses on the analysis of price instability and consumer accessibility to main crops (millet, sorghum, maize and rice) and on the analysis of the dynamics of flows on the basis of extent of price seasonality. That by using data from the Agricultural Market Observatory (AMO), which cover the period from January 2010 to July 2017.

Overall, the results show that there is better access to cereals in grain markets with some pockets of price inflation distributed over time and space. In order to ensure regular access to cereals in the region, it is important to ensure a better distribution of the benefits of growth in the country. Crops grain flow are a function of the seasonality of production and demand onmarkets. They confirm the results of research on the seasonality of agricultural commodity prices in Africa, where the seasonality of cereal grain prices is highest for maize (33.1 percent on average) and lower for rice (16.6 percent on average) (Gilbert et al., 2017). In Ségou region, millet is the cereal with the highest seasonal variation coefficient across markets at 17%. Millet is followed by sorghum with 16%, maize with 13% and rice with 11%. As for maize, contrary to the results of this research in Africa, the seasonal gap in its price ranks among the lowest compared to that of rice. Two main reasons explain the small amplitude of variation of seasonal coefficients of maize and rice prices compared to other cereals in the region of Ségou. First, the seasonality of maize prices varies with the types and patterns of consumption of main cereals in different localities on the African continent. Secondly, the national supply of rice from irrigated crop areas is reinforced by imports, off-season crops and the liberalization of peasant's stocks and commercial at the beginning of the season, and that of corn by imports from neighboring countries.

To the extent of instability, it appears that cereal prices (millet, sorghum, maize, rice) are less volatile in the Ségou region. This low instability does not necessarily translate into better accessibility by consumers. Conditions for a fair redistribution of the fruits of growth must be met in order to raise the level of demand and best guarantee consumer access to basic foodstuffs.

The regularity of cereal availability in almost all consumer markets in the Ségou region is mainly ensured by the flow of maize and rice. During the normal marketing period and the lean season (specifically between April and September), the availability of rice on the markets is the largest compared to the three other cereals (millet, sorghum, maize). This is due not only to increased availability of cereals through out-of-season rice harvests, but also to the release of rice stocks during the lean season when dry cereal stocks are depleted. This translates into a lower level of seasonal coefficient of rice.

We can therefore say that the availability and accessibility of cereals in the Ségou region is tainted by pockets of cereal price inflation whose causes can be attributed to political instability, the security situation and unequal distribution fruits of the country's economic growth.

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