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The Determinants of Inflation in Cote D'ivoire: An Explanatory Model

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Abstract

This study examines the determinants of inflation in Côte d'Ivoire through an error correction inflation model. It shows that the variables that contribute most to inflation in Côte d'Ivoire are diverse and of varying magnitude. We note the preponderance of monetary inflation in the long run with an elasticity of 0.32 against an elasticity of 0.22 points for the output of the agricultural sector. In the short run, the inflation is due to the increase in -credit offre -and insufficient offre in the agricultural commodity market.

Keywords: Inflation; Money supply; Harmonised consumer price index (HCI); Error correction model (ECM) ; Côte d'Ivoire; WAEMU.

1. Introduction

In general, economists have always paid particular attention to inflation because of its harmful economic and social consequences. The goods and services that constitute the wealth of nations are measured in monetary terms, and in this case there is a symmetry between the holding of money and the holding of goods. The problem with inflation is that it alters this symmetry which is the basis of economic stability. The functions of money as a unit of account and as a store of value are blurred. It is therefore necessary to favour economic policies that maintain the stability of the purchasing power of money. To do this, knowledgeof the causes of inflation is essential. Since the early 1980s, controlling inflation in order to promote the stability of the internal and external value of money has become the main objective of most central banks. However, controlling inflation requires the identification ofits determinants. Faced with this problem, economic and monetary authorities regularly seek to study the links between inflation and the various macroeconomic indicators. This article contributes to the debate on the question of the determinants of inflation. The question that emerges from this study is what are the levers on which the Ivorian authorities can act to control and maintain price stability in Côte d'Ivoire? To answer this question, the main objective of this study is to identify the main determinants on which the authorities can act to control and maintain price stability in the country. Specifically, the effect of different variableson the control and maintenance of inflation at a desired optimal level will be determined. This model will be constructed from certain variables on the basis of the different theories on the causes of contemporary inflation and by drawing on similar studies carried out in other countries.

The remainder of the article is presented as follows: section two presents the literature review, section three deals with the methodology, section four presents the results of the study and section five deals with the conclusion and recommendations.

2. Literature Review

Among the global approaches to inflation, we distinguish between the monetarist and the Keynesian approaches. These two approaches have been at the root of one of the greatest controversies in modern economics.

2.1. Global or Traditional Theories

According to the banking school Law J. (1717), bank credit can never be the cause ofinflation. Only speculative abuses should be controlled. On the other hand, the proponents of the currency principle (D. Ricardo) proclaim that every bank must maintain, by virtue of the criteria of convertibility, strict equality between the quantity of banknotes put into circulation and its true basis: the quantity of gold. This theory is based on the idea that money is only a "veil", that true wealth is found in labour and goods.

Continuers of the currency principle in the 20th century believe that there is a direct link between the money supply and the general price level. According to Fisher's formula.

$$MV = PY \qquad (2.1)$$

For monetarists, inflation is the result of a monetary imbalance, created by the Central Bank issuing too much money in relation to the economy's output. For Milton Friedman, the"number one" enemy in economics is inflation, which should be fought by a draconian controlof the increase in the money supply and by high interest rates. His reasoning starts from the quantity equation of money which expresses the link between transactions and the money supply (equation 1.1). Monetarists assume that the velocity of money is constant and that output is determined by the productive capacity of the economy (factor of production). These different considerations have several implications:

- The nominal value of output PY is determined by the money supply ;
- The price level P is nothing more than the ratio between the nominal value of output and the general level of output Y.

Any price change is the result of a change in the money supply. From this point of view, the stabilisation of inflation is in the hands of the monetary authorities who can decide on the general price level by influencing the growth rate of the money supply with the help of monetary policy instruments. The main target is the interest rate, which determines the cost ofmoney. To this end, the monetary authorities can carry out *open market* operations to achieve short-term interest rate targets or set the discount rate directly.

Several empirical studies have shown the consistency of this theory. Indeed, the seminal study by Milton and Anna (1963) on the monetary history of the USA clearly indicates a positive correlation between the growth of the money supply and the level of inflation. In Africa, we have the case of the Democratic Republic of Congo (DRC or ex-Zaire)which financed its public deficit by money creation between 1991 and 1994 leading to a hyperinflation of 4500% in 1993 and 9800% in 1994 (Agenor, 2001). Loungani and Swagel (2001) arrive at the same result. In OECD countries, monetary variables have been identified as an important source of inflation in the long run. Gerlach and Svensson (2003) examine the determinants of inflation in Japan, Great Britain, the United States and the Eurozone and find that money supply growth plays an important role in determining inflation in these countries. Studies conducted on WAEMU countries nevertheless identify an effect of money on inflation in the long run. Diop *et al.* (2008), Doe and Diallo (1997) demonstrate that money plays a major role in the change of the price level in the long run but they point out that the empirical relationship is less significant than predicted by theory. For Mali, Diouf (2008) notes that money market imbalances have a significant impact in the long run on price level dynamics, but that the quantity of money in circulation does not affect inflation in the short run. Finally, Fielding (2004) analyses the impact of monetary policy interventions on the consumer price index in each WAEMU country and finds that a change in the stock of money in circulation leads to permanent changes in prices across WAEMU countries. Kinda (2011), finds that imbalances in the money market do not affect the short-run dynamics of the inflation level. Heattributes this result to the fact that monetary policy is not decided at the national level, but at the level of the monetary union.For other schools of thought, the causes of inflation must be sought in the real sector.

View stems from the neo-Keynesian paradigm. Indeed, for this school of thought, money is a means of intervention in the economy in order to ensure the objectives of the economy.

They believe that inflation has other causes than monetary ones. For them, inflation has other causes than monetary ones. Keynes' approach is to believe that the supply of goods is determined by the consumption demand of economic agents. In this framework, an expansionary monetary policy allows households or the state to relax their budgetary constraints, which increases their demand for consumer goods. This excess demand will only lead to an increase in the general price level if the economy's production capacity is saturated. In this case, Keynes shows that a government deficit, even if financed by money creation, is only inflationary if the economy is at full employment. Thus, Keynesians and neo-Keynesiansattribute a significant part of the rise in prices to imbalances in the market for goods and services, including production costs. However, these two approaches complement each other rather than conflict. The question then arises as to what mechanisms are at play in the inflationary process. One analytical framework often used to explain these mechanisms is the IS-LM-BP framework. This model is an extension of the IS-LM model (reduced to theanalysis of a small closed economy) to the open economy. In an open economy, domestic production no longer serves only to satisfy domestic consumption and investment, but also those of the rest of the world. Moreover, goods and services consumed and invested withinthe country can be imported. Thus, the resource-use balance in an open economy is given by:

$$Y = C + I + G + X - Z \qquad (2.2)$$

With, Y: national income in real terms, C: household consumption, G: government expenditure, I: private sector investment, X: exports and Z: imports.

It is considered that the higher the income, the higher the imports, and that the latter increase with the real exchange rate. Similarly, exports depend positively on the income of the foreign country and its real exchange rate.

Thus, if we consider that consumption is an increasing function of disposable income, investment is an increasing function of the interest rate and the expected inflation rate, and public spending is exogenous, then the equilibrium of the goods and services market (IScurve) can be expressed as follows.

$$Y = C(Y, t) + I(i, \pi^{*}) + \bar{G} + X(Y^{E}, e) - \frac{Z(Y,e)}{e} \qquad (2.3)$$

Y^E : the income from abroad, e : the exchange rate quoted at the uncertain, t : the average tax rate, π^* : the expected inflation rate and i the interest rate.

Here, price fixity is not assumed, so the variables in this equation are taken at their real values.

On the money market in an open economy, domestic agents have no reason to hold foreign currency (except in an extreme situation). The equilibrium on the money market (LM curve) is therefore not directly affected, so we have:

$$\frac{M}{P} = L(Y, i) = L(\pi^*, t, e, Y^E, i) \qquad (2.4)$$

The balance of payments (BP curve) is equal to the sum of the current account balance and the capital account balance. We then have:

$$X(Y^E, e) - \frac{Z(Y,e)}{e} + K(i, \pi^*) = 0 \qquad (2.5)$$

Where K is the capital balance and NEA is the change in net foreign assets. The IS-LM-BP model or Mundel-Flemming model (1968) is a theoretical framework for analysing economic policies. Also in this framework the monetarist-neo-Keynesian controversy remains.

However, the theoretical approach to inflation cannot be limited to a simple controversy between monetarists and neo-Keynesians.

2.2. Structuralist Theories

The global approach to inflation must be complemented by a structuralist approach to inflation. The structuralist approach focuses on the sources of inflation, on price formation at the heart of the production process. The best-known structuralist theories of inflation are the dirigiste approach of Galbraith J. K. and the sociological approach. The dirigiste approach of Galbraith (1967) attributes inflation to the way in which industrialised economies function. For Galbraith, inflation in industrialized economies is largely due to price fixing by the managers of large firms, a group he refers to as the "technostructure". The "technostructure", whose main objective is profit maximisation, sets prices above the competitive level. Galbraith's theories are empirically verified in the work of Gardiner & Means. Indeed, they show that the rise in prices from 1953 to 1958 in the United States was almost entirely due to the oligopolistic behaviour of large firms. However, faced with this steady increase in prices, employees, who were not without power, did not sit back and watch. The sociological approach analyses the sources of inflation through the struggle for the sharing of added value. The workers, knowing that an increase in prices leads to a decrease in their purchasing power, watch over their share of the cake, they will demand an increase in wages each time prices rise and the entrepreneurs, wanting to keep the same level of profit, pass on the increase in wages to the prices. Thus we enter in a process where inflation leads to inflation. It is obvious that in this context the increase in prices depends on the capacity of employees to demand wage increases and the capacity of entrepreneurs to increase prices. We are entering a kind of class struggle, and this is the sociological dimension of the problem. In developing countries the economic structures are different from those of the so-called developed economies. Indeed, in a developing economy, capital, technology and entrepreneurship are limited, whereas labour is unlimited, so it can happen that the marginal productivity of labour is zero whereas the average productivity is higher than zero. There is then an imbalance between output and income. The implications of such an imbalance are that income always increases faster than the real product and its consequence is the increase of the general price level. Thus, apart from the above-mentioned theories, the organisation of the various sectors of the economy (agriculture, industry and services) and the imbalances that may characterise them can be significant sources of inflation.

3. Methodology

In this section, we will attempt to develop an explanatory model of inflation in Côte d'Ivoire. This model will be constructed from a number of variables based on the different theories on the causes of contemporary inflation and drawing on similar studies in other countries.

3.1. Model Specification and Data

3.1.1. Specification of the Model

There are many possible causes of inflation. All other things being equal, an increase in demand leads to higher prices and an increase in supply leads to lower prices. However, over long periods of time, when it comes to explaining inflation, economists focus on a single factor - the growth of the money supply - because the other factors do not generally have a lasting influence on the price level. Indeed, for movements in supply or demand to lead to a repeated rise in prices, they must be repeated. However, for a given level of technology, a repeated decrease or increase in supply is unlikely.

On the other hand, the money supply can increase at almost any rate, and large variations in the money supply are frequently observed; whether they are negative as during periods of deflation or positive as during periods of hyperinflation. To see formally why money is essential, consider the money market. In an open economy with a fixed exchange rate, the supply of credit depends on the domestic credit and net foreign assets of the country under consideration. Thus, the money supply can be expressed as follows:

$$M^O = \left(\frac{M}{P}\right)^{\alpha} \left(\frac{\lambda R}{P}\right)^{1-\alpha} \qquad (3.1)$$

With M^O the money supply, M the money supply, P the general price level, R the net foreign assets and λ the unsterilised share of net foreign assets.

The demand for money depends on the volume of transactions Y and the interest rate i.

Thus, we have:

$$M^d = L(i, Y) = \exp(\alpha i)\, Y^{\beta} \qquad (3.2)$$

The volume of transactions is composed of the demand for goods and services in the country. This demand is made up of the output of the three sectors of the economy (agricultural sector Ya, industrial sector Yi, service sector Ys) and imports I. And imports depend on the foreign exchange rate (dollar exchange rate E) and the price of imported goods, measured by the priceindex of imported goods Pi.

$$M^d = L(i, Y) = \exp(\alpha i)\,[Y(Ya, Yi, Ys, I(E, Pi))]^{\beta} \qquad (3.3)$$

This is equivalent to :

$$M^d = L(i, Y) = \exp(\alpha i)\, Y_a^{\delta a}\, Y_i^{\delta i}\, Y_s^{\delta s}\, E^k P_i^T \qquad (3.4)$$

The equilibrium of the money market obtained by the equilibrium between the supply and demand of money is given by:

$$\left(\frac{M}{P}\right)^{\alpha} \left(\frac{\lambda R}{P}\right)^{1-\alpha} = \exp(\alpha i)\, Y_a^{\delta a}\, Y_i^{\delta i}\, Y_s^{\delta s}\, E^k\, P_i^T \qquad (3.5)$$

This equilibrium can be interpreted as a global equilibrium of the economy, because it also corresponds to an equilibrium of the goods and services market (supply of goods and services equal to demand for goods and services) and of foreign trade. Linearising by log, we have:

$$\log P = a1 \log M + a2 \log \lambda R + a3i + a4 \log Ya + a5 \log Yi + a6 \log Ys + a7 \log E + a8 \log Pi$$

The linearisation of the model allows us to capture the short and long term elasticities. Replacing the uppercase log with the lowercase log, we have:

$$pt = a1mt + a2rt + a3it + a4yat + a5yit + a6yst + a7et + a8pit + \xi t \qquad (3.6)$$

This equation represents the long-run equilibrium. The coefficients ai represent the long-run elasticities, e.g. a1 = dp/dm = d log Pd/dlog M is the elasticity of price demand with respect to money demand. ξt is the residual of the long-run relationship.

It should be noted, however, that due to methodological constraints, not all variables in this equation will be represented at the same time in the same estimated model. This equation is based on the idea that the mechanisms of the economy are supposed to determine thegeneral level of prices in the long term as a function of the output of the different sectors of the general level of prices in the long term as a function of the output of the different sectors of the economy, the supply of credit, the exchange rate of the dollar or the price index of imported goods and the level of foreign exchange reserves. The short term dynamics that are supposed to ensure the convergence towards the long term equilibrium are given by :

$$\Delta pt = b0\, \xi t\text{-}1 + \Sigma i^k{}_{=0}\, b_i^T\, \Delta zt\text{-}i + vt \qquad (3.7)$$

which is equivalent to :

$$\log \frac{Pt}{Pt-1} = b_0\, \xi_{t-1} + \Sigma i^k{}_{=0}\; b_i^T \log \frac{Zt-i}{Zt-i-1} + vt \qquad (3.8)$$

with

$$z't = (mt\ rt\ it\ yat\ yit\ yst\ and\ pit) \text{ and } Z't = (Mt\ Rtexp\ (it)\ Yat\ Yit\ Yst\ Et\ Pit$$

The *bi* coefficients are the short-term elasticities. They are interpreted as the elasticity of the growth rate of prices with respect to the growth rates of the other explanatory variables. Clearly, *bi* is the rate at which the price level would increase if the variable *Zi* increases by 1%.

o estimate the theoretical model estimated above we use the econometric approach described below. Economic theory does not always explicitly specify how adjustments lead to a long-run equilibrium situation or to a predetermined target. Econometric theory fills this gapby proposing adjustment mechanisms that are consistent with previously defined targets. These specifications are described as ad hoc or partial adjustment or error correction. To test the model whose theoretical contours have been previously defined, an error correction specification is used. This form of specification is based on the two-stage method of Engleand Granger (1987). However, the latter is only for two variables and 100 observations. However, Engle and Granger (1987) and later Phillips and Ouliaris (1990) proposed respectively an extension to five and six variables for different sample sizes (50; 100, 200 and 500). Thus, the latter method will be used to test the cointegration between the different variables and eventually estimate the error correction model. The so-called error correction models were introduced in the early 1980s, by Hendryin particular. These dynamic models make it possible to integrate long-term and short-term changes in the variables. Consider two variables (Yt, t ∈ Z) and (Xt, t ∈ Z) cointegrated of order 1 and (β, -1) a cointegrating vector. The idea of error correction models is to consider relations of the general form:

$$\Delta Y_t = \mu + \sum_{i=0}^{p} \alpha i \Delta Yt - i + \sum_{j=0}^{p} bj \Delta Xt - j + c\,(Y_{t-1} - X_{t-1}) + \eta t \qquad (3.9)$$

In this equation, classical inference methods can be used. Indeed, the estimators of thedifferent coefficients are

convergent and equivalent to those of the maximum likelihood. As all variables are stationary, the Student statistics of the different coefficients have standard distributions. However, in the long-run relationship we cannot test the significativity of the coefficients, so the long-run relationship only allows us to show that there is a long-run equilibrium, and that the estimators of the long-run elasticities are super-convergent.

The methods based on the Engle and Granger two-way approach, despite their widespread use, still contain many grey areas. Firstly, there is a significant risk of including too many variables in the cointegration relationship since there is no Student's t test. Secondly, when estimating the cointegrating relationship, explanatory variables are (generally) omitted (the one for the short-term dynamics), which leads to a bias in the coefficients. But the estimation bias disappears asymptotically ("super convergent" estimators) with correct sample sizes (more than 30 observations in general), which is the casehere. Enfin consider the following cointegration test:

Let the residual of the cointegration relation $\xi t = yt - \beta xt - \mu$. If we take the simplest version ofthe unit root test $\Delta\xi t = \rho\xi t + {}_{ut}$. With *H0:* $\rho = 0$ (no cointegration) *Ha:* $\rho < 0$ (cointegration) which can again be written $\Delta (yt - \beta xt - \mu) = \rho (yt - \beta xt - \mu) + {}_{ut}$ i.e. $\Delta yt = \beta \Delta xt + \rho (yt - \beta xt - \mu) + {}_{ut}$ Thus, is the cointegration test performed on a particular ECM with respect to the model $\Delta yt = \gamma \Delta xt + \rho (yt - \beta xt - \mu) + {}_{ut}$. That is, making the assumption $\gamma = \beta$. Engle and Granger'stwo-step method thus constrains the long-run elasticity to be the same as the short-run elasticity. This is too strong a restriction that is not vérifiée in practice. Thus, cointegration istested under this same assumption while this restriction is not This leads to a strong incompatibility of the estimators.

3.1.2. The Data

Most of the series come from the World Bank. Indeed, the data on currency, GDP and price index are taken from the WDI 2002 available on CD.

- **M** is the broad money supply (i.e. M2). The data were obtained from the BCEAO. They are available monthly. The series covers the period from 1970 to 2008.
- **Pi** is the price index of imported products. The import price is obtained as the ratio of imports in value and volume. These data are taken from foreign trade statistics.

Pt is the general consumer price index (base 100 in 1995). This index is produced monthly andpublished by the price department of the Direction de la Statistique de la Côte d'Ivoire (INS),it is a Laspeyres type index. Its annual value is obtained by taking an arithmetic average of themonthly indices.

GDP is gross domestic product at constant 1995 prices. This data is taken from the WDI and covers the period 1960 to 2004. It is divided by three of which :

Ya: Share of GDP produced by the agricultural sector.

Yi: Share of GDP produced by the industrial sector.

Ys: Share of GDP produced bythe tertiary sector.

E: is the exchange rate of the dollar against the CFA franc for the period 1970 to 2008. **DEV** is a dummy variable representing the devaluation. It takes the value 0 for the period1960-1993 and the value 1 for the period 1994-2002.

- A dummy variable (DEV) was introduced to account for residual effects of devaluation that the other independent variables would not have sufficiently incorporated.
- A dummy variable (WAR) has been introduced to account for the residual effects of the military-political crisis on inflation.
- The data are annual and cover the period 1971-2009.
-
- Now that the model has been defined and the econometric approach presented, we can move
- on to processing the data and analysing the results.

3.2. Model Estimation and Results

3.2.1. Estimation Technique Used

The classic estimation methods assume that the series used are stationary. However, with reference to the work of Nelson and Plosser (1982), macroeconomic series are not stationary in level. Before continuing, let us therefore examine the stationarity of the series at our disposal.

To estimate our model, we will use the two-step method of Phillips and Oularis. This method requires that the series be cointegrated C(1,1), i.e. that the series are all integrated of order oneand that the residual of the long-run relationship is stationary. Thus, it will first be necessary, using unit root tests, to establish that the series in question are integrated of order one.

After having shown that our variables are integrated of order 1 [**I(1)**] using the Dickey Fuller and Phillips-Perron tests, we will estimate the different equilibrium and possibly error- correction relationships and then choose the best model.

❖ **Stationarity test**

To check the order of integration of the various components, the ADF and PP tests are used. The ADF test is done based on the following model: $\Delta Xt = \varphi Xt\text{-}1 + \mu + \beta t + \sum_{j=1}^{p} \lambda i \Delta Xt - j + \eta t$, the value of the statistics and the

results are reported in Table 3.1.

We find that the variables are all integrated of order one with LMOD (log of industrial sector output) having a trend. These results are confirmed by the Phillips- Perron tests, except for thetrend in the LMOD series, which is not confirmed by the latter.

Table-3.1. Result of the stationarity test

Variables	DIFFERENCE 1st				level			Conclusion
	t_β	t_μ	t_ϕ	Results	t_β	t_μ	t_ϕ	Results
yit	0,75	2,77	-4,34	I(0)	2,93	0,36	2,82	I(1)
et	1,10	0,98	-5,09	I(0)	2,42	0,39	1,04	I(1)
pit	0,80	2,08	-5,73	I(0)	2,73	0,34	1,86	I(1)
pt	-0,44	2,18	-3,17	I(0)	2,38	1,21	3,04	I(1)
yst	-1,84	3,78	-2,08	I(0)	2,09	2,44	3,72	I(1)
m1t	-0,24	2,77	-3,78	I(0)	2,33	0,93	2,72	I(1)
yat	0,25	1,77	-5,47	I(0)	2,21	1,22	1,69	I(1)
m2t	-0,59	3,46	-4,36	I(0)	2,35	1,40	6,27	I(1)

Source: DNSI/BM/our calculations

Now that we have verified that all variables are integrated of order one we can apply the two-step method of Phillips and Oularis. Let us start by testing the cointegration of the variables. Moreover, concerning the price index of imported goods, the Perron test (see Appendix P.) shows that despite the break in level and trend in 1994 the series is not stationary. With the ADF and PP tests we have shown that the variables in the study are all integrated of order one. We can then apply the cointegration test based on the residual and if this is conclusive, estimatethe error correction model. But first let us examine the causality of the variables.

❖ Granger causality test

The Granger causality test, generally used to reduce the number of coefficients to be estimated in a Vector Autoregressive (VAR) model, makes it possible to know whether the past of another variable contains information on the variable under consideration, which is notcontained in the past of the variable under consideration itself. It is used here to examine the links between the different variables in the study.

The results of the Granger causality test on the paired variables are summarised in thefollowing table (Table-3.2). The causality tests show that:

- it is the output of the service sector that causes the output of the agricultural sector andnot the other way around;
- It is the dollar exchange rate that causes the general price level and the price index forimported goods, not the other way around;
- There is an interactive causality between the supply of credit and the output of theindustrial sector;
- The general price level and the output of the different sectors are causing each other;
- There is an interactive causality between the general price level and the price index of imported goods ;
- the increase in credit does not cause production in the agricultural sector;
- The output of the industrial sector has an inter-active causality with credit.

Table-3.2. Summary of causality test

	yit	and	pit	pt	yst	m1t	yat	m2t
yit				*(*)	*(*)	*(*)	*(*)	*(*)
and			*(0)	*(0)	*(*)	*(0)	*(*)	*(0)
pit				*(*)	*(*)	0(*)	*(*)	0(*)
pt					*(*)	*(*)	0(*)	*(*)
yst						*(*)	0(*)	*(*)
m1t							0(*)	*(*)
yat								*(*)
m2t								

Source: DNSI/BM/our calculations

❖ Long-term balance

To verify that there is a long-run equilibrium between the general price level and the variablesthat are supposed to explain it, a residual-based cointegration test is used here. After applying the residual-based cointegration test, three equilibrium relationships were obtained. These three models are then tested to compare the results. Since LMOD has a trend, the specifications of the long-run relationships will take into account a trend. To take into accountthe effect of the devaluation of the 1994 FCA, a dev indicator variable, equal to 1 over the period 1994-1998 and 0 over the other periods, has been introduced. Similarly, an indicator variable Guer, equal to 1 for the period 2002.

Modèle 1

p_t =3, 20 + 0, 28 m_{1t} − 0, 14 y_{it} +0, 14 y_{st} − 0, 24 y_{at} +0, 04 p_{it} +0, 02 t+0, 10 dev+ 0,7guer+ ξ_{1t} (0,82) (3,37) (−1,38) (1,37) (−2,89) (0,38) (−2,17) (2,72) (2,33) DW =1, 49 R^2 =0, 98 F stat = 163, 38

Model 2

pt = -0.55 - 0.10 yit+0.37 yst- 0.13 yat- 0.02 $_{pit+0}$.20 $_{et+0}$.02 t+0.15 dev+ 0.08guer+ ξ2t (0,87) (-1,04) (5,08) (-1,76) (-0,19) (-3,68) (2,42) (4,18)(4,27)

DW =2, 01 R^2 =0, 98 F stat = 173, 94

Model 3

pt = -0.84 - 0.10 yit +0.38 yst - 0.13 yat +0.19 and +0.02 t +0.15 dev + ξ0.9guer+ ξ3t (-0,26) (-1,04)(5,61) (-1,78)(4,01)(3,15) (4,33)(4,31)

DW =2, 00 R^2 =0, 98 F stat = 211, 38

These results are consistent with the "intuitive rule" of Granger and Newbold (1974) concerning the presumption of spurious regression, as they point out that one should ask questions as soon as the R-squared is greater than the Durbin Watson (DW) statistic. In our models all DW statistics are greater than the R-squares. However, this rule is not sufficientand it is always necessary to perform the cointegration test (stationarity of the residual).

Indeed, for these equations to constitute long-run equilibria, their residuals must be stationary.To vérifier this, a cointegration test must be performed. This cointegration test is based on the estimated residuals ξˆt and not on the true value of the residual. Therefore, the critical values tabulated by Mckinon (1991) should be used. These critical values depend on the number of explanatory variables I(1) of the long-run relationship and the presence or absence of a trend. The latter gives the following results:

Table-3.3. Summary of cointegration tests

Variables	ADF statistics	Critical values at 5%.	Results
ξ1t	-5.10	-4.72	I (0)
ξ2t	-5.48	-4.43	I (0)
ξ3t	-5.50	-4.43	I (0)

Source: DNSI / WB / our calculations

Now that the long-run equilibria are defined and estimated and it is vérifié that the growthpath converges towards this long-run equilibrium, the Error Correction Model (ECM) must be estimated. This represents the mechanism by which the system converges to the long-run equilibrium.

It should be emphasised that the long-run relationship provides a super-convergent estimate of the long-run elasticities. However, because the variables in the regression are not stationary, itis not possible to test the individual significativity of the coefficients, nor to carry out restriction tests, which is one of the limitations of the method.

❖ **Short-term adjustments**

The MCEs to be estimated by OLS, possibly with lagged and first difference variables andindicator variables, are of the following form:

Model 1a

Δpi = - 0.66 ξ1t-1 +0.18 Δm1t - 0.18 Δyat +0.50 Δpt-1 +0.18 dev + 0.13guer + z1t(-4,87) (4,01) (-3,25) (5,39) (4,85) (4,55)

R^2 =0, 74 AIC = -3, 82 SIC = -3, 59

Model 2a

Δpi = - 0.65 ξ1t-1 +0.50 Δpt-1 +0.11 dev + 0.15 guer + z1t(-4,87) (5,39)(4,85)(4,55)

R^2 =0, 64 AIC = -3, 62 SIC = -3, 49

Model 3a

Δpi = - 0.64 ξ1t-1 +0.68 Δpt-1 +0.18 dev + 0.13guer + z1t(-4,39)(6,56) (4,70)(4,65)

R^2 =0, 74 AIC = -3, 60 SIC = -3, 46

For these estimates to be interpretable, the models will first need to vérifier the estimation assumptions, including assumptions about the estimation residuals. It will also be necessary tovérifier the stability of the coefficients and the quality of the specifications.

The variables *dev* and *guer* take into account respectively the effect of the 1994 devaluation and the effect of the 2002 military-political crisis on the inflation rate.

3.2.2. Tests

❖ **Residue testing**

The basic assumption of ordinary least squares estimation is that the residual must be a White Noise. That is, it must be of constant variance, zero mean and not serially self- correlated. It is also usual to test the normality of the residual, but this assumption is not necessary, as OLS does not require the errors to follow a normal distribution. However, if a model does not meet this assumption, this would mean that the Student's t-test statistics for the significativity of individual coefficients do not follow a Student's t-test. In this case, the asymptotic distribution is used, which is the normal distribution, which can be a problem in a small sample.

To test these different hypotheses, six tests are usually used: Jarque and Bera (JB) normality test, White's cross-term and no cross-term test, ARCH test, Breusch-Godfrey test and the Ljung-Box test.

Table-3.4. The results of these different tests are summarised in the following table

	Model 1a		**Model 2a**		**Model 3a**	
	F-stat	**nR2**	**F-stat**	**nR2**	**F-stat**	**nR2**
Tests of JB normality	JB: 1.33 Probability: 0.51		JB: 5.46 Probability: 0.06		JB: 5.46 Probability: 0.06	
Test						
White's hetero-	1,43	18,25	1,03	6,35	1,01	6,27
codedasticity	(0,24)	(0,24)	(0,42)	(0,38)	(0,43)	(0,39)
With						
cross-referencedterms						
Test						
White's	1,61	12,67	1,28	6,35	1,26	6,26
heterohedastic	(0,17)	(0,17)	(0,29)	(0,27)	(0,30)	(0,28)
ity without cross						
Terms						
HARCH test	0,08	0,19	0,28	0,61	0,28	0,62
	(0,91)	(0,90)	(0,75)	(0,73)	(0,75)	(0,73)
BG LM test	0,44	0,26	0,37	00	0,39	00
	(0,64)	(0,87)	(0,68)	(1)	(0,67)	(1)
Test of LJUNG-BOX	Statistiq ue 18.98	Statistiq ue 17.62	Statistiq ue 18,20	Statistiq ue 18.98	Statistiq ue 17.62	Statistiq ue 18,20

Source: DNSI / WB / our calculations the results of these tests show that:

- The residuals of all models follow a normal distribution as all JB statistics are lessthan 5.99;
- He White test, the ARCH test, the Breusch-Godfrrey test and the Ljung Box test show that the residuals are non-correlated and homo-correlated. Indeed, in all cases the probabilities associated with the statistics of the tests considered are greater than 0.05.

These results make it possible to test the overall and individual significativity of the models and coefficients. However, the coefficients would still have to be stable and the models well specified.

❖ **Stability Test and Specification Test**

The coefficients and models only make sense if the coefficients are stable and the models well specified. The stability hypothesis is tested by the Cusum test and the Cusum-Square test.This test has the advantage of testing structural breaks without choosing a priori a break point.To test the quality of the specification of the model we will use the Ramsey test. The Ramsey specification test (see following table) shows that the three models are all well specified.

Table-3.5. RAMSEY specification test

	Model 1a		Model 2a		Model 3a	
	F-stat	LR	F-stat	LR	F-stat	LR
Testof RAMSEY	0,12 (0,88)	0,32 (0,85)	0,95 (0,33)	2,20 (0,33)	1,20 (0,31)	2,74 (0,25)

Source: DNSI / WB / our calculations

The Cusum and Cusum-Square tests (see Appendix) show that the hypothesis of no structural break is accepted. Indeed, in all figures the curves are in the corridor.

As in these regressions all variables are stationary, classical inference methods can be applied.For an economy of degree all non-significative variables have been removed from the equations.

The error correction coefficients , i = 1, 2, 3, are all between 0 and -1 and significantly different from zero and therefore guarantee that the growth path converges towards equilibrium. The closer these coefficients are to -1, the faster the convergence to equilibrium. This is in fact the case for model (1a) whose error correction coefficient is -0.65.

The coefficients of the models are all significantly different from zero. But between these three

Which of the models best answers the questions posed? To choose the best model we use three criteria (see following table): the coefficient of determination; the Akaiké information criterion and the Schwartz information criterion. The values of these criteria for the three models are in Table 3.6.

Table-3.6. Specification test by criteria

	CRITERIA		
	R-squared	**AIC**	**SIC**
Model 1a	0,74	-3,82	-3,59
Model 2a	0,64	-3,62	-3,49
Model 3a	0,64	-3,60	-3,46

Source: DNSI / WB / our calculations

It can be seen in this table that on the three selected criteria, model (1a) is the best. In addition to minimising the information criteria (AIC; SIC), model (1a) explains more than 74% of the information contained in the data, compared to 64% for model (2a) and model (3a). Moreover, model (1a) includes more variables. Thus, it is from model (1a) that we will draw the conclusions of the study.

Since the model has already been chosen, it now remains to analyse and comment on the results afin order to draw conclusions. However, in the models estimated so far the money supply in the strict sense (M1). Thus, one may wonder what the difference would be if M1 were replaced by M2. Estimating model 1a by replacing M1 with M2 gives the following results.

4. The Results of the Study

Estimate With M1

Long-term Relationship

pt =3, 20 + 0, 28 m1t- 0, 14 yit+0, 14 yst- 0, 24 yat+0, 04 $_{pit+0}$*, 02 t+0, 10 dev + 0, 7guer + z1t (0,82)(3,37) (-1,38)(1,37)(-2,89)(0,38)(-2,17)(2,72)(2,53) DW =1, 49* R^2*=0, 98 F stat = 163, 38*

Short-term Adjustment

Δpi = - 0.66 ξ_{1t-1} *+0.18 Δm1t +0.18 Δyat +0.50 Δpt-1 +0.18 dev + 0.23guer + z1t (-4,87)(4,01) (-3,25)(5,39)(4,85)(4,55)*

R^2 *=0, 74 AIC = -3, 82 SIC = -3, 59*

Estimate with M2

Long-termrelationship

$_{pi}$ *=0.05+0.32* $_{m2t+0}$*.15 yst-0.09 yit - 0.22 yat +0.11* $_{pit}$ *+0.005 t+0.10 dev + 0.9 guer + z1t (0,01) (2,97) (0,14) (-0,93)(-2,60)(1,06) (0,54)(2,51)(2,73)*

DW =1, 49 R^2 *=0, 97 F stat = 151, 16*

Short-term Adjustment

Δpi = - 0.73 μ2t-1 +0.20 Δm2t - 0.17 Δyat +0.46 Δpt-1 +0.08 dev + 0.13 guer + z1t (-5,02)(4,31)(-3,62) (4 ,75) (2,09) (2,11)

R^2 *=0, 75 AIC = -3, 85 SIC = -3, 57*

As stated above, the long-run relationship provides a super-convergent estimate of the long- run elasticities and definishes a long-run equilibrium, while the short-run relationship gives the short-run elasticities and represents the short-run adjustment mechanism.

Thus, the long-run relationship shows that:

❖ **In the long term**

The money supply (here measured by M2) and agricultural sector output have a positive and negative influence on the general price level respectively, while service sector output, industrial sector output and the price index of imported goods do not have a significative effect on the general price level in the long run. The effect of devaluation on prices between 1994 and 1998 is also positive and significative. So was the crisis of 2002. We find the preponderance of monetary inflation in the long run with an elasticity of 0.32. In other words, an increase in M2 of one unit (one billion CFA francs) leads to an increase in the general price level of 0.32 points. While an increase in agricultural output by one unit (one billion CFA francs) leads to a decrease in the general price level by 0.32 percentage points. of the general price level by 0.22 points. Furthermore, in the long run, the transition from a "non-devaluation" situation to devaluation leads to an increase in the general price level of 0.10. When we replace M1 by M2 in the model, we see that the long-run elasticity of the general price level with respect to the money supply (here M2) increases from 0.28 to 0.32 and that of the output of the agricultural sector decreases from 0.24 to 0.22, the effect of devaluation remains unchanged.

The fact that the elasticity of M2 is higher than that of M1 is explained by the fact that quasi- liquidity, even if it is not totally liquid, constitutes a reserve of purchasing power and therefore has a non-negligible impact on the general price level. The long-term relationships between the general price level and the variables considered are not economically surprising. The positive relationship between the general price level and the credit offre is a result of

neoclassical macroeconomics. Indeed, some believe that this is the only remaining effect of monetary policy in the long run. There is also evidence that, in the long run, an increase in the output of the agricultural sector leads to a decrease in the general price level. In other words, a high price level in the long run may be partly due to a supply deficit in the market for agricultural products, the so-called inflation of scarcity.

❖ **In the short term**

The correction coefficient in both models is significantly less than zero. This confirms the existence of he cointegrating relationship and guarantees convergence to the long-run equilibrium.

It can be seen that in the short run the variable whose influence is preponderant is the inflation of the previous period, the elasticity of the latter with respect to the inflation of the current period is 0.50 this elasticity decreases by 0.04 points when M1 is replaced by M2 in the model. Nevertheless, the effet of the money supply remains large, this is fixed at 0.18 and increases by 0.02 points when M1 is replaced by M2. The short-run elasticity of agricultural sector output is lower than in the long run and is fixed at 0.18 and falls by 0.01 points when M2 is replaced by M1. The effect of devaluation is larger in the short run 0.18. So is that ofthe military-political crisis.

In short, in the short term, inflation is due to the increase in the supply of credit and the lack of supply on the market for agricultural products. If the inflationary character of monetary expansion is a classic result, the inflationary imbalance of the market for agricultural products is characteristic of a developing country with low productivity agriculture. Indeed, agricultural production occupies more than 80% of the active population in Côte d'Ivoire and is largely food-based (rice, maize; millet, sorghum, banana, yam, cassava, livestock etc.). Thus, a low supply on this market in the face of a steadily increasing demand (population increase) is inflationary. The inflationary nature of a supply deficit on the agricultural products market is amplified by the anticipatory behavior of the players on this market. The fact that this result persists in the long run shows that, the increase in product supply is only deflationistic if it is sustained and regular at a rate at least equal to that of demand. The influence of the agricultural sector's output on inflation shows more than ever the importance of agriculture in an economy of this type.

The non-significance of the impact of the general price level of imported goods in the short term could be explained by the degree of openness of the Ivorian economy.

The ultimate objective of any study is to help make economic policy decisions. Thus these results call for some policy recommendations, but first the conclusions must be drawn.

5. Conclusions & Recommendations

Developing economies, including that of Côte d'Ivoire, are characterised by a structural imbalance between production and income. Indeed, in a developing economy, capital, technology and entrepreneurship, among others, are limited, while labour is unlimited. Thus,it can happen that the marginal productivity of labour is zero while the average productivity isabove zero. Thus, there is an imbalance between output and income. The implications of such an imbalance are that income always increases faster than real output and its consequence is an increase in the general price level.

Thus, the analysis of inflation in developing countries must necessarily take into account imbalances in the goods and services market. And since the market for goods and services is made up of several more or less homogeneous compartments, a division of the market for goods and services into several markets (market for agricultural products; market for in this context, the following conclusions can be drawn from our study: the need to develop a more efficient and effective approach to inflation in a developing country is not only a matter for the government, but also for the private sector. On this basis, the following conclusionscan be drawn from our study:

- In the long run, an increase in the output of the agricultural sector is deflationist, while an increase in the money supply is inflationist.
- In the short run, monetary growth is inflationary and agricultural supply growth is deflationary. It should also be noted that convergence to equilibrium is relatively fast with an error correction coefficient close to -1.

These results call for some policy recommendations:

Keeping the inflation rate at an acceptable level, requires the maintenance of monetary rigour. But the fight against inflation would only be effective, if it is accompanied by actions in the real sector as, for example:

- an intensification of agricultural production in order to reduce the imbalances on the market of agricultural products by a sustained increase in the supply of agricultural products;
- the establishment of an effective marketing policy for agricultural products;
- An in-depth study of the different sectors of the economy would allow for a better understanding of their contribution to the rise in the general price level and therefore a better implementation of the different policies. Perhaps the influence of structural imbalances are at the root of the often high level of price increases despite themonetary rigour of the BCEAO;
- A study on the impact of inflation on the standard of living of poor social categories should be carried out, as price increases are closely linked to agricultural production, which employs more than 70% of the working population.

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