International Journal of Economics, Commerce and Management
United Kingdom Vol. VI, Issue 12, December 2018
http://ijecm.co.uk/ ISSN 2348 0386

DETERMINANTS OF THE RICE IMPORT BILL IN BURKINA FASO

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Abstract

Income, price, exchange rate and domestic production are the main variables usually used to estimate the import function. The potential effects of demographic variables are not taken into account in the explanation of imports. The objective of this article is to determine the economic and demographic factors that lead to the rise of the rice import bill in Burkina Faso. To achieve this objective, a vector error-correction model (VEC) was estimated. The results highlight mainly urban population growth and insufficient domestic production as the main factors driving the rise in the import bill.

Keywords: Rice, Import bill, Vector error-correction model, Burkina Faso

INTRODUCTION

Sahelian and essentially agricultural country, Burkina Faso still faces the permanent challenge of sustainable food and nutrition security. The country's agriculture is mainly based on rainfed cereals, which annually occupy more than 88% of the areas sown. Despite the commitments made at major international summits and the implementation of a number of policies and strategies to improve agricultural production, the country still faces a real challenge to ensure the food security of its population, which has led to an increase in food import demand that has been steadily increasing over the last two decades. In fact, the country's overall imports increased from 652.8 billion in 2009 to 1,658.8 billion in 2014. The analysis of the import structure shows that foodstuffs occupy the 4th place after fuels, rolling stock and pharmaceutical products.

This heavy food dependency contributes not only economically to widen the structural deficit of the country's trade balance, but also to accentuate the precariousness at the social level as evidenced by the 2008 hunger riots.

It should be noted that the economic and institutional reforms initiated in the early 1990s (including the devaluation of the CFA franc) to improve the competitiveness of the country's economy by boosting exports did not reverse the rampant trend of imports. In view of the increase in the rice import bill in a context of high population growth and accelerated urbanization, it is pertinent to question the explanatory factors of the rice import bill.

This study aims to answer this question by looking for explanatory factors of the rice import bill. This research will help formulating relevant economic policy recommendations for agricultural development in line with the National Social and Economic Development Plan (PNDES). Specifically, it will (i) analyze the rice import bill change (ii) determine the explanatory factors of rice imports in Burkina Faso.

In order to meet the objectives of the study, this article will be structured in three parts. The first presents the data and methodology used. The second part is a synthesis of the literature review. The third part gives the results of the study.

LITERATURE REVIEW

Theoretical aspects

The determination of prices and trade volumes derives from the general theory of demand and production. Specifically, the analysis of imports in the literature is dominated by two general models: the perfect substitute model and the imperfect substitute model. In these models, price and national income are key variables in the import demand function. In addition to these two basic models, important developments have been made in the search for determinants of the import demand function.

Monetarists consider that national expenditure can be related to the difference between current and actual monetary compensations. According to monetarists, national expenditure assumes the role of money in trade and payments balance adjustments. As a result, they estimate that instead of national income, it is rather national expenditure that would be more important for import demand (Aghveli and Khan, 1980).

Pilbeam (1998), Collier and Gunning (1991), continue to follow the idea that exchange rate policies (especially devaluation for developing countries) play a key role in import determinants. They highlight the relevance of the change rate in the import demand estimate.

Given the fact that imports involve necessarily the rest of the world, Polak and Rhomberg (1962) have highlighted the relevance of introducing the external constraints as import determinants. This external constraint includes the capacity of the country to cover its import demand by exports.

Like most macroeconomic variables, import demand may depend on its own past behavior. To account for this situation, adjustment mechanisms taking into account lagged variables were introduced into analysis models of the import function determinants (Koyck (1954).

These theoretical developments served as a basis for the realization of various empirical studies. The main empirical work on the import determinants in developing countries, which can serve as a guideline for this work, should therefore be examined.

Empirical studies

Urbain (1990) sets the objective of empirical modeling of aggregate imports from two open European economies, namely Belgium and the Netherlands. He uses an error-correction model and shows that income elasticity is more important in the long term for Belgium, while the opposite is observed for the Netherlands. He also accepts the hypothesis of price effects symmetry in the long term.

Capet et al (1993) attempt to propose imports and exports equations for manufactured goods by volume, using recent developments in the econometrics of nonstationary variables. Like Urbain, they consider an error-correction model according to Johasen's approach. They find that the growth rate of imports is therefore explained by past import growth rates, present and past growth rates of the explanatory variables and the deviation with the long-term targets of the previous period.

Hervé (2001) uses panel data to estimate an econometric model and calculate the trade elasticities of 17 industrialized countries. These results indicate that short-term import elasticities of all countries have the expected sign and are all above 1 with the exception of Japan. An acceleration of national activity leads in all countries, except Japan, to a significant rise in imports in the short term. With the exception of Italy's and Ireland's consistent elasticities, and Japan's inconsistent theory, the price elasticities of imports are statistically not different from zero for the other countries.

Kombaté et al (2010) use the linear approximation of the Almost Ideal Demand System (LA / AIDS) model to estimate the demand for rice (local rice and imported rice) in Togo using data from 1986 to 2006. They estimate the linear approximation parameters of the LA / AIDS model using an error-correction model. The results of their short- and long-term estimates indicate that an increase in income results in a more than proportionate increase in each demand for these goods. These results also show that imported rice is very sensitive to variations in its own price in both the short and the long term, since its demand falls sharply when prices rise. These results are very interesting but the fact of having considered only the price and the income in the estimate of the demand function could be seen as a limit of their work.

RESEARCH METHODOLOGY

Data source

The data come from the FAOSTAT databases, the World Bank, the National Institute of Statistics and Demography, the Directorate General of Studies and Sector Statistics of the Ministry of Agriculture and Hydraulic Development.

These data are collected annually by these institutions and cover the period from 1965 to 2014. This time period is sufficiently long and the number of years of observation makes it possible to guarantee a better accuracy of the estimators, to reduce the risks of multi-collinearity and specially to widen the field of investigation. It allows to have the three effects constituting a time series:

- A long-term effect, called trend (we sometimes add long-term), trend component or trend;
- A so-called seasonal effect, which reappears at regular intervals; this effect is reflected in a component of the series called seasonal component.
- An unexplained effect: this effect, which is generally assumed to be due to chance, is manifested by accidental variations.

Variables of the study

Apart from the estimated rice import price, all the variables are contained in the databases of the above-mentioned institutions. Table 1 presents the variables used and their sources.

Table 1: Synthesis of the variables of the study

Variables	Name	Sources
Imp_riz	Rice import	FAOSTAT and INSD
Te	Change rate ($/CFA)	World Bank
Open	Opening level	World Bank
Pop_ur	Urban population	INSD
Rev	Income per capita	World Bank
Prix_m	Import price	Calculated from FAOSTAT
Prod_riz	Rice production	DGESS/MAAH

Source: Compiled by Authors

Analysis tools

To analyze the determinants of the rice import bill change in Burkina Faso, two (2) models will be used.

The vector error-correction model (analysis model of explanatory factors for rice imports)

This model is reputed in the analysis of the dynamic links between a group of variables chosen to characterize an economic phenomenon. Moreover, the use of this model could permit to understand not only the effects of a shock related to a variable (eg rice production) on its own values and on the rest of the system (on all the other variables of the model), by analyzing impulse response functions and causality. To determine the explanatory factors of the rice import bill, let's consider:

Y_t'= $(Imp\_riz_t, Prod\_riz_t, Prix\_riz_t, Pop\_ur_t, Open_t, Rev_t)$ the transpose of the vector of endogenous variables of dimension (6, 1). We say that Y_t follows a VAR(p) where p is the optimal lag length, the order of the VAR, if there are matrices denoted A_i , $i = 1,..,p$ and a vector ε of dimension (6,1) following a white noise that is to say of null average and constant variance such as $Y\_t = C + \sum\_(i = 1)\hat{}p\ A\_i * Y\_(t - i) + \varepsilon_t$

Where, C is a constant of (6, 1) format.

In the formulation of our model, we consider the variable "anne_1972" as exogenous variable to isolate the specific effect of that observable year on graph 1.

$Anne_{1972} = 1\ if the\ year\ is\ 1972\ and\ 0\ otherwise$,

The interest of this approach is to avoid that the very atypical value observed in 1972 disrupts the estimates. The formula of our model becomes:

$Y\_t = C + \sum\_(i = 1)\hat{}p\ A\_i * Y\_(t - i) + anne\_1972_t + \varepsilon_t$

Where, Imp_riz_t: the logarithm of rice imports in Burkina Faso at date t.

$Prod\_riz_{t-1}$: The logarithm of national rice production at date t-1;

$Prix\_riz_t$: The logarithm of the rice import price at date t.

Rev_t : The logarithm of the national available income per capita at date t.

Pop_u_t : The logarithm of the urban population at date t.

$Open_{t:}$ The logarithm of the sum of imports and exports relative to GDP at date t.

ε_t : The error term.

The modeling of the VAR model (VEC if there is a co-integration between the variables) consists mainly of six (6) stages that are: stationarity tests, the determination of the optimal lag length, the co-integration tests, the estimation of the model, the diagnostic tests on the model residues and finally the analysis of the causality.

Box-Jenkins forecasting model

In a second step, the Box-Jenkins modeling will permit to obtain the model (the theoretical process) which best generates the rice import bills by 2025. This modeling is adapted to develop a model permitting to represent a chronic with as a goal of predicting future values based on past and present values.

Let X_t be a variable for which we want to find the process generating the data. On the basis of Box-Jenkins modeling, the model is formulated as follow:

$\Delta^d X_t = \sum_{i=1}^{p} \Delta^d \theta_i * X_{t-i} + \sum_{j=1}^{q} \varphi_j * \varepsilon_{t-j}$ With ε_t a Gaussian white noise. The X_t process is said to be an $ARIMA(p,d,q)$ where d is the differentiation order of the X_t series, p and q the optimal lag length to introduce respectively in the autoregressive (AR) and mobile average (MA) part.

From this process which traces the observations, forecasts are made on the basis of this model. The modeling steps include (i) the stationarity analysis (ii) the prior identification (iii) the estimation (iv) the verification (v) the choice of the model and (vi) the forecast from the model selected. These steps were followed to forecast the rice import bill.

RESULTS AND DISCUSSIONS

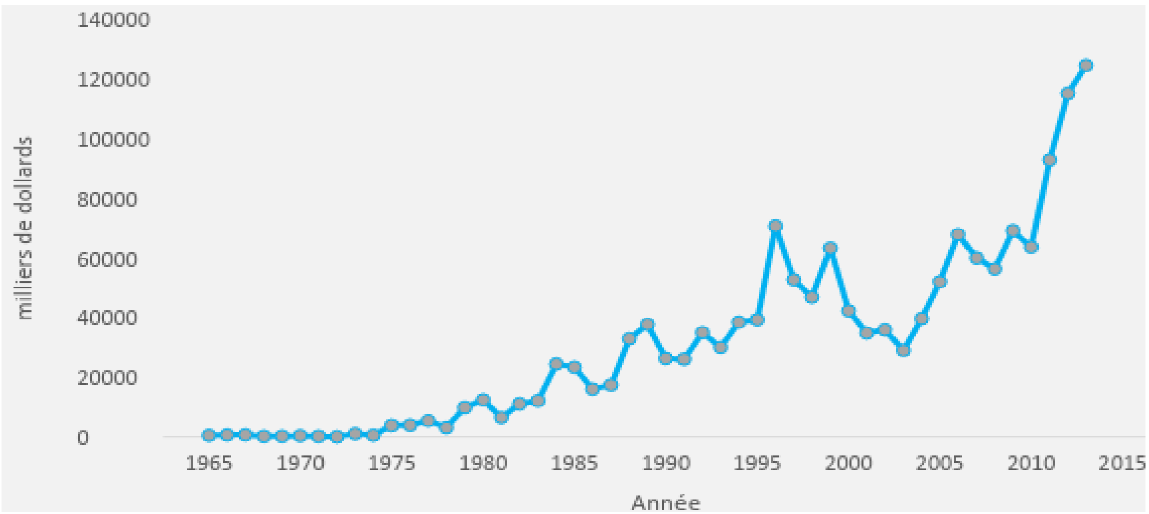
This section presents the empirical results of the analysis of the rice import bill change as well as the explanatory factors for this change. It also gives the level of the rice import bill by 2025.

Rice import bill change and forecast by 2025

Rice import bill change between 1965 and 2013

Figure 1 shows the change in the rice import bill from 1965 to 2013. Four (4) phases emerge during this period. The first phase is essentially characterized by a relatively stable level of the rice import bill until 1974. The second phase, on the other hand, shows an upward fluctuation during the period from 1975 to 1995. The third phase (1995 to 2002) would be affected by the devaluation of FCFA in 1994. The 2003-2013 period is marked by peaks and troughs in the rice import bill. The trough of 2009 would be the effect of food policy reforms in the aftermath of the 2008 food crisis and the numerous projects and programs initiated for the development of the rice sector. These include measures to subsidize inputs (seeds and fertilizers) by the Government and accelerate development to increase rice production.

Figure 1 : Food import bills in thousands of US dollars



Source: Compiled by the author, 2016

Rice import bill forecast by 2025

The descriptive analysis showed an upward trend in the rice import bill; it is necessary to wonder about the change in the rice import bill by 2025. The results of the rice import bill forecast for 2025 are shown in Table 2. It appears that the rice import bill would rise from less than US $ 100 million in 2014 to about US $ 216 million. (About 107 billion FCFA) by 2025, an increase of 92%.

Table 2: Results of the rice import bill forecast

Années	Rice import (in $ thousands)	Import rice (tons)
2017	134102,563	443 531
2018	142317,875	470 709
2019	151036,394	499 553
2020	160288,957	530 164
2021	170108,287	562 651

Table 2...

2022	180529,112	597 128
2023	191588,283	633 719
2024	203324,912	672 551
2025	215780,501	713 763

Source: Compiled by the author on the basis of FAO-STAT data

Analysis of rice import determinants

The analysis of rice imports determinants is done using a vector error-correction model (VEC) and permits to highlight the most significant factors in the explanation of rice imports. These factors have been grouped into two categories: demographic factors (urban population) and economic factors (the available income per capita, imports, rice import price, domestic rice production, opening level of the economy).

Stationarity study of variables

The strategy for building the relationship that best models rice imports involves studying the stationarity of the variables in order to avoid fallacious regressions. To test the stationarity of the variables, we first used an ADF (Augmented Dickey-Fuller) test strategy which consists in testing the presence of unit root in the series conditionally to different specifications (presence of trend, presence of constant and neither of them). Only the best model for testing the presence of unit root is retained for the final evaluation. The choice of the lag length to be retained in the test equation is based on the Aikake Information Criterion (AIC) and the Bayesian Information Criterion (BIC). In a practical way, we proceeded parsimoniously, retaining the criterion which gives us the least number of lag to be retained in the test. In a second step, we tested Kwiatkowski-Phillips-Schmidt-Shin (KPSS) and Philips Perron (PP) on the basis of the number of lag and the specification for the corresponding ADF test.

Table 3: Stationarity test

Variable	ADF	PP	KPSS	Decision
Log(Imp_riz)	I(1)	I(1)	I(0)	I(1)
Log(Prod_riz)	I(1)	I(1)	I(0)	I(1)
Log(Open)	I(1)	I(1)	I(0)	I(1)
Log(Rev)	I(1)	I(1)	I(0)	I(1)
Log(Pop_u)	I(0)	I(2)	I(0)	I(0)
Log(Prix_m)	I(0)	I(0)	I(0)	I(0)

Source: Compiled by the author

The result of the tests indicates that the logarithm of the urban population and the logarithm of the rice import price are stationary that is to say integrated of order 0. The rest of the variables of the model are integrated of order 1. This result implies that there may be a co-integration relationship between the variables we are going to check.

Analysis of the co-integration

The co-integration analysis aims to verify the existence of a long-term relationship between the series studied. Engle and Granger (1987) were the first to introduce the notion of co-integration into time series analysis. Their approach, which includes shortcomings, has been improved by Stock (1987); Banerjee et al (1993). Like the Engle and Granger approach, the latter also have limits because they do not permit to take into account several co-integration relationships. To overcome these shortcomings, Johansen (1988) proposed a multivariate version of the co-integration test. However, one of the necessary conditions for using the Johansen test is that all variables in the model are integrated in the same order. This test is not applicable to our situation because the series we analyze have different integration orders (see stationarity test). For our situation, the test of Pesaran et al (2001) which is a more general method than that of Johansen is adapted. Indeed, to perform this test, series are no longer required to be integrated of the same order. Just make sure of the integration of the explained variable. In addition, this test has good properties for small size (Narayan and Peng (2007) referred to by Esso (2009)) samples as the case of our study (36 observations, and the explained variable is integrated of order 1). But before that, we will determine the optimal lag length. The following table 4 shows that the optimal lag length to introduce into the VAR is 2.

Table 4: Choice of the optimal lag length

Lag	LR	AIC	SC	HQ
0	NA	0,713687	1,181487	0,890469
1	489,2549	-10,01769	-8,146485*	-9,310556
2	94,41162*	-11,29450*	-8,019897	-10,05702*

Source: Compiled by the author

* indicates the order of the lag length selected by the criterion

LR: value of the LR-test statistic (at the 5% threshold)

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

The performance of the Pesaran test is nothing more than that of the Wald or Fisher test under the assumption of no co-integration. Given the small size of our sample and in view of the fact that the critical values provided by Pesaran are calculated on the basis of large sample sizes of 500 to 1000 observations and 2000 and 40000 observations, we will use the critical values provided by Narayan (2005). In fact, he has produced a new set of critical values ranging from 30 to 80 observations including the size of our sample.

The following table 5 gives the result of the test and shows that the statistical F is greater than the critical value greater than the threshold of 5%. As a result, we reject the hypothesis of no co-integrating relationship.

Table 5: Pesaran co-integration test (2001)

	Critical value at 5% (Critère de AKAIKE)	
Fstat	Inferior	Superior
18,822	3,47	5,85

Source: Compiled by the author

Results of the estimates

The model on which the Pesaran procedure is based on a number of hypotheses of which the most problematic is that the error terms follow Gaussian white noise processes of null average and constant variance. It is therefore necessary to carry out diagnostic tests on residues. These tests are a means of detecting the possible failure of certain assumptions made during the estimation of the model. The adopted specification is globally satisfactory. The tests reveal no major problems.

The Jarque-Bera test shows that the assumption of residues normality is accepted ($jarque - bera =$ 3,773343 and $p - value$ =0, 1515).

The homoscedasticity is accepted by the Breusch-Pagan-Godfey test ($= 1{,}310477$ and $p - value =$ $0{,}2635$) and confirmed by that of white at 5% threshold (χ^2 = 550,6308 and $p - value = 0{,}6812$).

The absence of autocorrelation is accepted by the Lagrange multiplier test of Breusch-Godfrey ($LM(1) = 44{,}69474$ and $-value = 0{,}1517$; $LM(2) = 31{,}45680$ and $p - value =$ $0{,}6845$).

The model is well specified in terms of Ramsey's good specification test ($Fstat =$ $0{,}087990$ and $p - value =$ $0{,}7697$). Estimated relationships are generally stable based on CUSUM and CUSUM squared tests.

The results of the estimates can therefore be interpreted. According to these results, there is a long-term relationship between imports, world rice price, opening level, rice production, income per capita and urban population. This long-term relationship is given by the following equation:

$$log\ log\ (imp_{riz}) = 2{,}26 *log\ log\ (open)\ + 2{,}96 *log\ log\ (pop_u)\ + 1{,}27 *log\ log\ (prix_m)\ -\ 0{,}45 * log\ log\ (prod_{riz})\ - 5{,}85 *log\ log\ (rev)\ + 9{,}76$$

This relationship is significant because the recall force, that is, the coefficient associated with imp_riz (-0, 98 between -1 and 0) in the vector plan containing the six variables is significantly negative ($t - stat = -8{,}26$). This recall force in absolute value indicates the speed of adjustment between the variables of the model towards the relation of long term. Any deviation of a variable from its long-term equilibrium value would be corrected by the error correction mechanism with a shock resorption speed of | -0.98 |. The inverse of this adjustment speed permits to estimate the time necessary to reduce the imbalances between the variables of the model and to return to the long-run equilibrium. Thus, at most two years are enough for an observed imbalance to return to the long-term equilibrium.

The analysis of the long-term relationship indicates that a 1% increase in the urban population leads to a 2.96% increase in rice imports at the 5% threshold. This positive effect of the urban population on the import bill is also observable in the short term but with a risk of 10%. Urbanization is often accompanied by increased consumption of out-of-home foods, a trend that boosts rice consumption due to ease of storage, preparation and cooking (AfricaRice, 2012). Also, urban populations, in addition to being large consumers of rice, are demanding on the quality of rice consumed; a growth in urbanization would increase the demand for imported rice, which they consider to be of better quality than domestic rice.

The opening level has a positive effect on the rice import bill, at the 5% long-term and the 10% short-term threshold. In the long term, a 1% increase in the sum recorded in the export and import GDP (opening level), rice imports will increase by 2.26%.

Regarding the rice import price, it has a positive long-term and short-term effect on the rice import bill at the risk of 5%. A 1% increase in the world price of rice leads in the long term to an increase in rice imports by 1.27%. This would mean that the volume of rice imports is not sensitive to the world rice price.

Any increase in the world rice price leads as for the same import volumes, to the proportional increase in the rice import bill. On the other hand, income produces similar effects in the long term and in the short term at the risk of 5%.

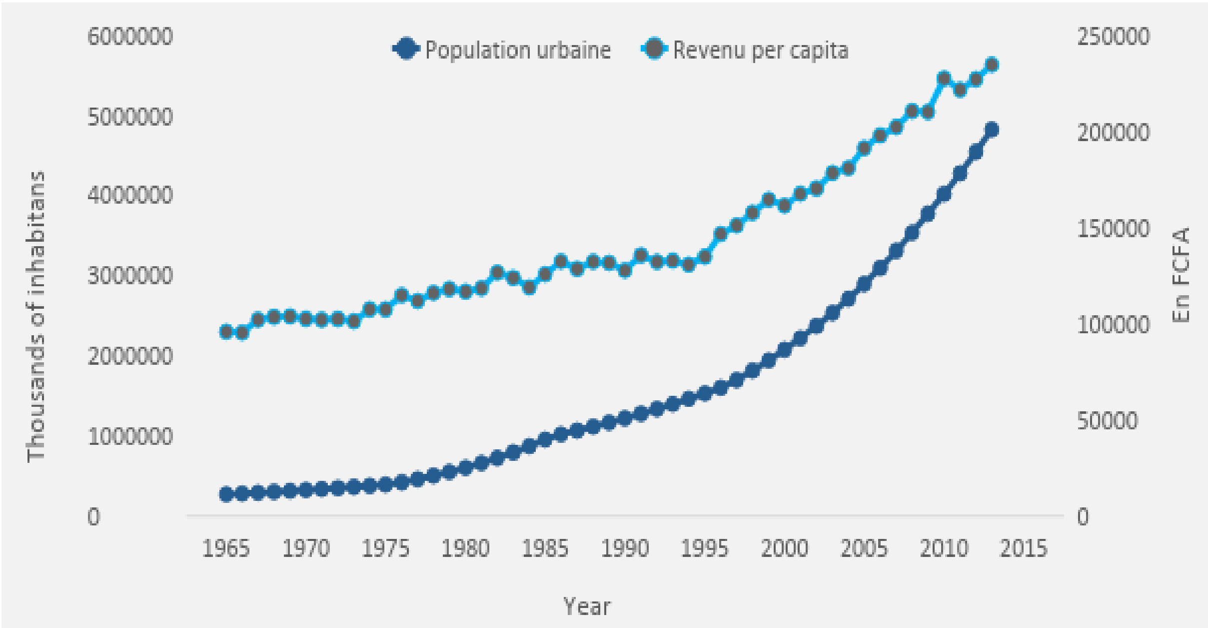
In the long term, a 1% increase in income per capita reduces rice imports by 5.85%. Household consumption surveys have shown that compared to high-income families, mostly urban consumers with the lowest incomes are more likely to spend a large part of their total budget on rice purchases (AfricaRice, 2012). The rise in the income per capita by expanding the group of high-income households, reduces rice imports through the reduction of their budget for rice purchases.

For rice production, it has a negative but not significant effect on the long-term and short-term rice import bill. Otherwise, a rise in domestic rice production does not have a statistically significant effect on the rice import bill. This paradox can be explained by the fact that the level of domestic production is very low so that, despite an improvement in the latter, populations continue to import. However, the analysis of impulse response functions shows that an orthogonal shock on rice production causes a permanent negative effect from the following year of rice production.

Change in the major explanatory factors of the rice import bill in Burkina Faso

Figure 2 illustrates the change in population and the income per capita (in FCFA). Despite the ups and downs in rice import bills, the urban population and income per capita evolved in increasing during the period 1965-2013. There is an exponential growth of the urban population since 1986. The correlation matrix shows a significantly positive correlation between the rice import bill and the urban / income per capita.

Figure 2: Urban population and income per capita (in FCFA)

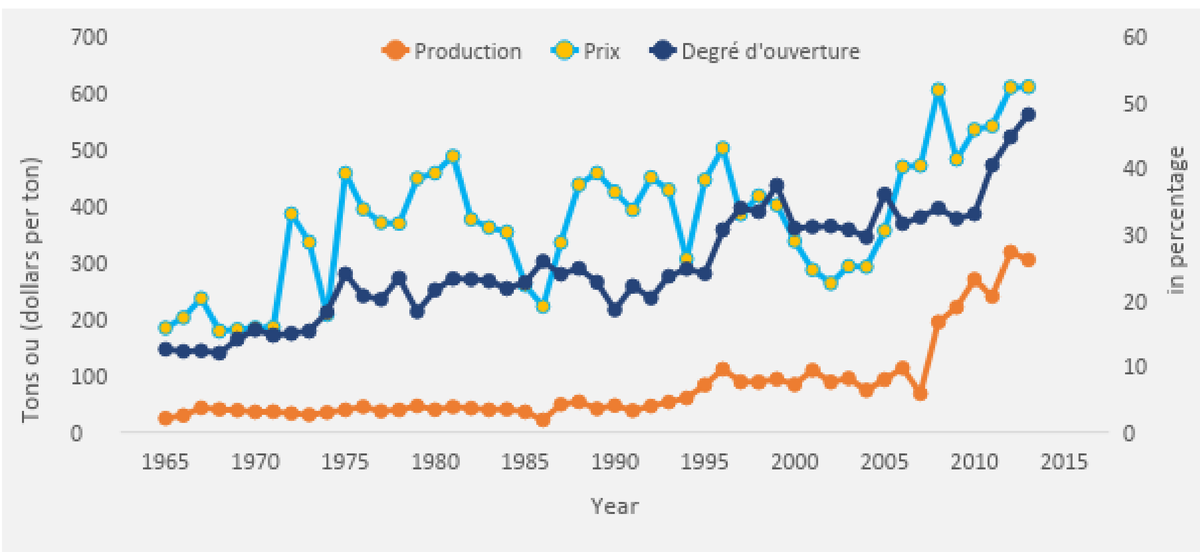


Source: Compiled by the author

Figure 3 shows the change in rice production (in thousands of tons), the import price of rice (dollars / ton) and the opening level of the Burkinabe economy. Examination of this shows that rice production remained stagnant during the period 1965-1985. Starting in 1986, rice production began to grow steadily until 1996, followed by a slight high fluctuation up to 2007. However, from 2008, a relatively strong growth in rice production is noted but insufficient to reduce the import bills. Although it is noted a stable trend in rice import price, it has strongly fluctuated over the years. The highest levels are observed in 1981 and 2008 where the import price has reached US $417 /ton. As for the lowest levels, they are recorded during the period 1968-1971 (less than 138 dollars/ton)

Figure 3 illustrates also the increasing opening of the Burkinabe economy, between years 1990-2013. During this period, the size of the international trade (import-export) in the economic activity did not stop growing.

Figure 3: Rice production in ton, rice price at import in $/ton and opening level



Source: Compiled by the author

CONCLUSION

The objective of this study is to know the explanatory factors of the change in the rice import bill by highlighting the role of urbanization over the period 1965 to 2013. Initially, a vector error-correction model is used to determine the explanatory factors of the rice import bill. The analysis of the long-term relationship indicates that a 1% increase in the urban population leads to a 2.96% increase in rice imports at the 5% threshold. This positive effect of the urban population on the import bill is also observable in the short term but with a risk of 10%. Thus a growth of urbanization would increase the demand for imported rice, which they consider to be of better quality than domestic rice. The opening level also has a positive effect on the rice import bill, at the 5% long-term and the 10% short-term threshold. The import rice price has a positive long-term and short-term effect on the rice import bill at 5% threshold. The income produces similar effects in the long term and in the short term at the risk of 5%.

The results of the application of the Box-Jenkins forecasting method indicate that the import bill will have an upward trend and could reach 107 billion FCFA by 2025. This perspective of the rice import bill change shows the need to accelerate the growth of domestic production by developing the existing potential. As a result, continued research on local rice production and promotion programs are needed to meet the growing needs of the population and reduce the cost of rice imports. Possibilities exist in the improvement of the technical itineraries and the varietal improvement.

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