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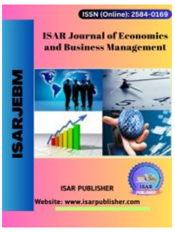

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HAS SECTORAL SPECIALIZATION SYNCHRONIZED BUSINESS CYCLES IN THE WAEMU?

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Abstract: This paper analyses the sectoral sources of synchronization or fluctuations in the WAEMU in the period from 1960 to 2021 using a linear common factor model and the Markov switching model. The partial correlation matrix from the common factor model indicates some correlation between economic activities in the WAEMU. In contrast, the Markov switching model indicates that the normal state does not dominate in the same way across the union countries, confirming Prebisch-Singer's (1950), hypothesis on terms of trade deterioration. Using the different value added as probability transition variables, our results show that all WAEMU member countries record high GDP growth rates in the expansion phase following a positive shock, regardless of the sector of activity. On the other hand, during a recession, business cycles in some WAEMU member countries do not follow activities cycles. Consequently, sectoral specialization has not been able to synchronize business cycles in the WAEMU. Despite the process of trade opening, most of the countries of the union that have adopted the policy of agricultural specialization are poorly integrated into world trade, no doubt due to unequal trade.

Keywords: Markov switching model, business cycles, Prebisch-Singer hypothesis, sectoral specialisation, synchronisation.

JEL classification: E32, F42.

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1. INTRODUCTION

West African Monetary Union (WAMU) was created in 1962 to foster the development of member countries whose economies depend on the primary sector in accordance with the recommendations of international specialization (David Ricardo's theory of comparative advantage). A sector that is constantly subject to instability in commodity prices due to supply and demand shocks. In practice, the hypothesis of Prebisch-Singer (1950) is not far from being confirmed. The trade balance is structurally in deficit at times (e.g. in the 1980s and 1990s) and the terms of trade deteriorate because export revenues are unable to cover import expenditure on a regular basis. In relation to other regions of Asia and Europe, investment flows are still insufficient, barriers to intra-regional trade related to transaction costs remain high, and the terms of trade are deteriorating due to a lack of export revenues to cover import expenditures on a regular basis. His situation highlights a certain difficulty in synchronising economic cycles despite a desire to intensify trade between member countries and a single monetary policy. However, regional cooperation and trade integration have in recent decades been seen as better strategies for poverty reduction, macroeconomic stability and increased production in a region.

According to Frankel and Rose (1998), countries of different economic size before entering an economic union end up having synchronized business cycles after entry into the union. This approach, referred to as the endogenous optimal currency area (OCA) criterion, follows criticisms of exogenous MFA criteria advocated by Mundell (1961) and Mc Kinnon (1963). The criteria that seem to guide WAMU economies are those of the ex-post theory of the OCA. Moreover, the integration model adopted in this zone is the opposite of the one recommended by the Balassa integration stages, since in 1994 WAMU became an economic and monetary union (WAEMU). Decades after the weak integration of WAEMU member countries into regional trade, it is now up to the various sectors of activity to contribute to the performance of the economies of member countries. Consequently, the synchronization of the phases (expansion or recession) of the economic cycle becomes an asset for this performance. Faced with fluctuations in the prices of primary products, has the agricultural sector become the determinant or the obstacle to the synchronisation of economic cycles?

The general objective of this paper is to analyse the effect of business cycles on macroeconomic fluctuations in the WAEMU in order to determine the existence of a possible comparative advantage or structural transformation of economies. In other

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words, it determines the extent to which the effects of each sector of activity in each economy are similar. Specifically, it determines the cyclical impact of the primary sector in relation to other sectors of activity on the business cycle in the WAEMU zone. These objectives make it possible to test the hypothesis of Prebisch-Singer (1950) on the long-term deterioration in the terms of trade. Thus, the analysis of the impact of each sector of activity on growth instability shows us the type of specialisation that can foster economic activity in member countries. To this end, common factor models (Kaiser, 1970; Gorsuch, 1983) using the partial correlation index first analyse synchronisation in a linear framework. Next, Markov regime-switching models (Hamilton, 1989) that estimate average growth rates for each regime and use probability transition variables become indispensable. These models estimate and compare different average growth rates by regime, the persistence of each regime, and the length of the business cycle across countries. If these indicators are close, it can be deduced that cycles tend to synchronize in the WAEMU. Within this framework, our article is divided into three parts. The first part focuses on the literature review and the theoretical framework, the second part on stylized facts and econometric modelling. The third part is concerned with the interpretation of the results.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1. Literature review

At the international level, the analysis of the sources of fluctuations has been addressed in the literature mainly with a view to seeking the best criteria for establishing an optimal currency area. Certain determinants of the international transmission of business cycles are at the origin of output fluctuations in a given country. To control economic fluctuations, membership of an economic and monetary union proves to be a less costly solution. Since Mc Kinnon (1961), the criteria for the viability of a currency area have evolved. Indeed, the viability of an optimal currency area depends on a number of factors responsible for the fluctuations or synchronisation of economic cycles. It is important for the exogenous theory of an optimal currency area where fluctuations are synchronous and controlled that it has prior price and wage flexibility and financial integration between countries before joining the union. In addition, integration of the markets for factors of production, goods and services; coordination of national fiscal, monetary and exchange rate policies; similar inflation rates; income correlation and the predominance of symmetrical shocks are required. Finally, there must be a predominance of symmetrical shocks and the existence of an adjustment mechanism to deal with asymmetrical shocks. In principle, if these criteria are met by the member countries of the monetary area, it will not be necessary to make adjustments to the nominal exchange rate within the area. Among these criteria, for some authors, it is the non-correlation of production structures (problem of integration of production markets, for example) that is one of the main sources of the fluctuations resulting in the non-optimality of growth and employment. For the proponents of the endogenous theory of optimal currency areas, most of these criteria can be satisfied after countries join the union. Kenen (1969) identifies two main transmission channels for macroeconomic co-fluctuations: sectoral specialisation and nominal shocks. Barrios et al. (2003) show in the case of Europe that sectoral specialisation leads to a certain asymmetry in GDP fluctuations. But it does not appear to be significant in explaining the reduction in correlations between business cycles in the United Kingdom and the European Union. According to the model initiated by Frankel and Rose (1997, 1998), it is the intensification of international trade that best explains economic fluctuations. And trade integration is positively related to the synchronization of business cycles. However, its effect on the synchronization of business cycles is positive under one condition. If demand shocks dominate the fluctuations of the business cycle, we would expect a strengthened trade integration to increase the transmission of shocks from one country to another through the impact of these shocks on the demand for imports.

The presence of industry-specific shocks may or may not reinforce the effect. In the case of different comparative advantage, trade leads each country to specialize in different industries, under these conditions, the net effect of trade integration on the correlation of business cycles will be negative (Eichengreen, 1992, Krugman, 1993). On the other hand, if trade is mainly intra-industrial in nature to the extent that countries' production structures tend to be identical with increased trade, trade integration will lead to a high degree of business cycle synchronization. The existence of a positive relationship between trade intensity and cycle synchronization has been empirically validated by Frankel and Rose (1997, 1998), Fontagné et al. (1999),Imbs (2003), Babetskii (2005), Fidrmuc (2005), Baxter and Kouparitsas (2005), Calderon et al. (2007), Inklaar et al. (2008) and Tapsoba (2011). Authors such as Artis et al. (1999), Clark et al. (2001) have confirmed the positive effect of trade on the synchronization of business cycles in industrialized countries. Imbs (2003) and Fidrmuc (2001) highlight the role of intra-industry trade. They explain the positive impact of trade intensity on business cycle synchronisation by the nature of trade and the externalities of aggregate shocks. Although, Calderon et al. (2007) estimate that the magnitude of the effect is smaller among developing countries than among industrialized countries. This is confirmed by Tapsoba (2011), in the context of West African economies.

Authors such as Erden et al, (2014) analyse the determinants of the international transmission of business cycles to the Turkish economy by examining the channel through which international business cycles are transmitted to Turkey. Applying several panel estimation methods to data from 22 countries from 1998 to 2009, they find that increased trade and financial trade are significant factors in the transmission of business cycles to the Turkish economy. These results highlight in particular the role of trade integration in the synchronisation of business cycles between Turkey and EU countries. At the level of the sectoral transmission of the business cycle Kouparitsas and Baxter (2003) consider that the sectoral breakdown of production, imports and exports is a necessary way to analyse the international transmission of business cycles. Similarly, Giovanni and Levchenko (2010) explain the impact of international trade on cycle synchronization.

Moreover, the link between business cycle and sectoral fluctuations in Côte d'Ivoire is highlighted by Aka (2009) in a non-linear Markov regime-switching model. The results lead to an interaction between sectors of activity in the business cycle, and an average cycle length per sector of activity of between 4 and 5 years. On the other hand, he finds that the business cycle of GDP in Côte d'Ivoire lasts an average of 10 years.

2.2 Theoretical framework

The national accounts distinguish several approaches to calculating GDP, the most common of which is the one that links value added to output. According to the output-side approach, GDP is the sum of value added; value added tax and customs duties.

$$PIB = \sum VA + TVA + DD \quad (1)$$

However, the value added can be calculated using two different methods. One takes into account the calculation by industry and the other by sector of activity. To determine the cyclical impact of agricultural specialisation on gross domestic production (GDP), we use Colin-Clark's (1947) analysis based on sectors of activity. He distinguishes three main sectors of activity: primary, secondary and tertiary sectors. This sectoral approach to calculating aggregate output indicates that GDP is the result of the sum of value added in agriculture (VAA), industry (VAI) and services (VAS).

$$GDP = VAA + VAI + VAS \quad (2)$$

The value added of each sector of activity can be a source of macroeconomic fluctuations. These fluctuations are accentuated in developing countries by their integration into international trade networks. Two principles underpin international trade and lead to two forms of exchange. These are the principle of specialization, which leads to complementarities between nations, and the principle of competition. Industrialized countries essentially conduct intra-industry trade among themselves to the extent that there is a differentiated specification of the same generic product. On the other hand, trade between industrialized and developing countries is more inter-industry and is based on differences and specializations. In the case of developing countries based on the model of comparative advantage of primary products, agricultural specialization should lead to productivity gains. A country has a comparative advantage in the production of a good if the opportunity costs of producing it are lower than the opportunity costs of producing the same good in another country (Feenstra and Taylor, 2014). Despite the difference in the sources of comparative advantage in the Ricardian and Heckscher-Ohlin-Samuelson (HOS) models, they lead to the same results. Countries can benefit from trade through specialization in the production of the good in which they have comparative advantage. The (HOS) model predicts that a country will export the good that makes intensive use of the abundant production factor (Feenstra and Taylor, 2014). Both countries can earn high relative prices by opening up to trade (Feenstra and Taylor, 2014).

The Prebisch-Singer hypothesis presents a bargain for the basic results of the Ricardian model, according to which the country that specializes in producing the good for which it has a comparative advantage will experience an improvement in its terms of trade. Prebisch (1950) and Singer (1950) suggest that gains from trade are unevenly distributed. While industrialized countries benefit from a long-term improvement in the terms of trade, this is not the case for developing countries that specialize in the production of raw materials. The countries producing these commodities therefore experience deterioration in their terms of trade over time Singer (1950). Primary commodities have inelastic price and income elasticities while manufactured goods have high income elasticity of demand. The increase in income is the result of a strong increase in the demand for manufactured goods. Similarly, the low price elasticity of demand for primary products suggests that a decline in price will lead to a decline in income in peripheral countries (Gemmill, 1962). The difference in elasticities determines, over time, the fall in the terms of trade of the countries located on the periphery.

3. DATA AND ECONOMETRIC MODELLING

The stylized facts allow us to explain over time the effect of (agricultural) specialization or structural transformations in the economic activity of WAEMU member countries. We adopt a descriptive analysis of the evolution of the terms of trade and the technique of cycle-tendency decomposition of the GDP of each member country.

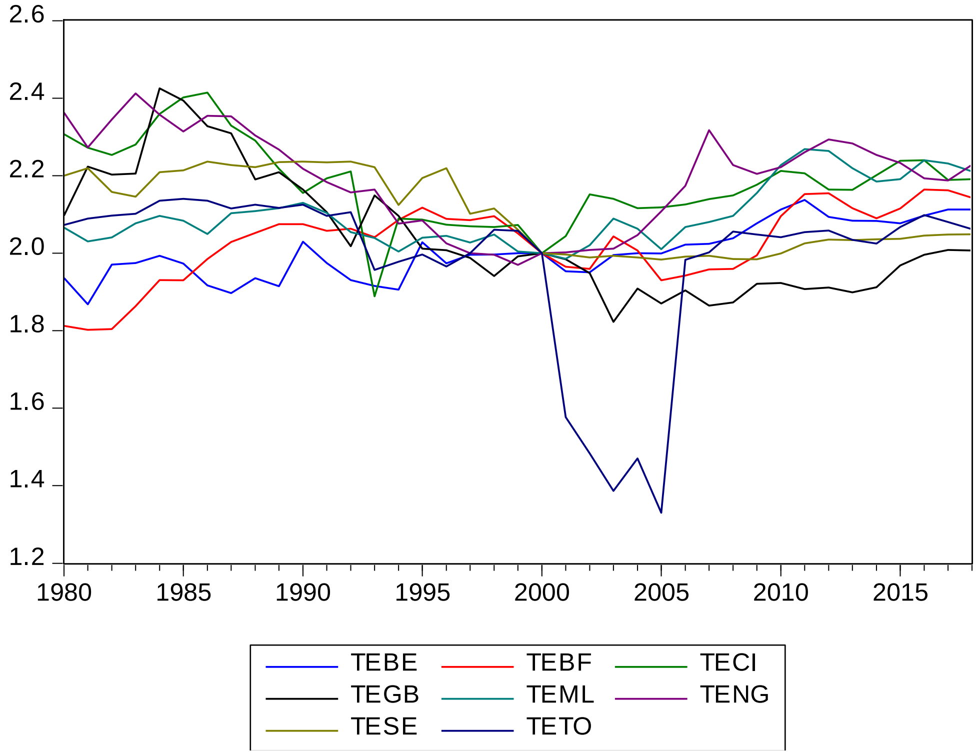
3.1 Data sources

Our database comes from the World Bank (WDI). The evolution of the terms of trade over time remains a necessary indicator to verify the Prebisch-Singer hypothesis. These terms of trade are subject to structural changes over time. Moreover, the autoregressive threshold (TAR) and smooth transition (SETAR) models generally indicate two regimes for the evolution of the terms of trade (TE). The same is true for the economic growth rates and the different values added as a percentage of GDP conferred by tables 6, 7 and 8 of the model selection criteria in the annex.

3.2 Stylized facts

The following figure 1 shows terms of trade (TE) instability from 1980-2018 with very large fluctuations in the terms of trade. The structure of international trade marked by exports dominated by raw materials shows that WAEMU countries are vulnerable. This explains their low integration into world trade. Moreover, the evolution of the terms of trade index (in logarithm) indicates a disparity between WAEMU member countries. The lowest index over the period from 1980 to 2018 is that of Togo in 2005 (1.33). The highest indices are those of Niger, Côte d'Ivoire and Guinea-Bissau (2.41; 2.42) between 1983-1986.

Figure 1: Evolution of the logarithm of the terms of trade (TE)in WAEMU from 1980 to 2021

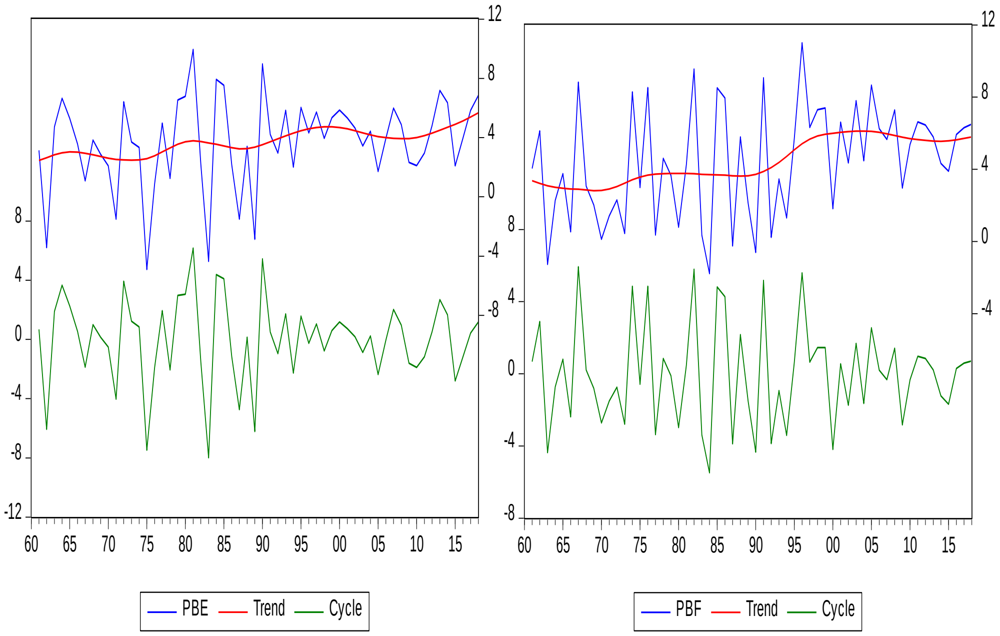


Note: The variables TEBE, TEBF, TECI, TEGB, TEML, TENG, TESE, TETO represent, respectively, the terms of trade of Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo

Source: author from World Bank data

Concerning the long-term evolution (Figure 6 in annex), a strong downward trend in Senegal's terms of trade indices can be observed. And a slight decline in the indices of Togo, Niger, Côte d'Ivoire and Guinea-Bissau. On the other hand, Mali, Benin and Burkina Faso, to a certain extent, show an improvement in the terms of trade over time with a strong upward trend. While five WAEMU member countries are experiencing deterioration in their terms of trade over time, three others are recording an improvement in their terms of trade. For countries with similar economic structures, this situation could be a source of desynchronization of business cycles within the union. The Hodrick and Prescott (H-P) filter decomposition technique provides an additional explanation. Indeed, the cycle/trend decomposition of H-P indicates that while some countries experience an upward trend in business cycles, others, on the contrary, have cycles that show a downward trend see figure 2 to figure 5 bellow.

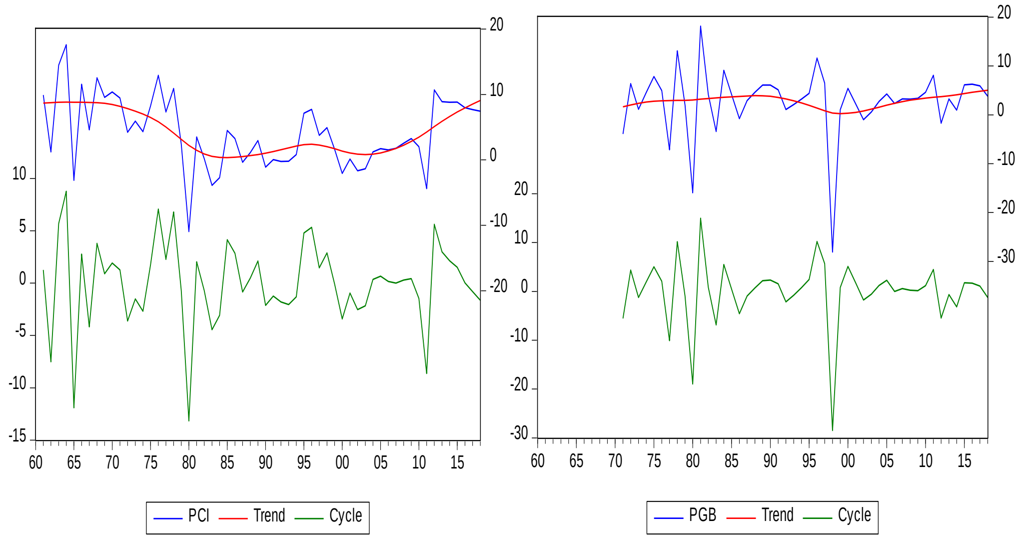
Figure 2: Cycle/trend decomposition by the H-P filter for the GDPs of Benin and Burkina-Faso



Source: authors from World Bank data

Thus, the GDP growth rates over the entire period in Benin, Burkina Faso and Senegal show a rising trend. While the trend curves for Togo, Niger and Côte d'Ivoire are more or less similar.

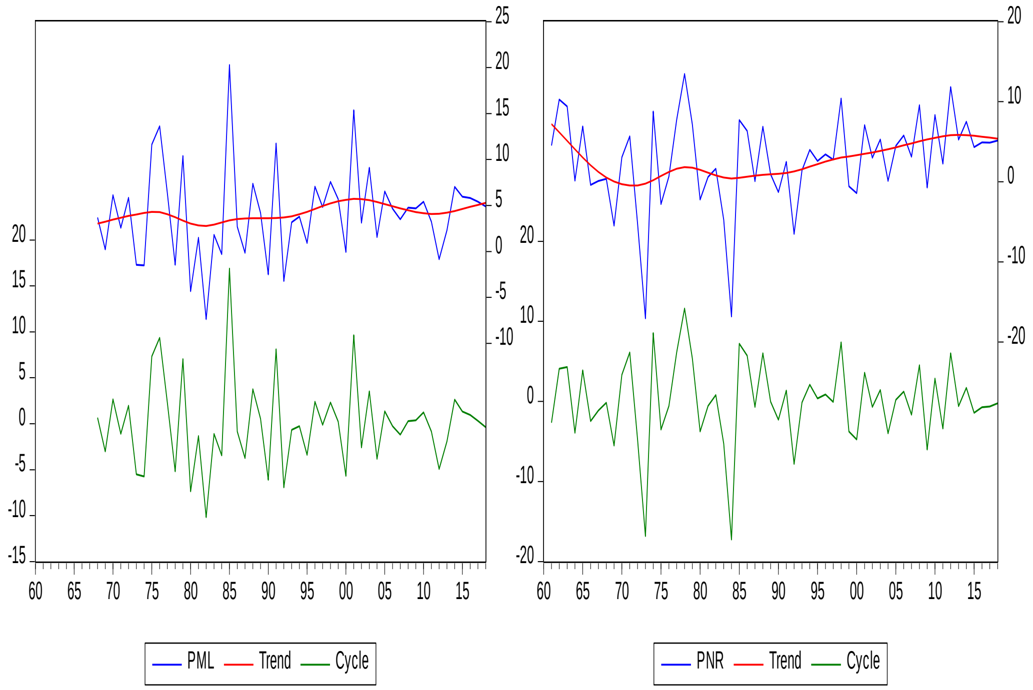
Figure 3: cycle/trend decomposition by the H-P filter for the GDPs of Côte d'Ivoire and Guinea-Bissau



Source: authors from World Bank data

The cyclical components show a number of very marked "peaks" and "troughs" that are very important for most countries. Overall, these fluctuations indicate one or two break points for each series. This suggests that there are two to three regime shifts in those countries that have experienced socio-economic events. The breaking points coincide with the economic and financial crises of the 1970s, 1980s and 1990s and even the 2007/2008 financial crises in Europe and the USA. Moreover, the upward or downward trends in growth rates can be justified by the mixed results of structural adjustment measures (1983-1986, 1990-1994 and 2008-2010). These World Bank and IMF programmes led to the withdrawal of states from financing agriculture and the reduction of spending in other sectors.

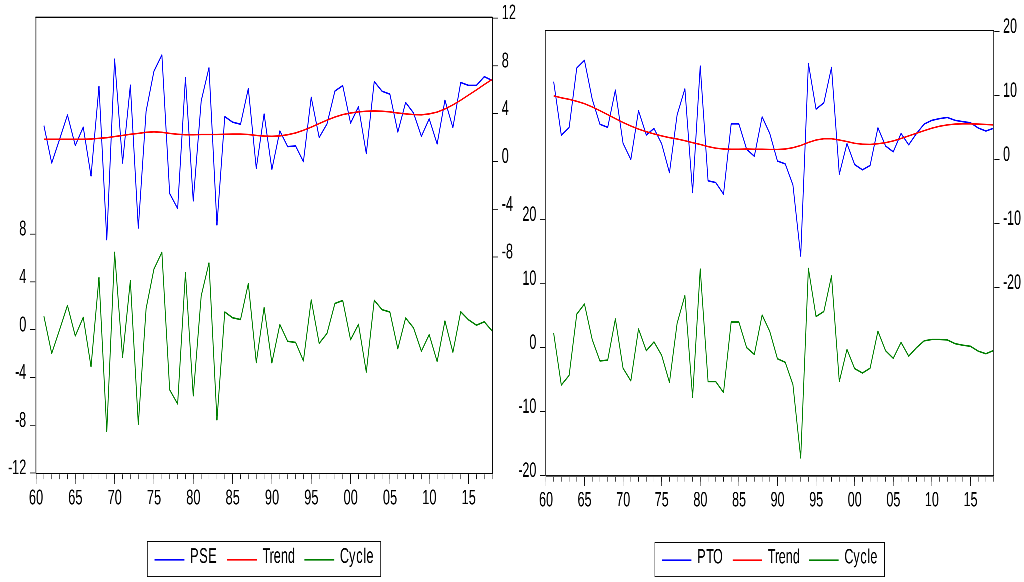
Figure 4: cycle/trend decomposition of the H-P filter for the GDPs of Mali and Niger



Note: The variables PBE, PBF, PCI, PGB, PML, PNG, PSE, PTO represent, respectively, the gross domestic product of Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo.

Source: authors from World Bank data

Figure 5: cycle/trend decomposition at the H-P filter for the GDPs of Senegal and Togo



Source: authors from World Bank data

The H-P filter technique suggests the non-linearity of the GDP growth rate series increasingly adopted by econometric modelling. This non-linearity is confirmed by the selection criteria for TAR models, which generally indicate two regimes for the variables. These regime shifts can be associated with socio-economic events and natural shocks.

2.2. Econometric modelling

Linear regression is one of the main tools of econometric and statistical analysis. However, the relevance of non-linear models, particularly in the macroeconomic analysis of switching model, is increasingly evident. Switching models have been important in the history of economic analysis. For details, see Goldfeld and Quandt, (1973, 1976); Maddala, (1986); Hamilton, (1994); Frühwirth-Schnatter, (2006). Hamilton's (1989) model with its analysis of output fluctuations is a notable example of a switching model specification with constant probability transition parameters. Alternatively Diebold, Lee, and Weinbach (1994), and Filardo (1994) adopt two-state models that employ time-dependent probability transition variables. Specifying model (3) based on theoretical model (2) allows us to specify a switching model with time-dependent probability transition.

$$GDP = \alpha VA_t + \varepsilon_t \tag{3}$$

ε_t is a white noise, GDP represents the economic growth rate in each WAEMU member country, Then VA represents the value added of agriculture as a percentage of for each member country and α a parameter affecting this value added.

The Markov switching model separates the expansion and recession phases for forecasting turnaround points. Using this model, it is possible to determine the transition probability P_j for an economy to move from one regime to another or from an expansion phase to a recession phase and vice versa. Similarly, it is possible to know the probability P_j of an economy remaining in the same regime (Hamilton, 1989). Moreover, the recent international financial crises, 2007-2008 in the United States, followed by the crisis in the euro area, have given rise to renewed interest in forecasting economic downturns. In particular, for macroeconomic performance indicators, the most important of which are output and employment. Thus, Markov switching autoregressive models (MSAR) make it possible to recognize, at any moment, a probability of occurrence of an unobservable variable with values in the set $\{1,\ldots,K\}$. This set is supposed to follow a chain from Markov to k states. In this context, the unobservable variable rated (S_t) is assumed to represent the current state of economic activity, and the number k of plans is generally assumed to be two or three. The variable (S_t) follows a diet Markov chain, i.e. for everything, depends only on S_{t-1}.

$$\forall_{ij} = 1,\ldots,K,\ P(S_t = j / S_{t-1} = i,\ldots) = P(S_t = j / S_{t-1} = i)P_{ij} \tag{4}$$

Les coefficients $(P_{ij})_{i,j=1,\ldots,K}$ are called transition probabilities. They measure the probability of an economy staying in one regime or moving from one regime to another. For a given regime i, the following equation is obtained:

$$p_{i1}|p_{i2}|...|p_{ik}|=1 \quad (5)$$

In each state i, probability is a measure of the persistence of state i. The model parameters are estimated by maximum likelihood using a filtering algorithm. This estimation allows recovering for each period t the filtered probability to belong to regime i for

$$i=1,...,K, \quad P(S_t = X_t,...,X_1,\theta) \quad (6)$$

Thus, at any given moment, it will be possible to infer that economic activity is in the strong regime (growth) that has the highest filtered probability. Starting from the previous Markov chain S_t, it is possible to define different types of Markov switching econometric models whose parameters and structure depend on the regime in which the Markov chain is located. As an example, the autoregressive p -order, $AR(p)$ switching model is defined as follows X_i with Z_i as an exogenous variable if it satisfies the following equation:

$$X_t = \mu(S_t) + \varphi_1\left[X_{t-1} - \mu(S_{t-1})\right] + ... + \varphi_p\left[X_{t-p} - \mu(S_{t-p})\right] + \sum_{i=1}^{k}\alpha_i Z_i + \varepsilon_t \quad (7)$$

Where $\mu(S_t)$ is the average of the process at time t and where ε_t is a White Gaussian Noise process of unknown finite variance σ^2 which can also depend on the regime. The parameters φ_p et φ_1 may also depend on S_t. In this model, the economic growth rates of each WAEMU member country can alternately follow two regimes under the influence of agricultural production translated into value added. There is a probability of transition from the expansion regime to the recession regime (or vice versa) depending on the evolution of value added over time.

A correlation between the GDPs of WAEMU member countries is analysed in order to understand how economic fluctuations in the union are driven by a cycle of primary product activity. To do so, we use primary sector value added as a probability transition variable from an expansion to a recessionary regime. To this end, we study the significance of the probability transition parameters and compare their impact on the growth rate in each country, depending on the regime, through the coefficient $\mu(S_t)$ in a univariate setting. We also compare the dependency properties to the length of expansion or recession, and the likely duration of each plan for each business cycle to analyse their co-movements. This is the study of the synchronization of economic growth rates across member countries using the Markov regime-switching forecasting model proposed by Filardo (1994), Filardo and Gordon (1998), and taken up by Kim et al. (2008).

In the formulation of the time-dependent probability transition model, it is possible to study the synchronization of business cycles across WAEMU countries with a probability transition variable the value added of each sector of activity. To show the extent to which business cycles are synchronised in the WAEMU, as a result of agricultural specialisation or structural transformation, we seek to determine whether the effect of a shock on the agricultural sector is transmitted symmetrically to economic activity (respectively a shock on the industry sector and then on the services sector). It is defined as an unobservable or latent variable governed by two regimes of a Markov chain of order 1

With the following transition matrix:

$$P_{ij}(S_t = i / S_{t-1} = j, z_{t-k}) = \begin{pmatrix} P_{11}(z_{t-k}) & 1-P_{22}(z_{t-k}) \\ 1-P_{11}(z_{t-k}) & P_{22}(z_{t-k}) \end{pmatrix} \quad (8)$$

With P_{ij} the probability of passing from regime j at time $t-1$ for regime i at time t and t, $j=1,2$ with $\sum_{j=1}^{2}P_{ij}=1$ for all $\forall_{ij} \in \{1,2\}$, k is a lag value. The functional form that links z_{t-k} to P_{ij} is logistic:

$$P_{11}(z_{t-k}) = \frac{\exp^{(\theta_{1.1}+\theta_{1,2}z_{t-k})}}{1+\exp^{(\theta_{1.1}+\theta_{1,2}z_{t-k})}} \qquad \textit{regime } 1 \quad (9)$$

$$P_{22}(z_{t-k}) = \frac{\exp^{(\theta_{2.1}+\theta_{2,2}z_{t-k})}}{1+\exp^{(\theta_{2.1}+\theta_{2,2}z_{t-k})}} \qquad \textit{regime } 2 \quad (10)$$

The logistic specification responds to the consideration of the probabilities of non-symmetric realizations, with two regimes associated with small and large values of the leading probability variables. Thus, these probabilities contain information on the probability of remaining in or leaving a given regime (either regime 1 or regime 2) k periods after a change in z occurs. Thus, y and z are growth rates, with regimes 1 and 2 capturing expansions and recessions, or regimes with low and high growth rates. The high growth rate regime is not selected a-priori, but is determined endogenously by the data. Suppose, for example, that the data contained in the estimated coefficients μ_1 with a positive sign and μ_2 with a negative sign. Regime 1 could then be interpreted as an expansion and regime 2 as a recession. Suppose in equation (4) that $\theta_{1,2}$ is positive. This means that any increase (resp. decrease) in z increases P_{11},i.e. the probability that y remains in regime 1 (resp. $1-P_{11}$, i.e. the probability that y exits regime 1) k periods later. A negative coefficient indicates a reduction in the probability of remaining in the expansion regime. We have a similar interpretation for $\theta_{2,2}$. For example, a negative coefficient ($\theta_{2,2}$ < 0) indicates that any decrease (rep. increase) in z increases the probability of remaining in regime 2 (or exiting regime 2).

If it turns out that the coefficients $\theta_{1,2}$ and $\theta_{2,2}$ are not significant, it is deduced that the effect of the productivity of the agricultural sector measured by the value added as a percentage of GDP on the business cycle of the country concerned is not informative in the probability of an expansion or recession (diffusion) occurring. These effects will be compared across countries to better identify possible co-movements in the business cycles of the countries concerned. Similarly, unconditional probabilities of being in recession can be calculated to monitor synchronization by the formula as follow:

$$\Pr(S_{t=2}) = \frac{1-P_{11}}{2-P_{11}-P_{22}} \qquad (11)$$

Furthermore, the choice of the typology of economic cycles is decisive for the analysis of synchronization. Among the multitude of empirical works on cyclical analysis, a certain amount of confusion has emerged regarding the definition of cycles. However, it is important to know exactly what type of cycle one is trying to date and then track in real time. In the empirical literature on the business cycle, we can distinguish between three types of cycles. Namely, the business cycle, the growth cycle which concerns the output gap, and the acceleration cycle which is actually the growth rate cycle. These different cycles have different characteristics (see Anas and Ferrara 2004, Zarnowitz and Ozyldirim 2006). Originally, the business cycle refers to the series level (log-), as defined by Burns and Mitchell (1946). It is the cycle of the activity level. In contrast, the growth rate cycle is described by phases of acceleration and deceleration that are of interest for short-term analysis in countries that are not often affected by recession. It is this type of cycle that we retain in our study, and which gives us the results of the estimations of the MSI-AR switching model with constant.

4. EMPIRICAL RESULTS

4.1 Analysis of the correlation of the growth rate in the WAEMU

The measure of the adequacy of the Kaiser model, which shows the importance of a common factor guiding the business cycle in the WAEMU, is relevant. Indeed, the table 5 (in annex) indicates that the use of the common factor model to determine the co-movements of GDP fluctuations remains reliable at 62.22% according to this method. On this basis, the partial correlation matrix from the common factor model indicates some co-movement between economic activities in WAEMU with the exception of a few country pairs such as Mali-Togo, Mali-Guinea-Bissau, Mali-Benin, Niger-Guinea-Bissau, Benin-Côte d'Ivoire, Côte d'Ivoire-Burkina Faso, Senegal-Togo, Senegal-Niger whose common component records opposite trends in growth rates. That is to say 20 positive correlations which are positive against 8 negative correlations so 71% of co-movements in economic growth rates. According to the partial correlation matrix describe in table 1 bellow, there is a tendency towards the synchronization of economic activities.

Table 1: Kaiser partial correlation matrix of economic growth rates in WAEMU

	PTO	**PGB**	**PBF**	**PCI**	**PBE**	**PNR**	**PML**	**PSE**
PTO	1							
PGB	0,100	1						
PBF	0,010	0,145	1					
PCI	0,147	0,214	-0,051	1				
PBE	0,119	0,060	0,075	-0,158	1			
PNR	0.113	-0,283	0,498	0,286	0,005	1		
PML	-0,043	-0,033	0,203	0,120	-0,048	0,073	1	
PSE	-0,218	0,095	0,336	0,206	0,107	-0,085	0,155	1

Note: The variables PBE, PBF, PCI, PGB, PML, PNG, PSE, and PTO represent, respectively, the gross domestic product of Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo.

Source: Author based on World Bank data.

4.2 Analysis of break points in GDP growth rates in the WAEMU

The endogenous threshold variable of our smooth transition model with residual autocorrelation (SETAR) assigned in table 6 (annex) indicates two regimes overall. This model uses lagged GDP as the threshold variable. However, by using exogenous or probability transition variables as threshold variables in a TAR model (Threshold Autoregression model) depicted in tables 7 and 8, we obtain two regimes (one breakpoint) for the agriculture value added variable of in Benin, Burkina Faso, Guinea-Bissau and Togo. This series presents a non-linearity linked to the socio-economic events that influence agricultural production (drought and oil shocks in the 1970s, the process of globalisation of the economies, etc.). On the other hand, in countries such as Côte d'Ivoire and Senegal, it is the value added of industry that presents non-linearity due to structural changes. Whatever the sector of activity, sectoral production in Guinea-Bissau shows structural changes in the series of value added. There is a structural break in the value added series in agriculture and services in Togo. In the WAEMU, the growth rate of value added as a percentage of GDP is subject or not to regime changes depending on the country. Shocks on sectors of activity seem to have different (asymmetrical) effects, which could complicate some coordination of sectoral policies.

4.3 MSI-AR (1) model results for the terms of trade

MSI-AR (1) represents the Markov switching model with constant and first-order autocorrelation. The results of estimating this model with the terms of trade as the probability transition variable are summarized in the following table 2.

Table 2: Cyclical impact of the terms of trade (TE) on GDP in WAEMU countries.

Impacts of Terms of Trade(TE)	**PBE**	**PBF**	**PCI**	**PGB**	**PML**	**PNR**	**PSE**	**PTO**
μ_1	4,598 (0,246)$^{(3)}$	6,661 (0,281)$^{(3)}$	4,695 (2,820)$^{(1)}$	3,698 (0,523)$^{(3)}$	9,302 (0,874)$^{(3)}$	3,740 (0,965)$^{(3)}$	4,754 (1,679)$^{(3)}$	3,897 (1,049)$^{(3)}$
μ_2	-1,465 (1,176)	1,770 (0,950)$^{(1)}$	-5,994 (3,288)$^{(1)}$	-25,832 (3,190)	1,168 (1,046)	-16,688 (4,768)	1.113 (1,709)	-15,953 (4.399)$^{(3)}$
$\mu_1+\mu_2$	3,133	8,431	-1,299	-22,134	10,470	-12,948	5,867	-12,056
$\theta_{11}-TE$	9,849 (6343)	0,167 (0,495)	9,128 (9480)	1,792 (0,582)$^{(3)}$	-6,910 (434,)	1,580 (0,516)$^{(3)}$	0,008 (0,404)	9,521 (7448)
$\theta_{21}-TE$	1,149 (0,370)$^{(3)}$	0,473 (0,274)$^{(1)}$	1,649 (0,526)$^{(3)}$	9,841 (9329,849)	-0,067 (0,018)$^{(3)}$	10,230 (23756)	2,976 (5,003)	1,809 (0,597)$^{(3)}$

Note: $\theta_{11}-TE$ and $\theta_{21}-TE$ respectively reflect the probability transition parameters from regime 1 when it was in regime 1 and the probability transition parameters from regime 2 (low regime) to regime 1 (high regime). The superscripts (1), (2) and (3) show the significance at 10%, 5% and 1% respectively. μ_1 and μ_2 are respectively growth rate in expansion and recession regime. The lag value $k=1$ is selected according the criteria of AIC, SC, and FPE carried out. The variables PBE, PBF, PCI, PGB, PML, PNG, PSE, and PTO represent, respectively, the gross domestic product of Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo.

Source: authors from World Bank data

Using the terms of trade as a probability transition variable, we find that the probability transition parameters are significant for Guinea-Bissau (1.792) and Niger (1.58) respectively in the expansion phase at the conventional level. The persistence of the state of economic expansion of these two countries depends on the improvement in their terms of trade. On the other hand, these parameters are significant for Benin, Burkina Faso, Côte d'Ivoire, and Togo when moving from recession to expansion. The terms of trade play an important role in GDP fluctuations in these countries. Côte d'Ivoire and Togo, in particular, have a negative average growth rate across the two regimes. Export revenues do not cover import expenditure, which tends to reduce the average growth rate across the two regimes.

4.4 MSI-AR (1) model results for business cycles

The impact of the value added of agriculture on the GDP growth rate depicted in table 3 is greater in the strong regime phase (expansion) than in the weak regime phase (recession) in countries such as Benin, Burkina Faso, Côte d'Ivoire, Senegal, and Mali. However, the impact of agricultural production is relatively more important in recession than in expansion for Guinea-Bissau, Niger, and Togo. When agricultural value added is used as the leading variable, its effect becomes negative in recession for Benin, Guinea-Bissau, Niger, Senegal, and Togo. In other words, when agricultural production is in decline, the economies of these countries are in recession. Under these conditions during the recession phase the business cycle follows the agricultural cycle for these countries.

On the other hand, the GDP of Burkina Faso, Côte d'Ivoire and Mali show positive growth rates in both expansion and recession phases. For both regimes combined, the impact of value added in agriculture is positive and more significant for Côte d'Ivoire, followed by Burkina Faso, Senegal and Benin. On the other hand, Guinea-Bissau, Niger and Togo have very significant negative rates. Moreover, the probability transition parameters from recession to expansion are positive and significant for Senegal, negative and significant for Côte d'Ivoire and Mali. The value added of agriculture plays an important role in output fluctuations in these countries. Transition parameters indicate a dependence on the expansionary state due to the primary sector in Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Niger and Togo.

Table 3: Analysis of business cycles in the WAEMU with the agriculture added value (VA) as a probability transition variable MSI-AR (1)

Impacts of agricultural value added (VA) on GDP	**PBE**	**PBF**	**PCI**	**PGB**	**PML**	**PNR**	**PSE**	**PTO**
μ_1	4,523 (0,340) (3)	6,492 (0,321) (3)	8,201 (0,644) (3)	4,031 (0,635) (3)	16,172 (2,925) (3)	3,403 (0,664) (3)	5,001 (0,539) (3)	5,231 (1,138) (3)
μ_2	-2,812 (1,068) (3)	1,526 (0,427) (3)	0,448 (0,668)	-21,615 (3,328)	3,431 (0,519) (3)	-16,448 (0,557) (3)	-1,005 (0,747)	-9,697 (2,715) (3)
$\mu_1 + \mu_2$	1,711	8,018	8,649	-17,584	16,603	-13,045	3,996	-4,466
$AR(1)$	0,098 (0,110) (3)	-0,370 (0,168) (3)	-0,220 (0,164) (3)	-0,068 (0,158)	-0,265 (0,181)	0,054 (0,141)	-0,255 (0,199)	0,463 (0,155) (3)
$Log\sigma$	0,711 (0,110) (3)	0,525 (0,128) (3)	1,271 (0,116) (3)	1,438 (0,110) (3)	1,361 (0,129) (3)	1,481 (0,099) (3)	0,843 (0,131) (3)	1,415 (0,119) (3)
$\theta_{11} - VA$	0,059 (0,015)	0,025 (0,015) (1)	0,107 (0,034) (3)	0,063 (0,015) (3)	-0,490 (82,753)	0,0723 (0,017) (3)	0,009 (0,031)	0,078 (0,020) (3)
$\theta_{21} - VA$	0,579 (110,488)	-0,003 (0,016)	-0,094 (0,028) (3)	0,424 (775,251)	-0,067 (0,018) (3)	0,493 (289,326)	0,129 (0,061) (3)	0,019 (0,032)
MV	-140,072	-140,090	-164,21	-143,177	-148,892	-174,859	-149,690	-175,720
P_{11}	0,857 (0,048)	0,688 (0,016)	0,9440 (0,025)	0,9503 (0,013)	0,000 (0,000)	0,9533 (0,032)	0,5450 (0,009)	0,9321 (0,030)
P_{12}	0,142 (0,048)	0,311 (0,016)	0,0559 (0,025)	0,0496 (0,013)	1,000 (0,000)	0,0466 (0,032)	0,4549 (0,009)	0,0678 (0,030)
P_{21}	0,999 (0,000)	0,470 (0,002)	0,0760 (0,030)	1 (0,000)	0,069 (0,028)	0,9999 (0,000)	0,911(0,037)	0,6661 (0,029)
P_{22}	0,001 (0,000)	0,529 (0,002)	0,9239 (0,030)	0 (0,000)	0,930 (0,028)	0,0001 (0,000)	0,0889(0,037)	0,3388 (0,029)
Expansion period	7,957 (2,981)	3,223 (0,175)	25,980 (23,996)	22,027 (7,386)	18,910 (12,750)	1,000 (0,000)	1,0995 (0,046)	1,515 (0,066)
Recession period	1,000 (0,000)	2,123 (0,012)	17,330 (13,084)	1,000 (0,000)	1,000 (0,000)	48,120 (57,430)	2,1989 (0,045)	19,160 (12,179)

Note: The superscripts (1), (2) and (3) show the significance at 10%, 5% and 1% respectively. The lag value $k = 1$ is selected according the criteria of AIC, SC, and FPE carried out. $\theta_{11} - TE$ and $\theta_{21} - TE$ respectively reflect the probability transition parameters from regime 1 when it was in regime 1 and the probability transition parameters from regime 2 (low regime) to regime 1 (high regime). μ_1 and μ_2 are respectively growth rate in expansion and recession regime. σ represents the variance and remain constant and MV is likelihood ratio. The variables PBE, PBF, PCI, PGB, PML, PNG, PSE, and PTO represent, respectively, the gross domestic product of Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo.

Source: authors from World Bank data

As regards the average duration of economic cycles, under the effect of primary sector, it varies according the country. The average length of the business cycle in Benin is 4.48 years, 2.67 years in Burkina Faso, 11.51 years in Guinea-Bissau, 9.96 years in Mali, 1.65 years in Senegal and 10.337 years in Togo. This situation reflects certain heterogeneity in the duration of economic cycles in the WAEMU due to the activities of the primary sector. This situation is confirmed by the unconditional probability of being in a very high recession phase for Mali, and close to 50% for countries such as Côte d'Ivoire, Burkina Faso and even Senegal. The normal state (expansion) is dominant for Benin, Guinea-Bissau, Niger and Togo.

Table 4: Unconditional probability of being in a crisis phase under the cyclical impact of agricultural added value (VA)

Unconditional probability	**PBE**	**PBF**	**PCI**	**PGB**	**PML**	**PNR**	**PSE**	**PTO**
$\Pr(S_{t=2}) = \frac{1-P_{11}}{2-P_{11}-P_{22}}$	12,52%	39,85%	42,33%	4,73%	93,45%	4,46%	33,30%	9,31%

The variables PBE, PBF, PCI, PGB, PML, PNG, PSE, and PTO represent, respectively, the gross domestic product of Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo.

Source: authors from World Bank data

Using industry value added as a transition variable (table 9 annex), Côte d'Ivoire and Burkina Faso recorded the highest growth rates, followed by Togo, Senegal and Benin. Guinea-Bissau and Niger have very high negative average growth rates. Benin, Burkina Faso, Côte d'Ivoire, Niger, Togo and Senegal are dependent on the state of expansion. Similarly, there is a state dependence on recession for countries such as Burkina Faso, Côte d'Ivoire, Guinea Bissau and Togo. The coefficients of the average growth rate are significantly different from zero with mostly opposite signs. According the probability transition parameters, we see that the increase in the economic growth rate is related to the high probability of remaining in the strong regime of the growth rate of industrial value added in Benin, Côte d'Ivoire and Guinea Bissau. The probability transition parameters from recession to expansion regime are significant and positive for Côte d'Ivoire and Niger indicate that these parameters from recession to expansion influence the low transition probability.

Concerning the impact of the tertiary sector (table 10 annex), the growth rate for the two regimes as a whole remains higher this time for Mali. Next come respectively Côte d'Ivoire, Burkina Faso and Benin to a certain extent. On the other hand, the other countries have very high negative growth rates. There is a dependence on the state of expansion in Benin, Burkina Faso, Côte d'Ivoire, Guinea Bissau, Niger, Senegal and Togo. Dependence on the state of recession is also important for Côte d'Ivoire and Mali. The significance and positive sign of the probability transition parameters in most countries indicate that the increase in the growth rate of value added in tertiary sector leads to an increase in the economic growth rate in these countries. This is the effect of structural transformations in these economies. The structural transformations in WAEMU indicate that the agricultural specialization of member countries is not sufficient by itself to lead these countries into the expansion phase. The industry and services sectors, despite their strong positive impact in growth in expansion phase and negative impact in recession phase for most member countries, drive business cycles differently in WAEMU. The reason may be linked to the delayed awareness of the limits of specialization and the slow pace of structural transformation, which is reflected in the relatively greater contribution of other sectors of activity in some member countries.

5. CONCLUSION

In analysing sectoral sources of synchronization or fluctuations in the WAEMU, this paper was based on common factor model and Markov switching models (Hamilton, 1989). Analysis of the correlations of growth rates with the common factor model suggests a tendency towards co-movement. In contrast, in a non-linear framework, the Markov switching model indicates that the terms of trade determine growth rate fluctuations in the WAEMU. Moreover, this model has allowed us to use the different values added as probability transitions variables to explain the extent to which sectoral (agricultural) specialisation can contribute to the synchronisation of business cycles. Our main results show that all WAEMU member countries record high GDP growth rates in the expansion phase following a positive shock regardless of the sector of activity. On the other hand, in periods of recession, business cycles in some WAEMU member countries do not follow activities cycles. While some countries such as Benin, Guinea-Bissau, Niger, Senegal and Togo find themselves in recession following a negative activity shock, other countries are still experiencing a expansion.

Moreover, the unconditional probabilities indicate that in our sample, 39.85% of observations should be in recession for

Burkina-Faso, 42.33% for Côte d'Ivoire and 33.30% for Senegal. The dominance of the normal state tends to be reduced for these countries, whereas for Mali it is the state of crisis that dominates at 93.45%. These results correspond well to the real situation of these WAEMU economies indicating that business cycles have not yet synchronized. Thus, the thesis of Prebisch-Singer (1950) according to which the terms of trade of primary products compared to manufactured products tend to deteriorate over time is confirmed and is a source of instability of growth rates in the union. In the long term, the prices of exported primary goods fall compared to those of manufactured goods, certainly because of differences in the income elasticities of world demand. The development of the world supply of primary goods would cause prices to fall in the face of relatively rigid demand.

With regard to the analysis of the co-movements of economic growth rates, and the wide disparity in average growth rates across all regimes, agricultural sector specialisation has not been able to synchronise business cycles in the WAEMU. Despite their high degree of openness, most of the countries of the union that have adopted the policy of agricultural specialization are poorly integrated into world trade, no doubt due to unequal trade. However, the disparities in economic growth rates can be linked to the structural transformation process of WAEMU member economies and their desire for better integration into the world economy, which makes them more vulnerable.

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Annex

Table 5: measuring the adequacy of the Kaiser common-factor model

	MSA
PTO	0.416973
PGB	0.376498
PBF	0.641312
PCI	0.642047
PBE	0.401385
PNR	0.581289
PML	0.825310
PSE	0.662283
Kaiser's MSA	0.622298

Note: The variables PBE, PBF, PCI, PGB, PML, PNG, PSE, and PTO represent, respectively, the gross domestic product of Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo.

Source: authors from World Bank data

Table 6: SETAR model selection criterion table

Threshold variable of GDP from optimal lag								
	Benin PBE(-3)	Burkina Faso PBF(-4)	Côte d'Ivoire PCI(-4)	Guinea-Bissau PGB(-2)	Mali PML(-3)	Niger PNR(-1)	Senegal PSE(-2)	Togo PTO(-2)
SRR	281,61	300,88	540,85	934,30	716,53	944,56	514,40	931,33
Number of regime	2	2	2	2	2	2	2	2

Note: The variables PBE, PBF, PCI, PGB, PML, PNG, PSE, and PTO represent, respectively, the gross domestic product of Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo.

Source: authors from World Bank data

Table 7: Table of TAR model selection criteria

Number of regime from threshold variables of the added values												
	Benin			**Burkina Faso**			**Cote d'Ivoire**			**Guinea-Bissau**		
	ABE	IBE	SBE	ABF	IBF	SBF	ACI	ICI	SCI	AGB	IGB	SGB
SRR	255	443	443	292	486	486	1324	916	1324	957	974	1122
Number of regime	2	1	1	2	1	1	1	2	1	2	2	2

Note: A denotes agriculture VA, I denote industry VA, and S denotes service VA. The abbreviations BE, BF, CI and GB represent, respectively Benin, Burkina Faso, Côte d'Ivoire and Guinea-Bissau.

Source: authors from World Bank data

Table 8: Table of TAR model selection criteria

Number of regime from threshold variables of the added values												
	Mali			**Niger**			**Senegal**			**Togo**		
	AML	IML	SML	ANR	INR	SNR	ASE	ISE	SCI	ATO	ITO	STO
SRR	**255**	**443**	**443**	**1673**	**1673**	**1673**	**297**	**195**	**191**	**957**	**1442**	**838**
Number of regime	2	1	1	1	1	1	1	2	2	2	1	2

Note: A denotes agriculture VA, I denote industry VA, and S denotes service VA. The abbreviations ML, NR, SE and TO represent, respectively Mali, Niger, Senegal and Togo.

Source: authors from World Bank data

Table 9: Analysis of business cycles in the WAEMU with industry VA as a probability transition variable: MSI-AR(1)

Impact of industrial sector value added VA on GDP	PBE	PBF	PCI	PGB	PML	PNR	PSE	PTO
μ_1	4,535 (0,333) (3)	6,520 (0,312) (3)	8,943 (0,970) (3)	4,026 (0,633) (3)	16,172 (2,925) (3)	3,400 (0,694) (3)	4,365 (0,624) (3)	6,952 (3,047) (2)
μ_2	-2,817 (1,009) (3)	1,548 (0,437) (3)	0,527 (0,745)	-21,616 (3,318) (2)	3,431 (0,519) (3)	-15,909 (4,116) (2)	-2,070 (1,718)	-2,209 (2,682)
$\mu_1 + \mu_2$	1,718	8,068	9,470	-17,590	19.603	-12,509	2,295	4,743
$AR(1)$	0,094 (0,152) (3)	-0,376 (0,167) (2)	-0,010 (0,247)	-0,073 (0,158)	-0,265 (0,181)	0,090 (0,137)	-0,143 (0,277)	0,012 (0,169)
$Log\sigma$	0,701 (0,110) (3)	0,522 (0,127) (3)	1,196 (0,128) (3)	1,439 (0,111) (3)	1,361 (0,129) (3)	1,481 (0,100) (3)	0,892 (0,143) (3)	1,627 (0,119) (3)
$\theta_{11} - VA$	0,131 (0,034) (3)	0,032 (0,022)	0,099 (0,034) (2)	0,205 (0,053) (3)	-0,490 (82,753)	4,875 (3731,98)	0,135 (0,080)	0,073 (0,080)
$\theta_{21} - VA$	0,753 (10,588)	-0,008 (0,025)	1,196 (0,128) (3)	1,545 (906,000)	-0,067 (0,018) (3)	0,215 (0,058) (3)	0,068 (0,051)	-0,105 (0,102)
MV	-136,304	-140,168	-164,198	-143,152	-148,892	-17,262	-148,443	-178,230
P_{11}	0,884 (0,061)	0,660 (0,017)	0,885 (0,035)	0,000 (0,000)	0,000 (0,000)	0,924 (0,098)	0,786 (0,036)	0,808 (0,039)
P_{12}	0,116 (0,061)	0,340 (0,017)	0,155 (0,035)	1,000 (0,000)	1,000 (0,000)	0,076 (0,098)	0,214 (0,036)	0,192 (0,039)
P_{21}	0,999 (0,000)	0,456 (0,005)	0,106 (0,034)	0,052 (0,029)	0,069 (0,028)	1,000 (0,000)	0,926 (0,030)	0,114 (0,035)
P_{22}	0,001 (0,000)	0,543 (0,005)	0,893 (0,034)	0,947 (0,029)	0,930 (0,028)	0,000 (0,000)	0,073 (0,030)	0,885 (0,035)
Expansion period	14,085 (12,617)	2,941 (0,158)	9,482 (2,758)	1,000 (0,000)	18,910 (12,750)	38,895 (31,255)	4,799 (0,779)	5,461 (1,381)
Recession period	1,000 (0,000)	2,190 (0,025)	10,334 (3,163)	35,496 (42,871)	1,000 (0,000)	1,000 (0,000)	1,081 (0,036)	9,834 (4,335)

Note: The superscripts (1), (2) and (3) show the significance at 10%, 5% and 1% respectively. The lag value $k = 1$ is selected according the criteria of AIC, SC, and FPE carried out. $\theta_{11} - TE$ and $\theta_{21} - TE$ respectively reflect the probability transition parameters from regime 1 when it was in regime 1 and the probability transition parameters from regime 2 (low regime) to regime 1 (high regime). μ_1 and μ_2 are respectively growth rate in expansion and recession regime. σ represents the variance and remain constant and MV is likelihood. The variables

PBE, PBF, PCI, PGB, PML, PNG, PSE, and PTO represent, respectively, the gross domestic product of Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo.

Source: authors from World Bank data

Table 10: Analysis of business cycles in the WAEMU with tertiary sector value added (VAI) with VAI as a probability transition variable: MSI-AR (1)

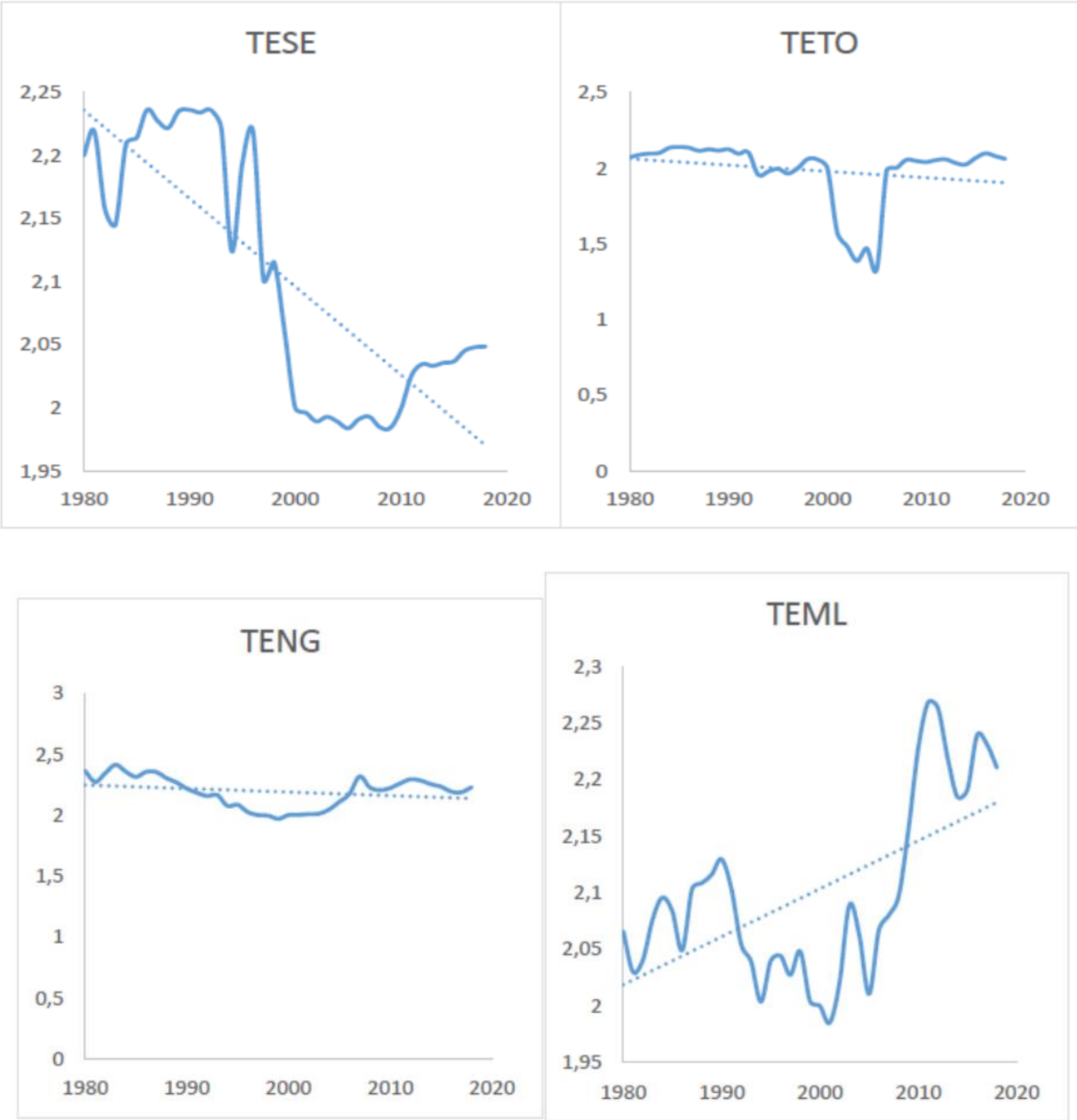
Impact of tertiary sector value added VAI on *GDP*	**PBE**	**PBF**	**PCI**	**PGB**	**PML**	**PNR**	**PSE**	**PTO**
μ_1	4,516 (0,342) (3)	6,521 (0,322) (3)	8,910 (0,081) (3)	4,030 (0,035) (3)	16,431 (2,746) (3)	3,395 (0,675) (3)	3,996 (0,439) (3)	4,288 (0,854) (2)
μ_2	-2,87 (1,049) (3)	1,525 (0,437) (3)	0,574 (0,773)	-21,614 (3,332) (3)	3,435 (0,500) (3)	-16,486 (3,511) (3)	-5,315 (2,951) (1)	-14,925 (5,531)
$\mu_1+\mu_2$	1,646	8,046	9,484	-17,584	19,866	-12,536	-1,319	-10,637
$AR(1)$	0,995 (0,153) (3)	-0,364 (0,173) (2)	-0,004 (0,247)	-0,069 (0,158)	-0,278 (0,158) (1)	0,071 (0,141)	0,106 (0,163)	0,192 (0,155)
$Log\sigma$	0,712 (0,110) (3)	0,523 (0,126) (3)	1,213 (0,144) (3)	1,439 (0,111) (3)	1,357 (0,120) (3)	1,408 (0,099) (3)	0,799 (0,122) (3)	1,584 (0,101) (3)
$\theta_{11}-VAI$	0,041 (0,010) (3)	0,014 (0,010)	0,039 (0,018) (2)	0,550 (60,722)	-0,786 (545,793)	0,799 (441,950)	0,349 (167,942)	0,103 (0,031) (3)
$\theta_{21}-VAI$	0,485 (441,953)	-0,001 (0,012)	-0,045 (0,017) (3)	0,091 (0,023)	-0,078 (0,020) (3)	0,088 (0,021) (3)	0,067 (0,021) (3)	0,512 (382,743)
MV	-138,816	-140,699	-165,011	-142,114	-148,256	-174,007	-88,882	-175,901
P_{11}	0,875 (0,026)	0,651 (0,014)	0,874 (0,031)	0,955 (0,025)	0,000 (0,000)	0,957 (0,029)	0,969 (0,002)	0,980 (0,013)
P_{12}	0,124 (0,026)	0,348 (0,014)	0,125 (0,031)	0,044 (0,025)	1,000 (0,000)	0,042 (0,029)	0,003 (0,002)	0,019 (0,013)
P_{21}	1,000 (0,000)	0,481 (0,001)	0,096 (0,029)	0,999 (0,000)	0,066 (0,039)	1,000 (0,000)	1,000 (0,000)	1,000 (0,000)
P_{22}	0,000 (0,000)	0,518 (0,001)	0,903 (0,029)	0,000 (0,000)	0,933 (0,039)	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)
Expansion period	8,381 (1,545)	2,878 (0,158)	8,365 (1,715)	29,088 (12,750)	1,000 (0,000)	38,046 (38,165)	33,281 (3,042)	83,505 (51,550)
Recession period	1,000 (0,000)	2,075 (0,008)	11,207 (2,766)	1,000 (0,000)	19,226 (8,132)	1,000 (0,000)	1,000 (0,000)	1,000 (0,000)

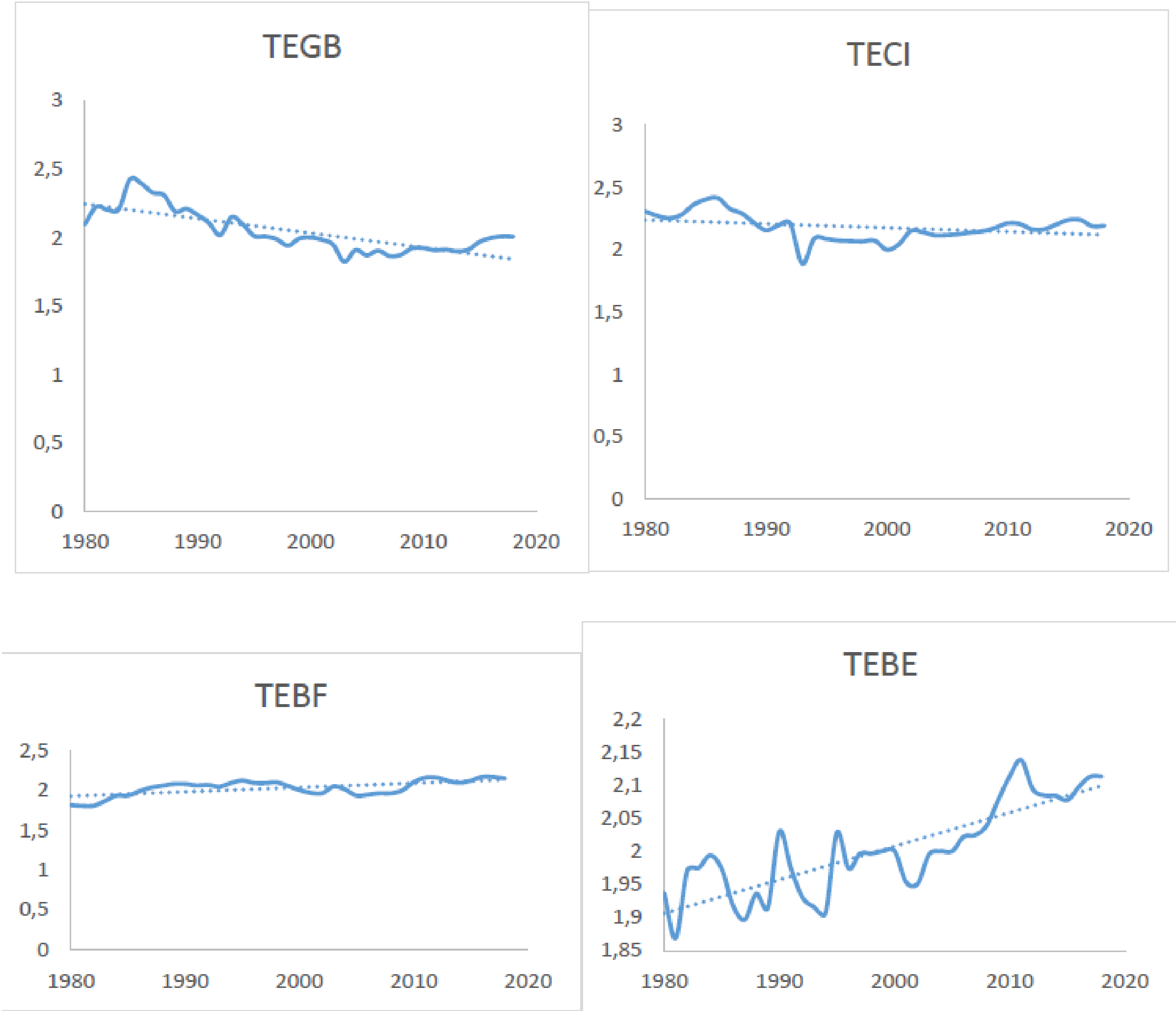
Note: The superscripts (1), (2) and (3) show the significance at 10%, 5% and 1% respectively. The lag value $k=1$ is selected according the criteria of AIC, SC, and FPE carried out. $\theta_{11}-TE$ and $\theta_{21}-TE$ are respectively reflect the probability transition parameters from regime

1 when it was in regime 1 and the probability transition parameters from regime 2 (low regime) to regime 1 (high regime). μ_1 and μ_2 are respectively growth rate in expansion and recession regime. σ represents the variance and remain constant and MV is likelihood ratio. The variables PBE, PBF, PCI, PGB, PML, PNG, PSE, and PTO represent, respectively, the gross domestic product of Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo.

Source: authors from World Bank data

Figure 6: Evolution of the terms of trade in the WAEMU with their long term trend.





Note: The variables TEBE, TEBF, TECI, TEGB, TEML, TENG, TESE, and TETO represent, respectively, the terms of trade of Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo

Source: authors from World Bank data