Retrospective Analysis of the Effects of Monetary Impulses on Economic Growth in Mali

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Abstract

In a context of financial liberalisation, monetary policy is essentially based on central bank policy rates. It is therefore important to ensure that changes in key interest rates are properly transmitted.This paper empirically analyses the contribution of monetary impulses to economic growth in Mali over the period 1970 – 2009. In terms of methodology, weused an error correction model (ECM). In general, the results show a relative inefficiency of the BCEAO's key rate policy on economic growth in Mali. In addition, an increase in credit to the economy leads to an increase in gross domestic product in the short and long term. In fact, for economic activity in Mali to be adjusted, active use of the money market rate is necessary.

Keywords : Monetary impulses, economic growth, key rates, BCEAO, Mali.

JEL classification: E52, G00, C10, C12.

1. Introduction

The member states of the West African Economic and Monetary Union (WAEMU) experienced, to varyingdegrees, a deepeconomic and financialcrisis in the 1980s and early 1990s. The implementation of structural adjustment programmes over a relatively long period and the change in the parity of the CFA franc against the French franc in January 1994 led to a resumption of economic growth, which should be supported and accelerated by appropriate macroeconomic and sectoral measures. Macroeconomic policy, in particular through monetary and fiscal policies, acts in the short term on aggregate demand and aims to adjust real output in order to keep the economy on a non – inflationary growth path in the long term.

Monetary policy is at the heart of economic policy discussions aimed at price stability and sustainable growth. Economicpolicyis the set of government interventions aimed at regulating the overall course of the economy. It generally comprises cyclical policy and structural policy. Structural policy is the term used to describe government initiatives that affect the structure of the economy. Example: regional planning, agricultural and industrial policies, privatization...

Focused on the short term, the economic policy is the set of actions carried out by the State on the economic situation, by means of monetary, exchange rate and budgetary policies. The economic situation is determined by short – term fluctuations in macroeconomic variables, mainly the level of production, prices, employment, external balances and public balances. Cyclical policy seeks to influence these macroeconomic variables.

In this paper we focus on the monetary policy of the BCEAO in general and in particular on the retrospective analysis of the effects of monetary impulses on economic growth in Mali during the period 1970 – 2009.

Monetarypolicy in the West AfricanEconomic and Monetary Union (WAEMU), which comprises eight countries [1]including Mali, is conducted by the Central Bank of West African States (BCEAO). The BCEAO's monetary policy is conducted in a context of rapid and profound changes in the environment. This situation has led the monetary authorities to seek constant adaptation of their instruments at all times. In such a context, the mechanisms of monetary transmission to the real sector can be multiple.

[1]The UEMOA zone is characterized by a common currency, the franc, grouping together eight member countries (Benin, Burkina Faso, Côte d'Ivoire, Guinea Bissau, Mali, Niger, Senegal and Togo).

The evolution of monetary policy in the WAEMU zone can be divided in to four main stages: the conduct of monetary policy between 1962 and 1975; the reform of monetary and credit policy; the reorganisation of monetary management rules; and the implementation of the new monetary management system. The new monetary management system of the WAEMU is based on increased recourse to market mechanisms, thusfavouring indirect liquidity regulation methods. Thus, the interest rate plays a key role and becomes the main instrument of monetary policy, particularly since the abandonment of the credit framework in January 1994.

Indeed, although price stability is the primary objective of many central banks, they are also interested in other objectives such as the fight against unemployment, economic growth, the stability of financial markets, interest rates and foreign exchange markets.

In this paper we focus on economic growth. Indeed, the search for strong economic growth is closely linked to the objective of full employment. This is because when we get closer to full employment, firms increase their capital expenditure in order to improve their productivity, which promotes growth.

During the period 1970 – 2009, Mali's economic situation was difficult. It was marked on the one hand by the Ivorian crisis which disrupted the economy in September 2002; the surge in oil prices and the fall in gold production in 2003. On the other hand, the invasion of locusts in 2004 and the poor rain fall of the 2004 – 2005 agricultural season. The highest growth rate was achieved in 2003 (7.6%) while the lowest rate was observed in 2004 (2.3%).

In addition, 2008 was marked by global economic crises (oil, food and financial). In Mali, these crises were characterised by an increase in the cost of production factors and consumer goods. Despite the persistence of the global crises, the real growth rate of the economy was 4.3% in 2009, down 0.9 percentage points compared to 2008. This improvement in economic grow this the result of the government's determination to stimulate strong growth with a view to reducing poverty.

Analysis of these statistics on the economic situation in Mali shows a high volatility in the rate of economic growth in Mali. This calls into question the objective of achieving strong economic growth through BCEAO monetary impulses, which is closely linked to the objective of full employment.

Given that in the WAEMU zone the same monetary policy instruments are applicable to all member countries, the effects of this policy differ according to the structure of the economies of the countries in the Union. It is therefore necessary to assess the impact of the retrospective effects of the BCEAO's monetary impulses on real gross domestic product in Mali. It is in this perspective that the present investigation is being conducted. Since one of the objectives of the BCEAO's monetary policy is economic growth, the BCEAO's monetary authorities and the government of Mali will be able to use this study for monetary planning and forecasting purposes. In addition, the BCEAO willbe able to use the results of this investigation for comparative purposes between WAEMU countries, of which Mali is an example, and also for monetary forecasting and planning.

To solve the problem, we asked the following question:What was the contribution of monetary impulses from the Central Bank of West African States (BCEAO) on the real gross domestic product of Mali over the period 1970 – 2009?

The fundamental objective of this research is to evaluate the contribution of monetary impulses of the BCEAO on the real gross domestic product of Mali during the period 1970 – 2009. More specifically, the general objective is to determine the contribution of the BCEAO's monetary impulses on the real gross domestic product in Mali. In the course of this research we seek to verify the following hypothesis: the monetary impulses of the BCEAO act positively on real gross domestic product of Mali.

To this end, in addition to this introductory part, the rest of the article is structured as follows:literature review; methodology and basic theoretical model; estimation of the model and interpretation of the results; conclusion.

2. Review of the literature

Monetary and fiscal policies can affect output, employment and the general price level through aggregates pending. The review of the economic literature highlights, not only theoretically but also empirically, a debate on the relative effectiveness of these two policies as instruments for regulating economic activity.

On the theoretical level, apart from the more recent contributions of the rational expectations current and the endogenous growth theories, the debate has for a long time and above all opposed the so – called Keynesian economists and those called monetarists.

According to the theory of rational expectations, developed in the United States from the 1970s onwards, no economic policy action (monetary and budgetary) is capable of acting effectively on economic activity unless it contains an element of surprise. The premises of this school are that: (i) expectations are rational, and (ii) goods and asset markets are in continuous and simultaneous equilibrium. The theory of rational expectations assumes that economic agents correctly anticipate all relevant variables and thatthey are fullyaware of how the economyworks, in particular the effects of economic policy decisions. However, this school of thought conceives, through the recent theories of endogenous growth, the possibility of state intervention when the economy is in a situation of sub – optimal equilibrium (the accumulation of human capital, the creation of infrastructures and public services, research and the diffusion of innovation).

The debate between Keynesian economists and monetarists has been mainly in the context of the analytical framework of the Keynesian general equilibrium for the determination of income (output) and the interest rate ensuring simultaneous equilibrium in the goods and services market and the money market in a closed economy. The Keynesian analysis, by calling into question the assumptions of the quantitative theory of its classical predecessors, relating to full employment and the constancy of the speed of circulation of money, reveals equilibria of under – employment, calling for a fiscal and/or monetary stimulus. The monetarist approach, held by Milton Friedman, maintains that in the short term, variations in the quantity of money can have temporary real effects due to the initial rigidity of prices. Moreover, fiscal policyis inefficient, mainly because of its crowding – out effects. However, in the long run, under the assumption of price and labour market flexibility, changes in the money supply only affect the general pricelevel. Output and employment are not affected.

This closed – economy analytical framework was enriched by the work of Mundell (1963) and Fleming (1962) who incorporated the external constraint and the international mobility of capital. Under the assumption of price and wage rigidity, they showed that in an open economy, the effect of the fiscal multiplier is reduced and fiscal action can only be effective under a fixed exchange rate regime, with some capital mobility. On the other hand, monetary action is ineffective, except under a flexible exchange rate regime, regard less of the degree of capital mobility.

Various empirical studies conducted in transition economies by Calvo and al. (1993) Coricelli (1998) Ould – Ahmed (1999) have shown that restrictive monetary policies had a recessionary macroeconomic impact, while neo – structuralist models (Van Wijnbergen, 1983 a; 1983 b). The concern for growth is all the more important because of the factthatitis the onlyway to ensure the sustainability of the economicgrowth of a country. The concern about grow this all the more legitimate as it seems to be linked to investment in the WAEMU zone. Indeed, empirical studies (Samba (1998);Tenou (1999) and Nubukpo (2002)) have generally high lighted, in the short term, the major role played by real investment and the evolution of the terms of trade, in addition to climatic factors.

In the long run, human capital, the investment rate and export growth are the variables that significantly influence per capita growth in WAEMU countries. Investment is therefore the main short – and long – term driver of growth in WAEMU economies. Its main determinants are: the stability of the macroeconomic framework, the quality of the legal, judicial and fiscal environment, the prospects for real profitability of enterprises, the efficiency of financial intermediation, the consolidation of public finances and the quality of public spending. However, the crucial role of credit to the economy as a driver of investment can not beignored. In this regard, the WAEMU banking system, because of its excessive reluctance to grant credit, in a context where the budget deficit of States is prohibited by convergence criteria that are more restrictive than those of the Euro zone, and where loans to the Treasury are henceforth banned (deletion of Article 16 of the BCEAO statutes on 19 September 2002 by the WAEMU Council of Ministers), is undoubtedly partly to blame for the weak performance of the zone in terms of economic growth. In particular, through a monetary policy with a pro – cyclical tendency due to the non – monetary origin of inflation in the UEMOA zone (inflation comes more from climatic hazards than from an excessive money supply (Doe, and al., 1997)) and excessive monetarism, the BCEAO cannot absolve it self of all responsibility for the poor performance of the WAEMU economies in terms of economic growth.

In order to assess the nature and effectiveness of monetary policy transmission channels in France, the Banque of France (1998) carried out simulations to assess the effects on growth and inflation of a 1 percentage point cut in key interest rates for two years. The underlying assumption was that the franc would remain unchanged towards the other currencies in the core group (France, Germany, the Netherlands, Belgium, Luxembourg and Denmark) of the European exchange – rate mechanism. The results are assessed in relation to a situation where the Central Bank considers the status quo preferable. The econometric simulations were based on the basic assumption that the fall was well integrated by the market, i.e. that it was reflected in a fall in interest rates at all maturities, including the long term.

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The additional growth obtained by reference to the scenario in which key rates would have remained at their initial level is 0.2% in the first year, 0.4% in the second and then decreases steadily thereafter. It is zero from the fifth year onwards. Thus, the effects on growth linked to the interest rate channel alone are on the whole limited and transitory. More generally, for the most industrialised countries (grouped together in the G8), the lags in monetary policy action do not differ significantly from one country to another (Gerlach and al. (1995); Cortet (1998)). Indeed, the impact of a change in key rates on activity is perceptible after six months and maximum after six to seven quarters.

Koné (1998) also used an error correction model to test the relative effects of monetary and fiscal policies on economic growth in WAEMU countries. The results show, on the one hand, that monetary and fiscal policies have a positive impact on nominal and real GDP. On the other hand, monetary policy was not inflationary in any of the WAEMU countries while fiscal policy was inflationary in Côte d'Ivoire in the short run and in Mali in the short and long run. The Nubukpo study (2002) study adds that a good transmission of key interest rates remains a necessary condition for WAEMU monetary policy to have a positive impact on economic activity.

3. Methodology and basic theoretical model

Methodologically, we use error correction models (ECMs). A large literature on ECMs has attempted to explain the credibility of macroeconomic policies because they are considered appropriate for studies of economic policy or macroeconomic variables in general. Errorcorrection models identify the impulses responsible for short – or long – run imbalances in different macroeconomic variables. These are dynamic models that incorporate both shortterm and long – term changes in the variables. The study of these models will allow us to identify the effects of BCEAO monetary impulses on economic growth in Mali.

In order to carry out a global evaluation of the effects of monetary impulses on real gross domestic product in Mali, the model of Kahn et al. (1991) model has been adapted. In addition, our growth equation is also inspired by the work of Agenor (1991) model; the PROMES model of Samba (1998) and Nubukpo (2002) These last three models are themselves derived from the model of Kahn et al. (1991). Starting from the definition of the real GDP (RGDP), these works study the dynamics of the real sector supply, by supposing that the growth of the GDP is a positive function of the excess supply of real balances and of the production gap or excess capacity. The effect of the variations of the key interest rates on the economic growth rate, can be evaluated thanks to the growth equation below:

$$\log(PIBR) = \gamma_1\left(\log PIBR^* - \log PIB\right)_{t-1} + \gamma_2\left(\log m_t^d - \log m_{t-1}^d\right) + \gamma_0 \qquad (1)$$

Where $\gamma_1 > 0$, $\gamma_2 > 0$; $PIBR^*$ represents the level of potential output (i.e., adjusted for cyclical fluctuations) and $m^d = \frac{M^d}{P}$ the level of real balances desired by wealth holders. Such a formulation holds that any excess supply of money will induce a temporary increase in real income. On the other hand, a restrictive monetary policy will negatively affect growth. Furthermore, Kahn et al. (1991) suggest that the response of output to monetary policy, as measured by γ_2 should be quite small. Equation (1) also indicates that output will tend to grow when its actual level is lower than its potential level. To highlight the impact of monetary policy on growth, the evolution of potential output has been endogenized. Thus, considering a Cobb – Douglas type production function, we obtain:

$$\log\left(PIBR^*\right) = \alpha_0 + g.tr + \alpha \log K_t + (\alpha - 1)\log L_t \qquad (2)$$

With $g > 0$, $0 < \alpha < 1$; tr represents the trend, the variables K and L indicating respectively the stock of capital and the stock of labour, used in the production process. The change in the capital stock corresponds to investment (INVTR) and the change in the labour force is assumed to grow at the same rate as the working population (PAC).

Equations (1) and (2) allow us to write the following dynamic relationship:

$$D\left(\log PIBR\right) = \lambda.D\left(\log PIBR^*\right) + \mu.\left(\log PIBR^* - PIBR\right)_{t-1} + \nu.\left(\log m_t^d - \log m_{t-1}^d\right) \qquad (3)$$

With $\lambda > 0, \mu > 0, \nu < 0$.

Equation (3) can still be written:

$$D(\log PIBR) = \lambda.g + \lambda.\alpha \log INVTR + \lambda.(\alpha - 1).D(\log(PAC) + \mu(\log PIBR^* - \log PIBR) + \nu.(\log m_t^d - \log m_{t-1}^d)_{t-1}) \qquad (4)$$

The level of the supply of real balances, which reflects the monetary policy stance (a fall in the supply of balances means a restrictive policy), is assumed to be a function of the central bank's key rates (IM and IPS) and the consumer price index (IHPC). Moreover, the short – term impact of a change in the working population on growth is almost negligible, insofar as only cyclical factors come into play in this context. The "active population" variable essentially plays a role in the determinants of structural growth, in the same way as human capital (Logossah 1994). As a result, these variables will not be included in the estimation of the growth equation.

Thus, the growth equation can be written:

$$D(\log PIBR) = F\left(D\underset{(-)}{(IPS)}, D\underset{(-)}{(IM)}, D\underset{(+)}{(\log INVTR)}, D\underset{(?)}{(\log IHPC)} \right) \quad (5)$$

With PIBR: the real Gross Domestic Product
IPS: the repo rate
IM: the money market rate
INVTR: total real investment
D(log(IHPC)): the rate of price change (or inflation rate).
The central bank's key rates (the repo rate and the money market rate), in accordance with theoretical and empirical lessons, are supposed to move in the opposite direction of short – term growth (Bank of France, 1998) Hence the negative sign assigned to them. Total investment is positively related to real GDP growth. The sign of the inflation – growth relationship has been the subject of much debate in the economic literature, against the backdrop of the Phillips curve controversy. However, in the sub – Saharan economies, Moser's estimates show an inverse relationship between growth and inflation. (1995) However, in sub – Saharan economies, Moser's estimates show an inverse relationship between growth and inflation. Such a result could be explained by the fact that in sub-Saharan countries, the growth of production, especially agricultural, generally has a depressive effect on prices. In our case, its sign will be determined after estimation of the model.

4. Model estimation and interpretation of results

For the estimation of the equation, the variables were expressed in logarithm and estimated using an error correction mechanism (ECM). If the variables are non – stationary, we will perform cointegration tests. The observations on the two-step method of Engle and al. (1987) with its prerequisites (determination of the number of cointegrating relationships) and its possible consequences (use of a vector error correction model (VEC), in case of existence of cointegrating relationship >1), are relevant in the case of large samples. In the case of this study, carried out on a fairly small sample, Hendry's one – step method (1986) method is a priori suitable. This does not exclude the possibility of checking the quality of the estimators using a vector error correction model, in order to reinforce the results obtained, if of course there is no problem of degrees of freedom, due to the small sample.

For our investigation we used second-hand data. The data come from the PROMES (Macro econometric and simulation projection) database of the Central Bank of West African States (BCEAO). They cover the period 1970 – 2009. In addition, based on the specificities of the Malian economy as well as previous studies conducted in the WAEMU zone mentioned in the methodology, we retained the following econometric equation:

$$D(\log(PIBR)) = C + b_1 D(\log(IHPC)) + b_2(IPS) + b_3(IM) + b_4 D(\log(MM)) + b_5 D(\log(CE)) + \varepsilon_t \quad (6)$$

With GDPR: Real Gross Domestic Product
IHPC: Harmonized Index of Consumer Prices
IPS: Repo Rate
IM: Money Market Rate
MM: Money supply
EC:Credit to the economy
IPM:Imported Goods Index.
C: Constant
ε_t :Error term

We will proceed to the study of the stationarity of the series. If the series are non – stationary, it is legitimate to be interested in their order of integration. To this end, we apply the tests of Dickey et al. (1981) increased on the LPIBR, LMO, LCE, LMM, IPS, IM and LIHPC series.

The study of the stochastic process Y_t representing the macroeconomic variables requires the analysis of stationarity. This is subject to the following conditions:

- The average must be constant and independent of time: $E(Y_t) = E(Y_{t+s}) = \nu \ \forall_t$ and $\forall_s$;
- The variance must be finite and independent of time;
- The autocovariance function depends on the time differences: $Cov(Y_t, Y_{t+s}) = \gamma(s)$;
- The different variables making up the process Y_t must fluctuate around their average, which regularly returns to their long – term equilibrium value.

The dynamic mechanisms defined by the term ε_t must generate stationary dynamics.

The unit root test of Dickey and al. (1981) which allows to determine the degree of stationarity (order of integration) consists in testing the significance of the coefficient of the following model Y_{t-1} $\Delta Y_t = \rho Y_{t-1} - \sum_{j=2}^{p} \phi_j \Delta Y_{t-j+1} + \varepsilon_t$ (7) where and $\rho = (\phi - 1)(1 - \theta_1 - ... - \theta_{p-1})$ et $Y_t = (LPIBR_t \quad LIHPC_t \quad LMM_t \quad LCE_t \quad IPS_t \quad IM_t \quad IPM_t)'$

The hypotheses of the (Dickey, and al., 1981) test are:

H_0 : $\rho = (\phi - 1)(1 - \theta_1 - ... - \theta_{p-1}) = 0 \Leftrightarrow \phi = 1$ (unit root: non – stationary);

H_1 : $|\phi| < 1$ (non – unit root:stationary).

If the value of ADF Test Statistic (Augmented Fuller Dickey Test) is less than the value of CV Critical Value (or if PROB is less than 5%) then we accept the hypothesis H1: the series X is stationary.

If the value of ADF is greater than or equal to the value of CV (or if PROB is greater than or equal to 5%) then we accept the hypothesis H0: the series X is non – stationary.

The results obtained by the application of the ADF test at the threshold of 5% are presented in table N°1 below.

Table N°1 : Stationarity test (ADF) on the variables in level at the threshold of 5% (Akaike criterion)

Variables	Calculated value	Critical Value	Number of delays	Stationarity	Constant	Trend	Conclusion
LCE	3.21	-1.95	0	No	No	No	**Non – stationary**
LIHPC	3.81	-1.95	0	No	No	No	**Non – stationary**
LPIBR	-1.43	-3.53	0	No	Yes	Yes	**Non – stationary**
LMM	5.93	-2.62	0	No	Yes	Yes	**Non - stationary**
IPM	-2.31	-3.53	1	No	Yes	Yes	**Non – stationary**
IPS	-2.64	-2.93	0	No	Yes	Yes	**Non – stationary**
IPS	-2.46	-2.93	0	No	Yes	No	**Non – stationary**
IM	-2.53	-3.55	1	No	Yes	No	**Non – stationary**

Source:Author's calculations

The analysis of the results of the test shows that at the threshold of 5%, for none of these variables, the null hypothesis of presence of unit root cannot be rejected: the variables are not stationary in level. Hence the administration of the ADF test on the variables in first difference, the main results are summarized in the table N°2 below.

Table N°2 : Stationarity test (ADF) on the variables in first difference at the threshold of 5% (Akaike criterion)

Variables	Calculated value	Critical Value	Number of delays	Stationarity	Constant	Trend	Level of integration	Conclusion
LCE	-5.30	-3.53	0	Yes	Yes	Yes	I(1)	**Stationary**
LIHPC	-3.41	-1.95	0	Yes	Yes	No	I(1)	**Stationary**
LPIBR	-5.82	-2.94	0	Yes	No	No	I(1)	**Stationary**
LMM	-5.00	-2.94	0	Yes	No	No	I(1)	**Stationary**
IPM	-6.28	-3.61	0	Yes	Yes	No	I(1)	**Stationary**
IPS	-8.35	-1.95	0	Yes	Yes	Yes	I(1)	**Stationary**
IM	-4.22	-3.54	1	Yes	Yes	Yes	I(1)	**Stationary**

Source:Author's calculations

The analysis of the results of the stationarity tests allows us to conclude that the series are stationary in first difference at the 5% threshold. In other words, they are integrated of order 1 or I(1). The presence of an equilibrium relationship between these variables is formally tested using statistical procedures, the most commonly used of which are those of Engle and al. (1987) and Johansen (1991; 1995).

The term cointegration was introduced by (1981) by Granger. The cointegration test is used to test for long – run equilibrium relationships among the variables LCE, LIHPC, LPIBR, LMM, IPM, IPS and IM. A linear combination of these variables is written:

$$LPIBR_t = \alpha_0 + \alpha_1 LIHPC_{1t} + \alpha_2 IPS_{2t} + \alpha_3 IM_{3t} + \alpha_4 LMM_{4t} + \alpha_5 LCE_{5t} + \varepsilon_t \quad (8)$$

The vectors $\alpha = \begin{pmatrix} \alpha_1 & \alpha_2 & \alpha_3 & \alpha_4 & \alpha_5 \end{pmatrix}'$ are called the cointegration vectors. This test is based on two steps. The first is an ordinary least squares estimation of the long term model. The second is an ADF test on the residual ε_t.

The stationarity of the residual ε_t from this regression remains the main condition for the cointegration relationship to be accepted. It will be tested using the Augmented Dickey –Fuller test under the following assumptions:
H_0: Unit root on the residual (non – cointegration);
H_1: Non unit root on the residual (cointegration).
The residual equation is represented as follows:

$$\varepsilon_t = LPIBR_t - \alpha_0 - \alpha_1 LIHPC_{1t} - \alpha_2 IPS_{2t} - \alpha_3 IM_{3t} - \alpha_4 LMM_{4t} - \alpha_5 LCE_{5t} \quad (9)$$

We use the Johansen cointegration test (1991; 1995). Johansen proposed a multivariate approach based on the maximum likelihood method. It isused to test the cointegration of the LPIB, LMO, IPS, IM and LIPC series by a cointegration rank test. The hypothesis test is as follows:

H_0: no cointegration (cointegrating rank is zero);
H_1:cointegration (cointegration rank greater than or equal to 1).

The cointegration hypothesis is accepted if LR (Likelihood Ratio) is greater than CV (Critical value). It is rejected otherwise.

Under the hypothesis of a specification with an optimal lag due to the relatively small number of observations, the Johansen cointegration test brings out two cointegration relationships according to the trace and maximum eigenvalue statistics at the 5% threshold. Indeed, we can affirm the existence of a cointegration relation between the variables of the model and use an error correction model (ECM).

We propose to estimate the error – correction model in accordance with the Hendry model representation using a one – step least – squares approach. The estimation procedure for this method and the estimation results are discussed in the next section.

For the purpose of this paper we have adopted the following model of growth:

$$D(\log(PIBR)) = b_1 D((\log IHPC)) + b_2 (IPS) + b_3 (IM) + b_4 D((\log MM)) + b_5 D((\log CE))$$
$$+ b_6 D(\log PIBR_{-1}) + b_7 (\log IHPC_{-1}) + b_8 (IPS_{-1}) + b_9 (IM_{-1}) + b_{10} (\log MM_{-1}) + b_{11} (\log LCE_{-1}) + C + \varepsilon_t \quad (10)$$

With the following theoretical signs:
b_1?, b_2<0, b_3<0, b_4?, b_5>0, b_6<0, b_7?, b_8<0, b_9<0,b_{10} ?,$b_{11} > 0$

In this expression, the coefficients at b_1 b_5, characterize the short – run dynamics, while the coefficients at b_6 b_{11} are used to derive the long – run equilibrium behaviour of the inflation rate. The coefficient b_6 is the error correction coefficient, it must be less than unity and negative. The error – correction coefficient indicates the speed of adjustment of the endogenous variable Y to return to the long – run equilibrium following a shock. The coefficient *C* represents the constant of the model, ε_t is the error term.

The short – run elasticities are: b_1, b_2, b_3, b_4 and b_5.

The long – run elasticities are: $-\frac{b_7}{b_6}, -\frac{b_8}{b_6}, -\frac{b_9}{b_6}, -\frac{b_{10}}{b_6}$ and $-\frac{b_{11}}{b_6}$.

The results from the regression of the economic growth equation are summarized as follows:

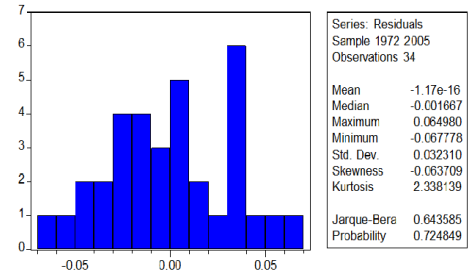
$$D(LPIBR) = 0,0377\,D\underset{(0,26)}{\left(LIHPC\right)} + 0,0079\,D\underset{(1,38)}{\left(IPS\right)} - 0,0211\,D\underset{(-2,00)}{\left(IM\right)} - 0,0854\,D\underset{(-0,75)}{\left(LMM\right)} + 0,0415\,D\underset{(0,81)}{\left(LCE\right)}$$

$$-0,6247\underset{(-3,88)}{LPIBR_{-1}} - 0,1290\underset{(-1,21)}{LIHPC_{-1}} + 0,0158\underset{(1,81)}{IPS_{-1}} - 0,0200\underset{(-2,85)}{IM_{-1}} + 0,1319\underset{(1,55)}{LMM_{-1}} + 0,1119\underset{(2,21)}{LCE_{-1}} + 3,4944\underset{(3,71)}{}$$

$R^2 = 0,577, R^2adj = 0,366, DW = 2,041, \Pr ob(F-statistic) = 0,021$, the numbers in parentheses are the student t's

Indeed, these results show that the error correction term associated with the recall force b_6 is negative (-0.625) and is significantly different from zero at the 5% statistical threshold (the Student's t is greater than 1.96 in absolute value). In other words, there is an error correction mechanism: in the long run, the imbalances between real gross domestic product, the harmonized consumer price index, the BCEAO key rates (repo rate, money market rate), the money supply and credit to the economy compensate each other so that the series have similar trends. The value of R2 = 58% illustrates a good explanatory power of the model. The administration of Ramsey RESET test gave probabilities higher than 5%, hence the correction model is well specified. The CUSUM and CUSUM SQUARE tests showed that the model is structurally and punctually stable, as the curve does not cut the corridor.

Jarque – Bera Test



Chow BreakpointTest: 1994

F-statistic	1.405949	Probability	0.298965
Log likelihood ratio	33.60822	Probability	0.000777

White Heteroskedasticity Test

F-statistic	0.469704	Probability	0.936705
Obs*R-squared	16.46888	Probability	0.791954

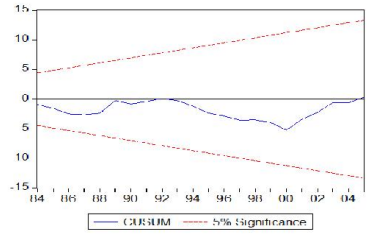
ARCH Test

F-statistic	0.360398	Probability	0.552649
Obs*R-squared	0.379241	Probability	0.538010

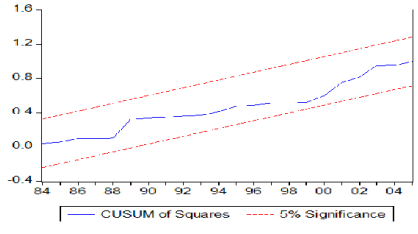
Ramsey RESET Test

F-statistic	2.120018	Probability	0.146207
Log likelihood ratio	6.537295	Probability	0.038058

CUSUM Test



CUSUM Squares Test



The coefficient b_6 represents the speed at which any imbalance between the desired and actual levels of real gross domestic product is resolved in the year following any shock. It adjusts for 62% of the imbalance between the desired and actual levels of gross domestic product. This percentage of 62% is important to stabilize the fluctuations of the Malian economy. This can explain the stabilization of the main macroeconomic aggregates during the period 1970 – 2009.

4.1. Analysis of short – termelasticities

The harmonized consumer price index, the key BCEAO rates (repo rate, market rate), money supply and credit to the economy have a short – term impact on the dynamics of real gross domestic product.

In fact, the short – term elasticity of real gross domestic product in relation to the harmonised index of consumer prices is b_1 = 0.0377, which implies that in the short term a 10% rise in the general price level leads to an increase in real gross domestic product of 0.38%. This result is in line with economic theory, as a price increase often leads to an increase in the volume of production in the short term. These increases are considered to be an incentive by producers.

The short – term elasticity of real gross domestic product with respect to the repo rate is b_2 = 0.0079, which means that in the short term if the repo rate increases by 10% real gross domestic product increases by 0.08%.

The short – term elasticity of real gross domestic product with respect to the money market rate is b_3 = -0.0211, this implies that in the short term a 10% increase in the money market rate translates into a 0.21% decrease in real gross domestic product. This result corroborates with that obtained by Nubukpo (2002). In the short run, the author finds a significant and negative relationship between the variation in the money market rate and the GDP growth rate in the WAEMU as a whole and in all countries except Niger.

The short – run elasticity of real gross domestic product with respect to the money supply is b_4 = -0.0854, which means that in the short run if the money supply in Mali increases by 10%, then real gross domestic product decreases by 0.85%. This is consistent with classical theory. According to the classics: an increase in the money supply results in an increase in prices (inflation) and not in production.

The short – run elasticity of real gross domestic product with respect to credit to the economy is b_5 = 0.0415, which implies that in the short run if credit to the economy of Mali increases by 10%, then real gross domestic product increases by 0.41%. Credit to the economy remains sensitive to changes in RGDP. This can be explained by the fact that the Malian economy is based on agriculture, as the major component of credit to the economy is agricultural credit. This result corroborates that obtained by Diagne and al. (2000) for the WAEMU countries. The authors conclude that a positive shock to the real interest rate has positive effects on credit to the economy in all WAEMU countries except Burkina Faso and Togo.

4.2. Analysis of long-termelasticities

The harmonized consumer price index, the key BCEAO rates (repo rate, market rate), money supply and credit to the economy have a long – run impact on the dynamics of real gross domestic product. Long – term elasticities are interpreted as follows:

The long – termelasticity of real gross domestic product in relation to the harmonised index of consumer prices is: $-\frac{b_7}{b_6} = -\left(\frac{-0,128977}{-0,624677}\right) = -0,2065$ which implies that in the long term a 10% rise in the general price level leads to a 0.21% fall in real gross domestic product. This resultis in line with economic theory, since a rise in prices often leads to a reduction in the volume of output in the long term.

The long – term elasticity of real gross domestic product with respect to the repo rate is: $-\frac{b_8}{b_6} = -\left(\frac{0,015805}{-0,624677}\right) = 0,0253$ this means that in the long run if the repo rate increases by 10%, real gross domestic product increases by 0.25%.

The long term elasticity of real gross domestic product with respect to the money market rate is: $-\frac{b_9}{b_6} = -\left(\frac{-0,020049}{-0,624677}\right) = -0,0321$ this implies that in the long term, a 10% increase in the money market rate results in a 0.32% decrease in real gross domestic product. This result is similar to that obtained by Nubukpo (2002) for the Ivory Coast. The author concludes for this country that the impact of the money market rate remains significant in the long run.

The long – run elasticity of real gross domestic product with respect to the money supply is: $-\frac{b_{10}}{b_6} = -\left(\frac{0,131868}{-0,624677}\right) = 0,2111$ this implies that in the long run, if the money supply increases by 10%, then real gross domestic product increases by 2.11%. The effects of the money supply on economicgrowth increase significantly in the long run. This result corroborates the arguments developed by monetarists who believe that monetary policy does not have a significant long – term impact on the growth of aggregate demand and output. It confirms the results obtained by Kone (1998). The author's study focuses on the impact of monetary and fiscal policies on economic growth in WAEMU countries. He argues in this paper that monetary policy positively influences economic growth in the WAEMU.

The long – run elasticity of real gross domestic product with respect to credit to the economy is: $-\frac{b_{11}}{b_6} = -\left(\frac{0,111911}{-0,624677}\right) = 0,1791$ this implies that in the long run an increase in credit to the economy of Mali of 10%, then real gross domestic product increases by 1.79%. Credit to the economy remains sensitive to the change in RGDP in the long run. This result is consistent with economic theory, as the money channel and the credit channel coexist in the transmission of monetary impulses on the real sector. This resultis consistent with the studies by Bernanke and al. (1988; 1992) and Nubukpo (2002). The authors conclude that: "The credit channel thesis (in both the narrow and broadsense) suggests that policy affects aggregate demand not only through its direct effects on the interest rate, but also because it affects the supply of bank credit.

5. Conclusion

In the specific case of Mali, BCEAO monetary impulses affect economic growth to a greater or lesser extent. However, real gross domestic product in Mali is determined by the short – and long – term dynamics of the evolution of the harmonized consumer price index, the key BCEAO rates (repo rate, money market rate), money supply and credit to the economy.

In fact, in Mali 58% of GDPR is explained by these variables. This result indicates that other factors than those mentioned also explain the GDPR (see Tenou (1999)). We note the existence, in the long run, of a significant influence of the real monetary variables of the economy, which has an important implication with regard to the effectiveness of the monetary policy of the BCEAO in Mali on economic growth. However, from the point of view of classical theory, monetary policy measures are not effective in influencing the real sphere of economies in the long run.

Generally speaking, the relative ineffectiveness of the BCEAO's key interest rate policy on economic growth in Mali highlights the need to consider other levers likely to increase the effectiveness of monetary policy.

Thus, it is essential to improve the mechanisms for transmitting monetary impulses in Mali. It is conditioned by a certain number of factors that are highlighted in this research:

- An active use of the money market rate seems to be indicated for an adjustment of the economic activity in Mali;

- strengthen the mechanism set up by the BCEAO for the financing and marketing of local agricultural products, a necessity to ensure better transmission of monetary policy through the credit channel to the economy in Mali.

However, despite its specificity, this work does not address all the issues related to the question. Future research could address the issue using other methodologies to project monetary impulses on economic growth in Mali.

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