LA MODELISATION DES DYNAMIQUES A MOYEN TERME DES PRIX AGRICOLES :

LE CARACTERE CYCLIQUE DES VARIATIONS DES PRIX AGRICOLES

Abdoul S. DIALLO

Université Montpellier

Paper presentation at the 46eme Journées de Statistique, 2nd to 6th June 2014

Agricultural commodities have proven to make up a strategic component of the economy.

Even more so, in the framework of the food insecurity assessment target aimed by our paper.

Numerous studies have highlighted the preponderant role of these commodities in stimulating growth

- Burns and Mitchell (1946)
- Lewis (1949)
- Mills (1927, 1936)

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- Bosworth and Lawrence (1982)
- Brown (1988)
- Clur and Morrison (1984)
- Cooper and Lawrence (1975)
- Kaldor (1976)
- Cashin, McDermott and Scott (1999)
- Labys (2000)

The study of commodity prices long term trend behavior is a well document subject, but very few studies have been conducted, addressing their variability due to their cyclical nature.

- Cashin et Mcdermott (2002) : the strong price variability induced by their cyclical aspect would be a substantial factor for the failure of attempts at determination of the exact nature of their long term trend.
- Turnovsky (1974) and also Schmitz (1984) : Numerous contra-cyclical price stabilization policies would have know better efficiency if decision-makers had had reliable prices cycle related estimates at their disposal (amplitude, duration and transition speed).

Furthermore, developing economies are highly specialized in the production and trade of one or a small number of commodities.
Their incomes prove thus heavily related to price movements of the latter.

Aim of our paper

Mitigate certain drawbacks of standard commodity prices modeling exercise, by focusing on the characterization of the cyclical components of agricultural food commodities prices.

OUTLINE

Methodological insufficiencies to cycle analysis :

- Difficulty differentiating cycle from trend
- Difficulty detrending series

Most importantly

- Absence of an institutional and functional definition of cycles and associated concepts

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- Hodrick-Prescott (1980) with HP filter : stationnarity bound and arbitrary steps in model calibration
- Baxter and King (1999) with BK filter and Christiano and Fitzgerald (2003) with CK filter :
  - impose potentially biasing *a priori* restrictions on cycle phase lengths,
  - loss of information relative to the time related aspect of the series, and
  - BK filter is stationarity bound.

Pioneer research illustrating the usefulness of wavelet analysis to the study of macroeconomic variables include :

- Ramsey and Lampart (1998)
- Gencay, Selcuk, and Whitcher (2002)
- Crowley(2010)

A Wavelet decomposition procedure is composed of 2 types of wavelets : a father wavelet ϕ and a mother wavelet Ψ and their dilatation equations such that :

$$\int \phi(t)d(t) = 1 and \int \Psi(t)d(t) = 0 \tag{1}$$

The dilatation equation of the father wavelet $\phi(x)$ can be expressed by :

$$\phi(x) = \sqrt{2} \sum_k l_k \phi(2x - k) \tag{2}$$

While the mother wavelet $\Psi(x)$ is :

$$\Psi(x) = \sqrt{2} \sum_k h_k \phi(2x - k) \tag{3}$$

And where l_k and h_k are respectively low-pass and high-pass filters expressed by :

$$\begin{aligned} l_k &= \frac{1}{\sqrt{2}} \int \phi(t)\phi(2t - k)d(t) \\ h_k &= \frac{1}{\sqrt{2}} \int \Psi(t)\phi(2t - k)d(t) \end{aligned}$$

Hence a wavelet representation of a signal $f(t)$ in $L^2(R)$ consists of a sequence of orthogonal projections onto ϕ and Ψ through scaling and translation. Its formal expression is given by :

$$\begin{aligned} f(t) &= \sum_k s_{j,k}\phi_{j,k}(t) + \sum_k d_{j,k}\Psi_{j,k}(t) \\ &+ \sum_k d_{j-1,k}\Psi_{j-1,k}(t) + \ldots + \sum_k d_{1,k}\Psi_{1,k}(t) \end{aligned}$$

Suggested wavelet procedure is not bound by stationarity assumptions, restores time-related specificities of a signal and need no *a priori* assumptions for its implementation.

Frequency Bands	Associated Periodicity	Identified Components
D1	1 to 2 months	High frequency noise and short term fluctuations
D2	2 to 4 months	
D3	4 to 8 months	
D4	8 to 16 months	Seasonal fluctuations
D5	16 to 32 months	Short, medium and long *Business Cycles*
D6	32 to 64 months	
D7	64 to 128 months	
A7	128months et plus	Trends

FIGURE : Wavelet decomposition and structure component associations.

Definition

A cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle ; this sequence of changes is recurrent but not periodic ; in duration business cycles vary from more than one year to ten or twelve years ; they are not divisible into shorter cycles of similar character with amplitudes approximating their own. (Burns and Mitchell, p.3)

Business cycles dating procedures are highly sensitive to the considered definition of cycles.

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A first collection regroups parametric estimation methods :

- ARMA and ARIMA based models (Beveridge and Nelson (1981), Nelson and Plosser (1982) as well as Campbell and Mankiw (1987)).
- Unobserved components based linear models (Harvey (1985), Watson (1986) and Clark (1987))
- Cointegration based models (Granger (1987))

All of which are based on the a priori asumption that considered variables are I(1) time series ; their Δtranform being linear and stationary random process.

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The second group of methods is the non parametric approaches, needing no underlying model for identifying turning points as is the BB Algorithm.

2. Bry and Boschan (1971) dating algorithm

1. Determination of extremes and substitution of values
2. Determination of cycles in twelve month moving average (extremes replaced).
   A: Identification of higher (or lower) than five months on either side.
   B: Enforcement of alternation of turns by selecting highest of multiple peaks (or lowest of multiple troughs).
3. Determination of corresponding turns in Spencer curve (extremes replaced).
   A: Identification of highest (or lowest) value within +/- five months of selected turn in twelve month moving average.
   B: Enforcement of minimum cycle duration of fifteen months by eliminating lower peaks and higher troughs of shorter cycles.
4. Determination of corresponding turns in short-term moving average of three to six months, depending on months of cyclical dominance (MCD).
   A: Identification of highest (or lowest) value within +/- five months of selected turn in Spencer curve.
5. Determination of turning points in unsmoothed series.
   A: Identification of highest (or lowest) value within +/- four months, or MCD term, whichever is larger, of selected turn in short term moving average.
   B: Elimination of turns within six months of beginning and end of series.
   C: Elimination of peaks (or troughs) at both ends of series which are lower (or higher) than values closer to the end.
   D: Elimination of cycles whose duration is less than fifteen months.
   E: Elimination of phases whose duration is less than five months.
6. Statement of final turning points.

Source: Bry and Boshan (1971, p. 21).

1. Wavelet Transform Implementation

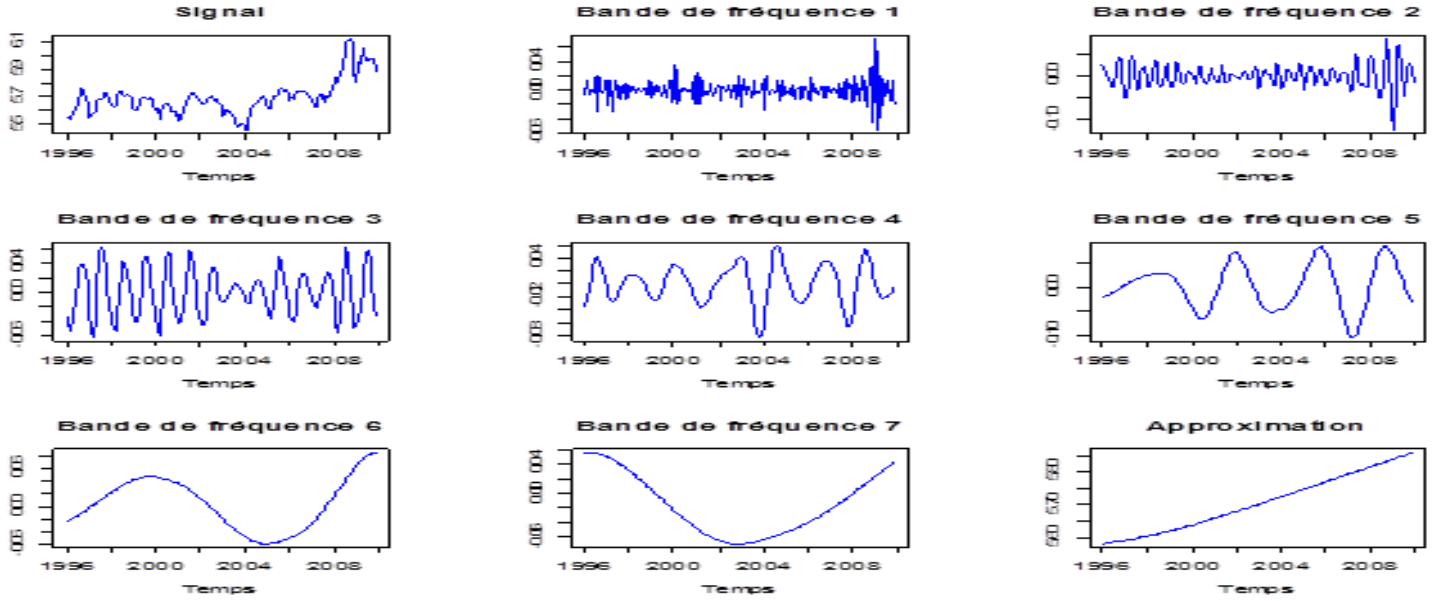

FIGURE : Wavelet decomposition of price signal (Local Rice)

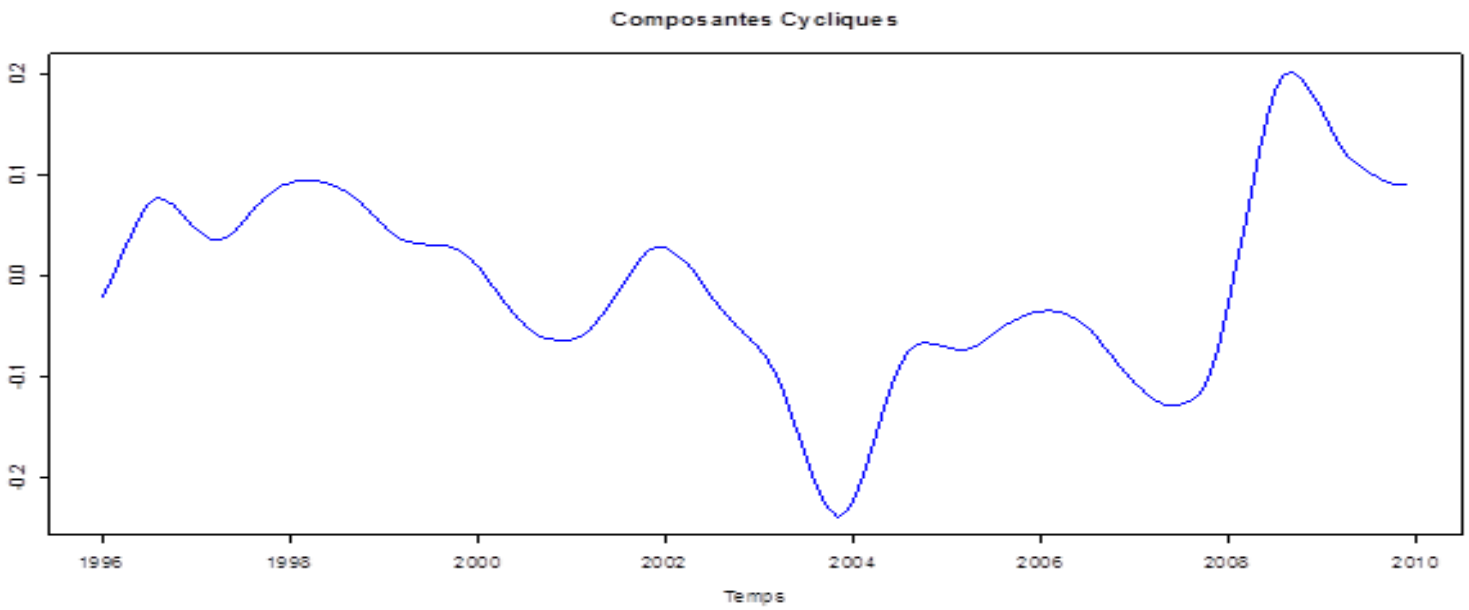

FIGURE : Cycle component recomposition of price signal (Local Rice)

CYCLICAL COMPONENTS CONTRIBUTION TO TOTAL VARIANCE					
	Local Rice	Import. Rice	Maze	Millet	Sorghum
$\Sigma_i VAR(D_i)$	0,0153	0,01873	0,0765	0,0320	0,0763
Cycle variance	0,0064	0,0065	0,0502	0,0200	0,0474
Ratio	41,6904	34,8392	65,6209	62,6726	62,1011

FIGURE : Cycle component contribution to signal variance (summary table)

2. BB - Algorithm Cycle Dating

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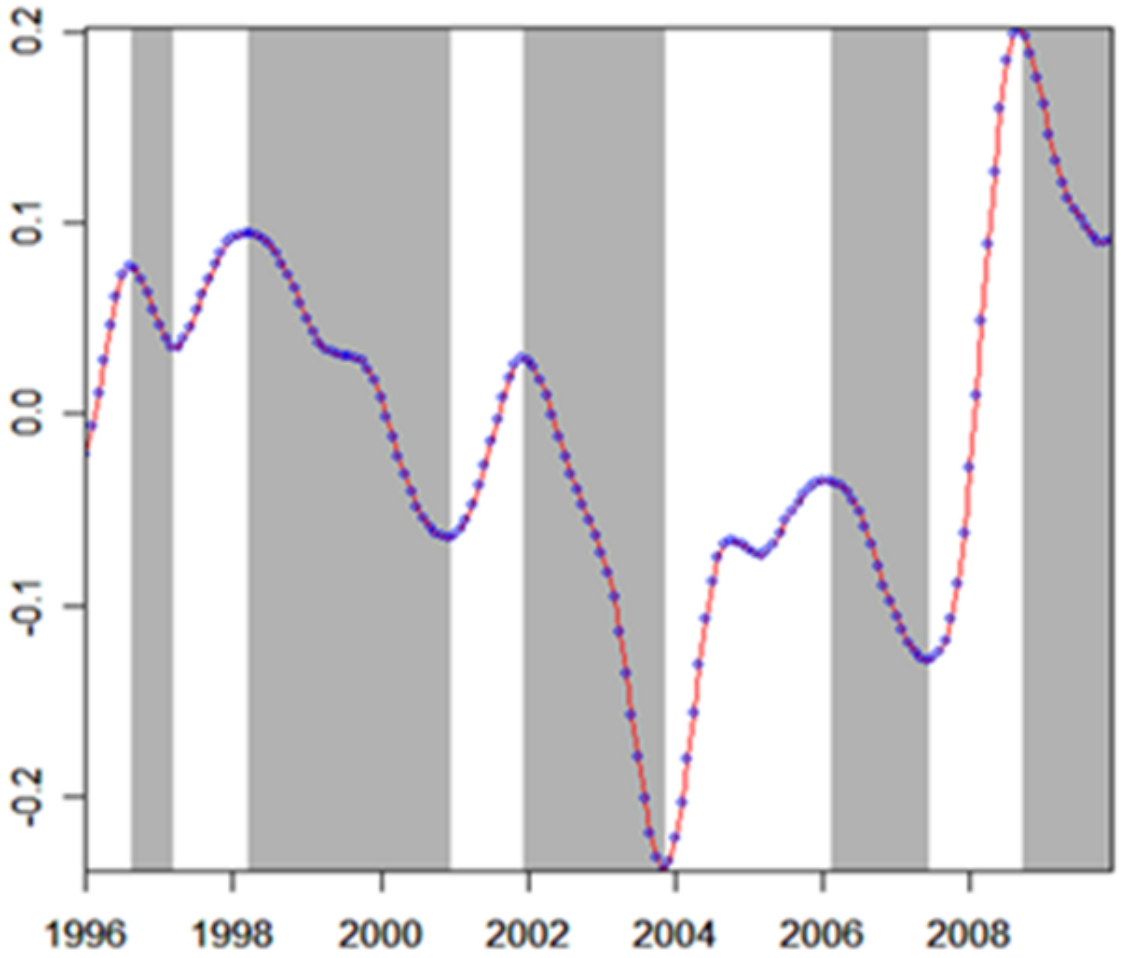

FIGURE : Bry and Boschan turning points dating (Local Rice)

2. BB - Algorithm Cycle Dating

	Number of cycles	Cycles Length			Average Phase Length	
		Min.	Max.	Av.	Contraction	Expansion
R. local	5	19	50	36,25	19,8	16,5
R. Importé	4	26	72	50,67	35,3	15,3
Maïs	5	29	43	35,25	18,2	17
Mil	5	28	41	35,75	16,8	19
Sorgho	5	22	47	36,25	19,5	16.8

FIGURE : Summary table of cycle properties

	Average phases variation of											
	Contractions						Expansions					
	Loc. R	Imp. R	Maze	Mill.	Sorg.	*Av.*	Loc. R	Imp. R	Maze	Mill.	Sorg.	*Av.*
BENIN	0,1	0,1	0,5	0,3	0,5	*0,3*	0,2	0,2	0,5	0,4	0,5	*0,36*

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- - allowing for more robust economic policies in relation to price variation concerns

Univariate framework : Enhancing structural analysis in relation to commodity prices variation and volatility.

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Multivariate framework : Analysis of commodities cycles relationships

- Co-movement patterns of studied commodities : study of Pro-cyclical, Acyclical and Counter-cyclical relationships
- Nature of said patterns : Cycles phase shift evaluation for lead, lag and synchronous relationships
- Extent of said relationship : low, mid or high degree of correlation

Extensions

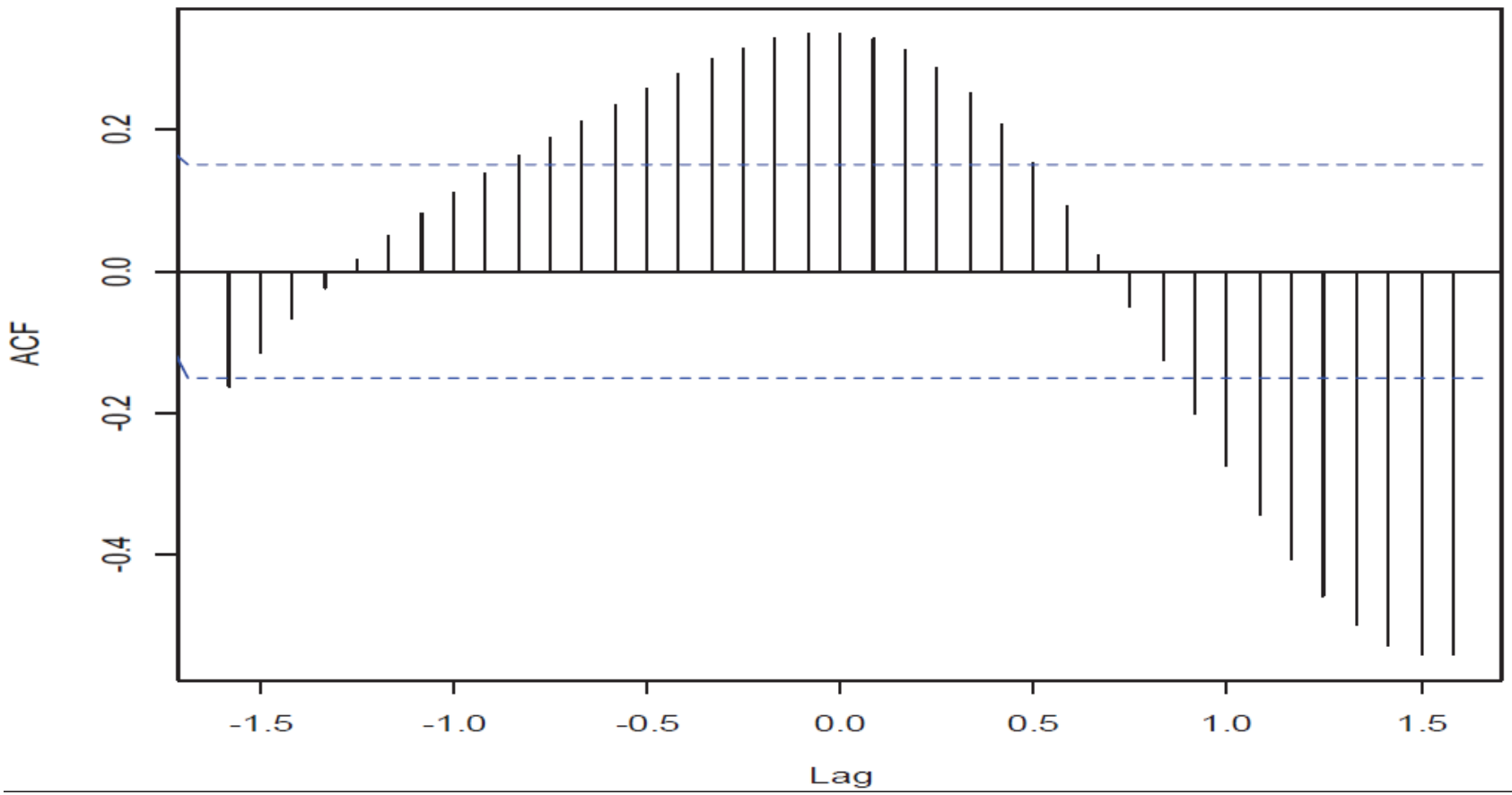

FIGURE : Example of Co-movement analysis output

THANK YOU FOR YOUR ATTENTION