Relationship between the price of oil and the cost of living in Cameroon, Ivory Coast and Senegal: a modeling with variable coefficients

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Abstract

The economy is generally sensitive to changes in the price of oil. A rise of the price of oil can lead to generalized inflation, which has a negative impact on our economies. In the beginning of year 2008, the increase of oil price has resulted in a high cost of living in some major cities in Africa especially Douala, Yaounde, Abidjan and Dakar, and was the cause of social unrest in those cities. Further to this social unrest, the Government of Cameroon, for example, has decided to subsidize the price of fuel at the pump. Since then, this subsidy weighs more and more on the budget of the State of Cameroon. Over the period from 2008 to 2011, this bill was 700 billion CFA francs, digging further public deficit, and it was estimated only for year 2012 to 400 billion CFA francs. The present paper analyses the relationship between the price of oil and the cost of living in Cameroon, Ivory Coast and Senegal in other to assess the relevance of the policy of subsidizing the price of fuel at the pump in these countries.

The methodology used is the cointegration with structural change developed by Gregory and Hansen (1996). The state-space representation applying a Kalman filter allows to confirm the instability of this relation and to determine the sources of this variability. The cost of living is apprehended by the Consumer Price Indice (CPI).

The application of the methodology of cointegration with structural change allowed us to prove a negative relationship between oil price and cost of living in Cameroon as well as in Ivory Coast. However, this analysis shows a positive long-term relationship between these two variables in Senegal.

Subsidy policies of the price of fuel at the pump would not significantly impact the cost of living in Cameroon, as well as in Ivory Coast. The Senegalese Government would gain to review its policy concerning stop subsidies of the price of fuel at the pump.

Key words: policy of subsidizing, cointegration with structural change, Kalman filter, Consumer Price Indice

1. Introduction

The Oil is one of the earliest and most widely used energy sources. It is the main energy source of industrialized economies. The economy is generally sensitive to changes in the price of oil. A rise of the price of oil can lead to generalized inflation, which has a negative impact on our economies. In the beginning of year 2008, the increase of oil price has resulted in a high cost of living in some major cities in Africa especially Douala, Yaounde, Abidjan and Dakar, and was the cause of social unrest in those cities.

What causes the inflation which has made more difficult recently the lives of millions of households in Cameroon, Côte d'Ivoire, or in Senegal? This generalized increase in prices would have multiple reasons. The most obvious are related to the soaring prices of commodities, including wheat, the rising price of oil per barrel which has risen above the

hundred dollars and increasing global demand for biofuels is to origin of the high price of corn. Cyclical economic reasons which they have added more structural causes, specific for African economies.

It was further attended social unrest in these cities during this period. Hence the interest of the government to analyze the relationship between oil prices and the cost of living in order to anticipate the policies to be implemented in case where the latter were considering an increase of oil prices. On the other hand, this increase in oil prices may lead to generalized inflation, which has a negative impact on our economies. Further to social unrest that have shaken the Cameroon in February 2008, the Government decided to subsidize the price of fuel at the pump. Since then, this subsidy weighs more and more on the budget of the State of Cameroon. Over the period from 2008 to 2011, this bill was 700 billion CFA francs, digging further public deficit, and it was estimated only for year 2012 to 400 billion CFA francs.

The Nigerian Government, anticipating the unsustainability of this measure decided in January 2012 to stop the subsidy to fuel prices at the pump. This measure has led to a general strike paralyzed the country for more than a week. The Nigerian Government has been any less forced to revise its policy for decreasing a new price of fuel on the order of about 30%.

The general aim of this study is to analyse the relationship between the price of oil and the cost of living (measured by the Consumer Price Index (CPI)) in Cameroon, Ivory Coast and Senegal in other to assess the relevance of the policy of subsidizing the price of fuel at the pump in these countries.

The research hypothesis we formulate is that rising oil prices negatively affect the cost of living in Cameroon, Ivory Coast and Senegal.

2. Methodology

The cost of living is apprehended by the Consumer Price Index. The data are monthly and cover the period 1994:01 à 2010:03.

The methodology used is the cointegration with structural change developed by Gregory and Hansen (1996). The state-space representation applying a Kalman filter allows to confirm the instability of this relation and to determine the sources of this variability. The estimates will be done for each country.

The development of cointegration is based on the validation of a key assumptions assumed by classical econometrics namely the assumption of stationarity. The contribution of this theory is that it relies on non-stationary series but by linear combination will become.

Space-state representation

To try to confirm the instability of the relationship, we will consider the following space-state representation:

$$y_{it} = \beta_i x_{it} + \eta_{it} \tag{1}$$

where y_{it} is CPI of country i at time t, and x_{it} is the price of oil in the country i at time t.
Consider here that the β coefficient can gradually evolve with the aid of a linear model to variable coefficient of the form:

$$\beta_{i,t+1} = A\beta_{it} + \varepsilon_{it} \tag{2}$$

with a slope varying as one autoregressive process of order 1. Taking β_t as state variable and $y_{i,t}$ as measured variable, the previous model is directly under the space-state form. The

Kalman filter will help to estimate the state variable, and the EM algorithm will be used for estimating the parameters of the space-state model.

3. Results and Interpretation

The study of the evolution of the series considered shows an upward trend, which suggests a variable averaged over time for the series, and therefore a non-stationary.

The results of ADF and KPSS unit root tests confirm that the proposed series of this study are not stationaries. They inform us again that these series are integrated of order 1.

In addition, the unit root tests in the presence of regime shifts developed by Zivot and Andrews confirm us the presence of nonstationarity in the studied series.

The order of integration being determined, the next step is to show whether there is a cointegration relationship.

Cointegration test with structural change

The cointegration test with structural change is based on the following structural regression:

$$IPC_t = \alpha + \beta PBP_t \tag{3}$$

where PBP_t is the barrel price of oil at time t.

Result of cointegration analysis for the case of Cameroon

The test results for the case of Cameroon allow to highlight on the threshold of 5% the existence of a cointegration relationship between the cost of living and the price of oil (in U.S. \$) when using model with structural change in the constant and trend (Table 1) because the statistical Z_t^* for this model is less than the tabulated critical value. So there is a cointegration relationship with a change in the constant and the trend in January 2003.

This change can be explained by the effects of the 2003 Iraq war because it helped to raise the price of oil having regard a significant reduction in supply. The results of the estimation of the long-term relationship with a structural change in January 2003 allowed to keep the following long-term equilibrium equation:

$$IPC\_CAM_t = \underset{\substack{(0.473296)\\ [187.0098]^*}}{88.51103} - \underset{\substack{(0.821177)\\ [-11.79117]^*}}{9.682635 D_{2003M01}} + \underset{\substack{(0.008319)\\ [42.51451]^*}}{0.353676t} - \underset{\substack{(0.014331)\\ [-3.109563]^*}}{0.044564 PBP_t} \tag{4}$$

The terms in parentheses denote the standard deviations. Those in brackets denote the t-statistics obtained from tests of individual significance of coefficients. All coefficients from this regression are significant at the 5% threshold because their t-statistics are all greater than 1.96 in absolute value.

This relationship shows the existence of a negative relationship between the cost of living and the price of oil in Cameroon.

Table 1: *Cointegration test with structural change for the case of Cameroon*

Models	Z_t^*	VC(5%)	Date of the break
Model (C)	-4.132699	-4.92	1997M09
Model(C/T)	-6.320450	-5.29	2003M01

| Model(C/S) | -4.077420 | -5.5 | 2007M09 |

Source: AFRISTAT, ours calculations in Eviews

Result of cointegration analysis for the case of Ivory Coast

The test results for the case of Ivory Coast allow to highlight on the threshold of 5% the existence of a cointegration relationship between the cost of living and the price of oil (in U.S. $) when using model with structural change in the constant and trend (Table 2) because the statistical Z_t^* for this model is less than the tabulated critical value. So there is a cointegration relationship with a change in the constant and the trend in October 1998.

Table 2 : *Cointegration test with structural change for the case of Ivory Coast*

Models	Z_t^*	VC(5%)	Date of break
Model (C)	-4.001088	-4.92	1997M08
Model (C/T)	-6.324491	-5.29	1998M10
Model (C/S)	-3.982492	-5.5	1999M07

Source: AFRISTAT, ours calculations in Eviews

Result of cointegration analysis for the case of Senegal

The test results for the case of Senegal allow also to highlight on the threshold of 5% the existence of a cointegration relationship between the cost of living and the price of oil (in U.S. $) when using model with structural change in the constant and slope (Table 3) because the statistical Z_t^* for this model is less than the tabulated critical value. So there is a cointegration relationship with a change in the constant and the slope in August 2007.

The results of the estimation of the long-term relationship with a structural change in August 2007 allowed to keep the following long-term equilibrium equation:

$$IPC\_SEN_t = \underset{\substack{(7.242075) \\ [8.103415]^*}}{58.68554} - \underset{\substack{(7.321427) \\ [6.828225]^*}}{49.99235 D_{2007M08}} - \underset{\substack{(0.399356) \\ [-4.260501]^*}}{1.701458 PBP_t D_{2007M08}} + \underset{\substack{(0.398814) \\ [5.304824]^*}}{2.115638 PBP_t}$$

$$(5)$$

All coefficients from this regression are significant at the 5% threshold because their t-statistics are all greater than 1.96 in absolute value.

Table 3 : *Cointegration test with structural change for the case of Senegal*

Models	Z_t^*	VC(5%)	Date of break
Model (C)	-5.173716	-4.92	2006M11
Model (C/T)	-7.305304	-5.29	2007M05
Model (C/S)	-5.659328	-5.5	2007M08

Source: AFRISTAT, ours calculations in Eviews

Results and interpretation of space-state model

This change over time coefficients leads to model the CPI as a space-state representation estimated by using a Kalman filter.

Figures 1 through 3 show the changes in time of estimates of the state variable according to the country for which the estimates are done.

Three periods can be distinguished. The first which goes from January 1994 to March 1997 corresponds to an increase of the coefficient of the space-state model. However, this coefficient is negative during this period. Following the devaluation of the CFA franc in January 1994, oil prices expressed here in U.S. $ has increased significantly in terms of the CFA Franc. The effect of devaluation on the cost of living has led gradually. The period from April 1997 to March 1999 marks a period of transition during which the coefficient is significantly reduced (Figures 1, 2 and 3). This may be due to the falling price of oil during this period. After this period, the ratio tends to stabilize, however, staying on most of the negative period and tending to 0. This confirms once again the negative relationship between the cost of living and the price of oil. The estimation of the cointegration relationship shows over the long term the existence of the negative relationship between the cost of living and the price of oil in the case of Cameroon (equation 4). In the case of Senegal (Figure 3), the coefficient remains negative throughout the period. However, the long-term relationship for the case of Senegal (Equation 5) shows that if the price of oil increases by one unit, the cost of living increases at 0.41418 unit. Thus, an increase in the price of oil affects positively in the short term the cost of living in Senegal and degrades it in the long term.

The relative stability of the coefficient in the third period explained by the fixing the price of fuel at the pump during this period.
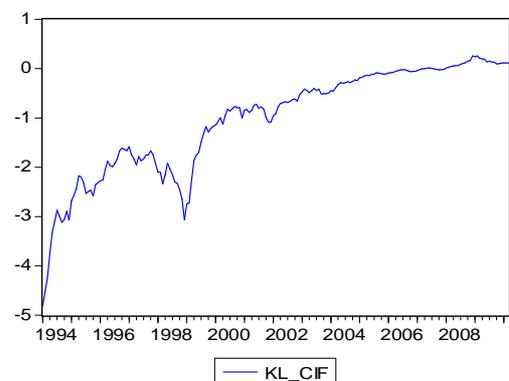
It appears from this analysis that the coefficient increases with the price of oil. Thus, more the price of oil is higher, less the cost of living decreases.

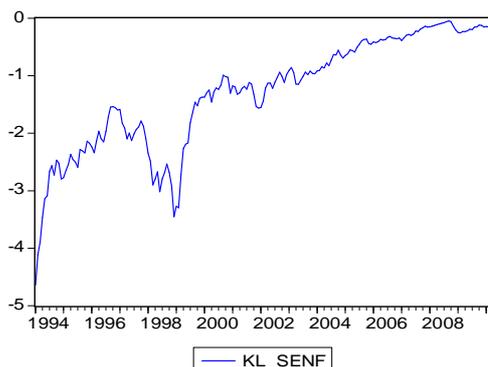**Figure 1 :** *Variation du coefficient pour le cas du Cameroun*
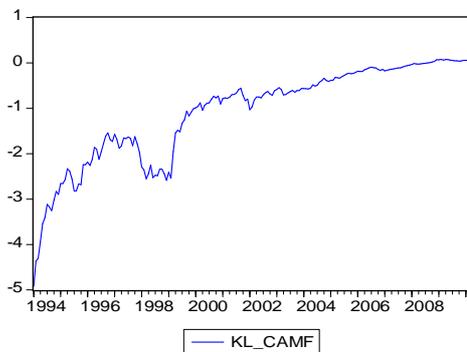
Source: AFRISTAT, nos calculs sous Eviews

Figure 2: *Variation du coefficient pour le cas de la Côte d'Ivoire*

Source: AFRISTAT, nos calculs sous Eviews

Figure 3 : *Variation du coefficient pour le cas du Sénégal*

Source: AFRISTAT, nos calculs sous Eviews

4. Conclusion

This study aimed to find the relationship connecting the price of oil to the cost of living, show that it varies over time and to determine the sources of this variability.

The application of the methodology of cointegration with structural change has allowed us to highlight a negative relationship between the price of oil and the cost of living in Cameroon, as well as in Ivory Coast. However, this analysis shows a positive long-term relationship between the price of oil and the cost of living in Senegal. The application of the methodology of the space state representation, however, shows a negative relationship between the price of oil and the cost of living in these countries. An increase in the price of oil affect positively in the short term the cost of living in Senegal and degrade it in the long term. The results of the space-state representation also show a similar evolution of the state variable for the three countries. The price of oil would have the same effects in the short term on the cost of living in these countries. The study results also show that the devaluation of the CFA franc in January 1994 contributed to increasing the cost of living in these countries.

As main recommendation of that study, the subsidy policies in fuel prices at the pump would not have a significant impact on the cost of living in Cameroon, as well as in Ivory Coast. The Senegalese Government would gain to review its policy concerning stop subsidies of the price of fuel at the pump.

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