

# THE MACROECONOMIC IMPACT OF NEGATIVE REAL INTEREST RATES IN NIGERIA: SOME ECONOMETRIC EVIDENCE

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## 1. Introduction

In his 1988 article C.C. Agu stressed the view that persisting negative real interest rates in Nigeria during the 1970-85 period caused a number of unfavourable macroeconomic effects (Agu 1988). Agu's considerations were based on the McKinnon/Fry-model of 'Financial Repression' arguing that interest rate ceilings combined with high and even rising rates of inflation cause an excess demand for investment and simultaneously restrict the supply of savings (Fry 1978)

We do not intend to reconsider the arguments for low (or negative) interest rates<sup>1</sup> but want to sum up the main conclusions of Agu's paper.

- i) Negative real interest rates depress savings and investment.
- ii) Savings are often wasted (non-market credit-rationing) thus distorting resource allocation and reducing investment efficiency.
- iii) Administration of low interest rates leads to the development of parallel markets where substantially higher interest rates are paid and charged.

Considering the interest elasticity of savings Agu points out that this relationship is inconclusive. He refers to empirical studies of Williamson and Gupta and examines Nigerian time series data thus yielding similar inconclusive results. Unfortunately, he does not give any empirical support for the second hypothesis concerning the impact of negative real interest rates on investment efficiency. Beyond, it is obvious that a brief look at a time series table cannot be a proper substitute for careful econometric analysis.

It is the intention of this paper to uncover some macroeconomic relationships hypothetically discussed by Agu. Therefore, my paper is organized as follows: Section 2 gives a brief presentation of the data used for further analysis. Section 3 presents several regression models to be tested and Section 4 discusses the estimation results. The main conclusions are summarized in Section 5.

## 2. The Data

The time series presented in Agu's article cover the period from 1970 to 1985 which is too short to be a sound basis for regression analysis. Despite the fact that there have been several empirical studies<sup>2</sup> relying on such short time series, we tried to extend

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<sup>1</sup> See, for an overview, Ligeti (1989).

<sup>2</sup> See, for example, the studies of Williamson and Gupta cited by Agu.

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the length of our series whenever possible.

Examining the main IMF and World Bank data sources we decided to base our analysis on a period starting in 1960 and ending in 1987 thus giving a time series of 28 years in length.

Data for the annual change in consumer prices (inflation rate), the growth rate of money supply and the savings rate were taken from the IMF 1989 International Financial Statistics Yearbook. Unfortunately, the nominal interest rate on deposits is solely reported from 1970 to 1987. Since the deposit rate and the discount rate (available from 1960 to 1986) are highly correlated ( $R^2 = 0.96$ ), the deposit rate being approximately one percentage point below the discount rate we calculated the deposit rate from 1960 to 1969 by subtracting one percentage point from the discount rate. We do not expect to introduce a serious bias by using this variable as a proxy for the 'true' deposit rate.

In order to cover Keynesian income motives for savings behavior we calculated a per capita real income index (in constant Naira) for the entire period using the IMF national accounts statistics. Finally we derived the growth rate of time and savings deposits in nominal and real terms from the above mentioned IMF source.

### 3. The Models

#### 3.1 *The Interest Elasticity of Savings*

The first model we propose is the standard relationship between the gross domestic savings rate and the real interest rate (= nominal interest rate minus inflation rate).<sup>3</sup> It can be written as follows:

$$(1) S/Y = f(i_r) \text{ where } i_r \text{ is the real interest rate}$$

In a next step we extend the model by introducing per capita real income as an explanatory variable to capture the Keynesian absolute income hypothesis. The modified function is:

$$(2) S/Y = f(Y_r, i_r) \text{ where } Y_r \text{ is the real income index}$$

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<sup>2</sup> See, for example, the studies of Williamson and Gupta cited by Agu.

<sup>3</sup> This implies the validity of the rational expectations hypothesis.

Finally we specify a lagged savings function in order to account for sluggish adjustment of the savings rate. So we get the following function:

$$(3) S/Y = f(Y_r, i_r, (S/Y)_{-1})$$

These functions refer to the 'global' savings rate which consists of the personal, business and government savings rates, each showing different reactions on movements in the real interest rate.<sup>4</sup>

Since Nigerian data do not allow for a sufficient disaggregation we were forced to use the highly aggregated domestic savings rate.

Nevertheless, it is possible to test the response of financial saving to interest rate movements. Therefore, we regressed the growth rate of time and savings deposits in real terms ( $g^{ts}_r$ ) on the real interest rate. We did not use the absolute amount of deposits because of an upward trend in that variable thus causing serious estimation problems.

The following models we specified:

$$(4) g^{ts}_r = f(i_r)$$

$$(5) g^{ts}_r = f(Y_r, i_r)$$

$$(6) g^{ts}_r = f(Y_r, i_r, D)$$

where D is a dummy variable taking a value of 1 in year 1975, otherwise taking a value of zero. This variable was introduced to account for a (presumably oil-induced) boost in real minimum wages in 1975, a fact not fully covered by the per capita income variable.<sup>5</sup> In accordance with Friedmans consumption theory this transitory income is mostly saved so that a positive regression coefficient of the dummy can be expected.

All other exogenous variables in the equations (1) - (6) are expected to show a positive sign of the estimated coefficient too.

### 3.2 Growth and Capital Productivity

According to the Harrod-Domar growth model we express the growth rate of real GDP

4 See for further discussion: Balassa (1990), pp. 113-116 who gives additional reasons for a low significance of the interest rate's regression coefficient.

5 See for the compiled data von Lonski/Rauch (1982), p. 308.

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as a function of the investment ratio and the incremental output-capital ratio.

$$\frac{\Delta Y}{Y} = \frac{I}{Y} \cdot \frac{\Delta Y}{I} = \frac{I}{Y} \cdot \text{IOCR}$$

As many time series studies for different countries have shown, we predict a positive, but weak relationship between the growth rate and the investment ratio and a much stronger positive relationship between growth and marginal capital productivity. Our regression equations are as follows:

$$(7) \Delta Y/Y = f(I/Y)$$

$$(8) \Delta Y/Y = f(\text{IOCR})$$

We then examine the impact of inflation and negative real interest rates on the IOCR. In order to cover Thirlwall's hypothesis of the impact of inflation depending on the magnitude of inflation rates we specify as follows:

$$(9) \text{IOCR} = f(\text{IR}, \text{IR}^2) \text{ where IR is the inflation rate}$$

We expect the regression coefficient of IR to be positive and that of IR<sup>2</sup> to be negative. Alternatively, a specification used by Thirlwall should not perform differently (see Thirlwall 1974):

$$(10) \Delta Y/Y = f(\text{IR}, \text{IR}^2)$$

Finally, the impact of real interest rates on the IOCR is tested in the following regression equation:

$$(11) \text{IOCR} = f(i_r)$$

Introduction of a squared term does not make much sense because of the mostly negative values for  $i_r$ . Obviously, a positive regression coefficient would confirm Agu's hypothesis. Hence the basic macroeconomic effects of the real interest rate are covered by our set of regression equations. In the following section, we shall see whether the 'classical' predictions of the 'Financial Repression' theorists are valid even in a Sub-Saharan developing country.

## 4. Estimation Results

It is commonly observed in time series analysis that reliable estimation of the regression coefficients by Ordinary Least Squares (OLS) is often distorted through the existence of autocorrelated residuals. Whenever the Durbin-Watson test statistic indicated the presence of serial correlation, this was corrected by re-estimating the equation using the Hildreth-Lu/Prais-Winsten technique (HL). In such cases only the HL estimates are reported.

### 4.1 *The Interest Elasticity of Savings*

Table 1 presents the estimation results of equations (1), (2) and (3).

Table 1

ESTIMATED REGRESSION COEFFICIENTS AND TEST STATISTICS DEPENDENT VARIABLES: S/Y

Equation	Y	i	(S/Y)	DW	F	R <sup>2</sup>	Method
(1)	—	0,1152 (1,01)	—	1,98	15,2	0,56	HL
(2)	10,304 (3,83)	0,1034 (0,96)	—	1,94	16,6	0,68	HL
(3)	5,732 (2,36)	0,1861 (1,47)	0,5140 (2,82)	1,19*	15,3	0,67	OLS

t-statistics in brackets, the constant term is not reported

\* Durbin's-h because a lagged dependent variable was included

Our findings are similar to those of other researchers who found a positive, but hardly significant interest elasticity of gross domestic savings.<sup>6</sup> As expected, the positive impact of the income variable and the lagged savings variable proved highly significant. An explanation of the low interest rate elasticity could be that the encouraging effect of rising real interest rates on private savings is partly offset by a depressing effect on business savings through a decreased capacity for self-finance.<sup>7</sup>

<sup>6</sup> See, for example, De Melo/Thybout (1986).

<sup>7</sup> In order to avoid serial correlation of the disturbances we additionally specified two models using first differences;

$$\text{(i.e. } [(S/Y)_t - (S/Y)_{t-1}] = F[(i_t) - (i_{t-1}) \text{ and } [(S/Y)_t - (S/Y)_{t-1}] = F[(i_t) - (i_{t-1}); (Y_t) - (Y_{t-1})]$$

Both regressions yielded marginally significant coefficients for the interest rate first order difference (+ 0,1311 resp. + 0,1065) thus confirming the HL results of the basic model.

The hypothesis is confirmed when the results of equations (4), (5) and (6) are considered. Table 2 reports the outcome of the regression calculations.

**Table 2**

REGRESSION RESULTS - DEPENDENT VARIABLE:  $g_t^{15}$

Equation	$Y_t$	$I_t$	D	DW	F	R <sup>2</sup>	Method
(4)	—	0,5059 (1,43)	—	1,87	2,04	0,07	OLS
(5)	8,3908 (1,39)	0,8226 (1,98)	—	1,86	2,03	0,14	OLS
(6)	9,3827 (1,63)	1,184 (2,71)	39,4769 (1,92)	2,17	2,73	0,25	OLS

The outcome of regression equations (4) to (6) is evident. There is a significant positive impact of the real interest rate on the growth of financial savings. Although the quantitative effect is rather small, it is worth mentioning that it occurs even at persisting levels of negative interest rates, where changes in real rates are mostly due to inflation changes.<sup>8</sup> This result strongly supports the suggestions of the 'Financial Repression' theory. Hence our regression approach could help to clarify a relationship which was found inconclusive when simply looking on time series tables or comparing different sub-periods of a time series.

#### 4.2 Growth and Capital Productivity

Examining the determinants of the GDP-growth rate presented in Table 3, we see that the investment ratio has virtually no influence on the growth rate whereas more than 90 percent of the growth fluctuations can be explained by variations of the marginal capital productivity.

This result is fully in accordance with the empirical findings of Dürr<sup>9</sup> and suggests that policies solely designed to promote investment (e.g. via low or negative real interest

<sup>8</sup> See, for comparison, Aghevli et. al. (1990), p. 47.

<sup>9</sup> See Dürr (1977), pp. 42-46 who summarizes the empirical evidence of the 1950ies and 60ies. See also UN (1988) examining various growth determinants in the 80ies. This cross-section study yielded somewhat higher coefficients of determination.



Table 3

REGRESSION RESULTS - DEPENDENT VARIABLE:  $\Delta Y/Y$ 

Equation	I/Y	IOCR	DW	F	R <sup>2</sup>	Method
(7)	-(0,2130) (0,49)	—	1,88	2,28	0,16	HL
(8)	—	14,0094 (15,88)	2,28	252,2	0,91	OLS

rates) prove unsuccessful. Since real interest rates in Nigeria are determined mostly by movements of the inflation rate we now examine the impact of inflation on growth and the incremental output-capital ratio. The results of the Thirlwall-type equations are reported below:

Table 4

REGRESSION RESULTS - DEPENDENT VARIABLES: IOCR (EQ. (9));  $\Delta Y/Y$  (EQ. (10))

Equation	IR	IR <sup>2</sup>	DW	F	R <sup>2</sup>	Method
(9)	0,0610 (2,19)	-0,0024 (3,42)	1,55	6,63	0,46	HL
(10)	0,8328 (1,84)	-0,0293 (2,51)	1,78	4,16	0,35	HL

All regression coefficients are significant at common levels so that Thirlwall's findings are fully confirmed. One can explain the curvilinear relationship as follows: From a theoretical point of view inflation can affect capital productivity both positively and negatively.<sup>10</sup> Capital productivity and thus growth rates will increase if:

- (a) Inflation leads to higher capacity utilisation.
- (b) Rising prices are necessary to maintain the allocation function of prices, particularly when prices of goods and factors are not allowed to decrease in nominal terms.

10 See, for a detailed discussion Dür (1977) pp. 300-305.

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Effects reducing productivity will occur if:

- (c) Inflation causes rising real wages and falling (or even negative) real interest rates thus stimulating investment projects with high capital intensity. If labour productivity does not grow at the same rate, the IOCR must fall.
- (d) Intensity of competition decreases.
- (e) Investment calculation is impeded through unforeseeable changes in the inflation rate.
- (f) The composition of gross investment is re-allocated in favour of less productive projects (e.g. buildings).

Our results suggest that at lower levels of inflation effects (a) and (b) tend to dominate whereas at higher levels (c), (d), (e), and (f) force the sign of the squared term to become negative. Calculating the 'optimum inflation rate' one yields in case of the IOCR equation (9):

$$d(\text{IOCR})/d(\text{IR}) = 0. \Rightarrow \text{IR}^* = 12,71\%$$

And in case of the growth equation (10):

$$d(\Delta Y/Y)/d(\text{IR}) = 0. \Rightarrow \text{IR}^{**} = 14,21\%$$

In the 1960-73 period Nigerian inflation rates were well below that critical level whereas the 1974-87 period shows an average rate of 17,5%.

The impact of the real interest rate variable on the IOCR is positive too, with a regression coefficient nearly significant at the 10%-level. An increase of 15 percentage points in the real interest rate (say from -10% to +5%) will improve capital productivity more than two-fold! The regression equation is reported below:

$$\begin{aligned} (11) \text{ IOCR} &= 0,4337 + 0,02210 i_r && (\text{HL Estimation}) \\ &\quad (1,98) \quad (1,68) \\ R^2 &= 0,195 \quad F(2;26) = 2,91 \quad \text{DW} = 1,78 \end{aligned}$$

This result strongly confirms the theoretical interrelation predicted by the 'financial repression' theory.<sup>11</sup> If this is the case, one would like to know something about the deter-

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11 See, for similar results, World Bank (1989).



minants of inflation which is again determining real interest rates in case of fixed maximum price controls (interest rate ceilings). Agu stressed the view that "...from our past experiences, inflation cannot be controlled in Nigeria." We do not agree with such a fatalistic outlook. Inflation is always a phenomenon originally initiated by too rapid monetary expansion. Even in a developing country like Nigeria this can be tested and the result is as follows: (The sample range was extended by adding observations for the year 1988).

$$\begin{aligned} \text{IR} &= 7,5002 + 0,3349 (\Delta M/M - \Delta Y/Y) && \text{(OLS-Estimation)} \\ &\quad (3,73) \quad (4,10) \\ R^2 &= 0,3837 \quad F(1;27) = 16,81 \quad DW = 1,44 \end{aligned}$$

The positive relationship ( $r = + 0,62$ ) between the inflation rate and the monetary 'overhang' ( $\Delta M/M$  is the rate of growth of money supply) comes out very clearly, despite the fact that a rate of 7,5% annual inflation remains unexplained by the monetary expansion. The overall explanatory power of the regression is not very high especially if we compare it with cross-section results. This is mostly due to business-cycle induced variations of the monetary circulation velocity, a problem which can be easily avoided in cross-section research by taking a time series mean (say 7-10 years) for each country observation. We do not want to examine the determinants of the monetary overhang in detail but we would recommend the use of restrictive monetary policy as an efficient instrument of inflation control.

## 5. Conclusion

To sum up the main findings of this paper we present the following statements:

- (1) The gross domestic savings rate is positively affected by the real interest rate although the corresponding regression coefficient is not statistically significant.
- (2) Growth of time and savings deposits is also interest rate sensitive, higher real interest rates stimulate financial savings. The coefficients are statistically significant.
- (3) The rate of growth of real GDP depends mostly on the incremental output-capital ratio, the magnitude of the investment ratio does not seem to have any impact.
- (4) GDP-growth and investment efficiency (IOCR) are positively affected by low inflation; higher inflation rates yield overall negative effects.

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- (5) Investment efficiency is positively related to real interest rates.
  - (6) Inflation in Nigeria was fueled by monetary expansion although it cannot be fully explained by the monetary overhang variable.
  - (7) The findings (1) - (6) fully confirm the hypotheses and predictions of the McKinnon/Fry model of 'Financial Repression'.

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## Abstract

*In this paper we examine the impact of the Nigerian interest rate policy on savings and growth in the period 1960-1987 by applying regression analysis to Nigerian time series data. The hypotheses to be tested are based on the McKinnon/Fry model of "Financial Repression", i.e. administered interest rates below market equilibrium. The results of our investigation strongly support the "classical" predictions of this theory. The domestic savings rate is positively affected by the real interest rate, although the effect is relatively weak; financial savings show a much stronger positive response. Furthermore, persisting negative real interest rates depress capital productivity which is the main determinant of growth. An examination of the impact of inflation (which itself is to a considerable extent due to excess money supply) shows that low inflation rates could promote growth, whereas higher rates depress investment efficiency and growth.*

## L'INFLUENCE DES TAUX D'INTERET REELS AU NIGERIA:

### RESUME

*Dans ce traité nous examinons l'influence de la politique nigérienne des taux d'intérêt dans le domaine des épargnes et de la croissance durant la période 1960-1987, en appliquant une analyse de régression. Les hypothèses à vérifier sont basées sur le modèle McKinnon/Fry de la "repression financière", c'est à dire des taux d'intérêts fixés en dessous de l'équilibre du marché. Les résultats de notre recherche soutiennent nettement les prédictions "classiques" de cette théorie. Le taux d'épargne nationale est positivement influencé par le taux d'intérêt réel, bien que l'effet soit relativement faible; par contre les épargnes financières réagissent positivement d'une manière beaucoup plus prononcée. En outre, les taux d'intérêt réel négatifs réduisent la productivité du capital qui est le principal facteur de la croissance. Examinant l'influence de l'inflation (elle-même, à une mesure considérable, crée par un excès d'approvisionnement monétaire) été montré que les taux bas de l'inflation pourraient favoriser la croissance économique, tandis que les taux élevés font diminuer l'efficacité des investissements ainsi que la croissance.*

