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INFLATION IN NIGERIA: A QUANTITATIVE ANALYSIS

Clark University PH.D. 1982

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INFLATION IN NIGERIA:
A QUANTITATIVE ANALYSIS

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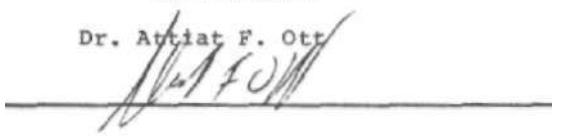
A DISSERTATION

submitted to the Faculty of Clark University, Worcester, Massachusetts, in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of

Economics
and accepted on the recommendation of

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INTRODUCTION

Historical observation of economic conditions in the less developed countries like Nigeria over the years have led economists to believe that underdeveloped economies are characterized by structural rigidities of various sorts, associated with inelasticity of agricultural output, bottlenecks in imports, inflexibility of the fiscal machinery, etc. These rigidities, experts claim, are the root causes of the chronic tendency towards inflation in the underdeveloped world, of which Nigeria is one. Other economists maintain that whatever the rigidities may be, chronic inflationary tendencies cannot hold unless validated by substantial increases in money supply.

This thesis does not intend to revive the Monetarist, Structuralist controversy. Instead, an attempt is made to appraise the extent to which the inflationary process in Nigeria can be explained using Monetarist and Structuralist models. The main objective is to present a quantitive analysis of the inflationary process in Nigeria and to determine which model best explains the causes of inflation in Nigeria.

The general technique used is to compute a number of indices representing structural and monetary elements and then by regression analysis of each model to determine the extent to which they might account for the variations in the rate of inflation in Nigeria for the period 1958 to 1978.

The structural and monetary elements selected are those

Chapter 1

INFLATION THEORIES

According to Arthur Curwen, "The state of Economic Science is still far too primitive to give a cast-iron answer to the vital question of what causes inflation. Nor is there a consensus amongst those who claim to have some expertise in the area about the policies which the current crisis demands."[1] No wonder then, that the public is extremely confused about the whole issue of inflation.[2] Jackson and Turner[3] have also noted that the variety of different policies being experimented by several governments at different points in time in their effort to combat inflation represents "an ironic tribute not merely to the phenomenon's toughness and durability but especially to the confusion caused by the large number of competing theories which purport to explain the origin and persistence of inflation."[4] The theories of inflation can be classified into two broad groups, namely, the "Monetary/Expenditure" theories and the "Structural/Social" theories.

The Monetary-Expenditure Theories

The Monetary/expenditure theory, better known as the Monetarist theory, has a line of ancestry which goes as far back as the 16th century Jean Bodin, John Locke, and the 18th century David Hume. It includes classical economists like David Richardo, J. S. Mills, and Irving Fisher of the 1920s and '30s, and of course the current and leading spokesman of

the school, Milton Friedman of the Chicago School. The Monetarist explanation of inflation range from the simple proposition of too much money chasing too few goods variety to the sophisticated statements involving a constant velocity of money or the real value of cash balance desired by the community.[5] In his Essays, Hume argued that an increase in the amount of gold and silver in a nation would first lead to an expansion of economic activity and eventually to a rise in prices, because it raises the cost of labor. Consequently, he concluded that the optimal economic state was characterized by mild inflation.[6] By 1936 the Keynesian revolution temporarily toppled the classical othordoxi centered around Humes 1741 Quantity Theory. According to Keynes, the momentum of inflationary tendencies are initiated whenever there is an increase in monetary flows without a corresponding increase in the flow of real output because the state of full employment has been reached. In this circumstance, an inflationary gap will be produced between the two flows which will be filled by rises in prices.

The rubbles of the demolished classical theory were again reassembled into what is now known as the Monetarist Theory. In 1969, Milton Friedman, the leading spokesman of this school, postulated that while an individual can adjust his cash balance to any level he desires, the community as a whole cannot, therefore an equilibrium in a situation of full

employment must be achieved by price changes.[7] This essential difference between the situation as it appears to the individual who can determine his own cash balance but must accept prices and money income as beyond his control and the situation as it appears to all individuals together whose total cash balance is outside their control but who can determine prices and money income is perhaps the most important proposition in the Monetarists' theory. The essence of the Monetarist theory begins by describing the economy in terms of straightforward stocks and flows. According to this school, inflation arises from disequilibrium between rising money stock relative to income flow or rising money expenditure flow relative to an output flow. A more recent analysis of the monetarist proposition infers that an expansion of money supply which eases credit conditions will itself lead to an increase of exogenous expenditure causing inflation at full employment level of income.[8]

The central proposition of the monetarist is that an increase in money supply will manifest itself in an increase in real output and perhaps a slight reduction in velocity as well as an increase in prices. However, the bulk of the increase shows up in increased expenditure rather than reduced velocity. The Monetarists also believe that the demand for money is quite stable and predictable and is largely independent of the supply of money, and changes in expenditures are inevitably

dominated by prior changes in the supply of money.

According to Friedman, velocity though constant is influenced by different variables from those which infringe upon the supply of money. Based on the above, Friedman's crucial proposition which represents the central tenets of the monetarist theory is that movements in velocity occur independently of movements in money supply. Furthermore, the demand for money is alleged to be more stable than the supply of money. Therefore changes ir aggregate expenditures are largely determined by changes in the quantity of money. If money supply is constant, then fiscal measures will only influence aggregate spending by influencing velocity. But since velocity is constant, fiscal measures exert little impact on aggregate economic activity. In the short run, money is the crucial determinant of economic activities. According to the monetarists, there is a direct and reliable link between money supply and the G.N.P. That link is the predictability of velocity. Because of it, any change in money supply will change the liquidity of the public, aggregate spending and G.N.P. by a predictable amount.

The essential point about the monetarist theory is that whatever the diagnosis, inflation is basically a monetary phenomenon and the required policy prescription must consist of some relevant and mainly fiduciary or fiscal variables so that equilibrium may be restored.[9] To counteract inflation,

then, appropriate monetary or fiscal measures or a judicious combination of both must be taken.

The Structural-Social Theory

In contrast to the above, the structural/social theory, better known as the structuralist theory of inflation, contend that inflation arises from some gross imbalance in the economic, institutional or social structure or some combination of the three. Such imbalance, they contend, may be due to scarcities of key things such as food, foreign exchange, or tax resources, or more broadly to structural quasi-monopolistic factors such as active labor unionism and inequitability in the distribution of national output. Those who are adversely affected retaliate by attemting to raise their income also, and the process develops "a whip'saw quality."[10]

According to the structuralists the original imbalance is viewed as a continuing conflict over the distribution of the social product. Based on the above, the structuralists envisage the result of the original imbalance as a continuing intergroup conflict over the distribution of the social output. These theories are therefore concerned not simply with the economic sources and mechanisms but also with the sociological dynamics of inflation.[11]

In summary, the structuralists attribute long-run trends of rising prices to:

1. Differences in the growth of productivity in the

industrial and service sector with smaller productivity growth in the latter.

2. Differences in the price and income elasticity between the two sectors.
3. Uniform growth of nominal wage in both sectors whereby the pace of money wage increase is determined by the faster growing industry.
4. Downward price and wage inflexibility.

With differing productivity in the industrial sectors, a uniform growth rate of money wage leads to a permanent cost pressure in the service industry. Cost-plus pricing leads in turn to a cost-push inflation. In this respect the core of the structuralist construct is that uniform money wage increase, given the productivity gap between the two sectors, will set the stage for the initiation of an inflationary process.

Hicks[12] uses the notion of "unfairness principle" to explain this. According to Hicks, wages rise in the non-expanding industry, not because of labor scarcity but because of "unfairness," because workers in the non-expanding industry feel they have been left behind. Tobin[13] (1972) explained the uniform rate of change in wage rate by a special supply function of labor. Tobin emphasizes Keynes central hypothesis that workers individually and collectively are more concerned with relative than with absolute wages. Therefore they will accept a uniform percentage rise in nominal wages and even a

reduction in real wages as a consequence of a general rise in prices. This is because both will not impair the status of workers relative to each other. But they may withdraw labor if wages fall relative to the wages of their reference groups. Even in the absence of active labor unionism pursuing a policy wage rate equalization, the operation of a competitive labor market works to the same end. A rise in relative earnings in the fast growing sector will have the effect of attracting labor force from the slower productivity growth sector which tends to increase wages in the latter sector and reduce the increase in the former.

The Role of Expectations in the Inflationary Process

More recently expectations theorists contend in essence that protracted experience of inflation will lead social groups and institutions, economic organizations and individuals to attempt to anticipate it, by increasing their incomes to compensate not only for the past increases but also for anticipated future increases or by adjusting their asset portfolio by additional acquisitions of things that are likely to appreciate faster in value than their cost. This type of action has the effect of increasing the rate of inflation further which makes attempts to anticipate it still more likely.[14]

"Inflationary expectation is determined by essentially unexplainable psychological forces, volatile, unstable vari-

able, subject to sudden and frequent shifts due to subjective economic factors that cannot be systematically explained."[15] The dynamics of inflationary expectations explain the acceleration of inflation. In the monetarist theory, they play a role in the acceleration theorem. It explains the temporary nature of monetary impulses on economic performance.

Expectations Augmented Phillips Curve

The underlying theory here is that wage increase is determined by excess demand in the labor market and by workers' and employers' anticipations of future price inflation. This theory maintains that the trade-off between wages and prices is only temporary; it depends upon people being fooled by unanticipated inflation. In the long run unanticipated inflation vanishes, price expectations fully adjust to experience and are completely incorporated in the wage-price setting behavior. Based on the above, the accelerationists argue that inflation stimulates economic activities only if it is unanticipated. Unexpected inflation induces producers who are pleasantly surprised to find their product prices rising faster and their real cost rising more slowly than expected to expand output and employment. But this stimulative effect eventually disappears when inflation becomes fully anticipated. There are two competing concepts of expectations formation, namely, adaptive expectations and rational expectations.

Adaptive expectation states that price expectations are systematically determined by objective economic data, namely, actual rates of inflation experienced in the past. This theory postulates that individuals form expectations of future rates of inflation from geometrically weighted average of experienced past rates of inflation and then systematically revise those expectations if actual inflation deviates from the expected.[16] It is an error-learning hypothesis. If the observed rate of inflation is greater than the expected rate of inflation, then the expectation of inflation is raised in proportion to the error. In the opposite case, the expectation is corrected downwards.[17]

The proponents of rational expectation criticize the above concept on the grounds of its neglect of other sources of information. The rational expectations theory stipulates that individuals will tend to exploit all pertinent information about the inflationary process while making their price forecasts. If this is true, then forecasting errors could only arise as a result of random unforeseen shocks accruing to the economy. Under such circumstances, the rational expectations of inflation are unbiased estimators of the actual inflation rate given all information at the beginning of the period. Thus price expectations will always be correct and the economy will always be in its long-run steady state equilibrium.

Adaptive Expectations and Monetarism

According to this theory, inflation is a function of excess demand and price expectations; and expectations are generated by past price history and hence by previous excess demand; that excess demand results from excessive monetary growth and therefore excessive monetary growth past and present in the root-cause of inflation.[18] Only monetary growth matters. Fiscal stimuli will only generate a temporary effect on inflation. Inflation-unemployment trade-off exists only in the short run.

Changes in monetary growth, by causing divergences between actual and expected rates of inflation can generate large and protracted transitory changes in excess demand and associated real variables. In the long run, however, expectations will be fully fulfilled, and money growth will influence only the rate of inflation. Monetary growth cannot affect real variables in steady state equilibrium.[19] Thus according to the temporaries theorem[20] monetary impulse influences employment and output only in the short run. The long run, money wages and market rate of interest will adjust to the higher rate of inflation and the real effect will disappear.

Imported Inflation

There is a general agreement that the major source of inflation in the international economy is the secular infla-

tionary trend in developed market economy countries. Therefore, a brief overview of those features of the developed market economy countries that make them prone to inflation is particularly important.

The secular inflationary trend in the O.E.C.D. countries is associated with certain institutional characteristics within the country, namely industrial concentration, industrial unionism, and protection accorded by government to various sectors to prevent the elimination of high-cost industries. These institutional elements have resulted in a downward inflexibility in factor and product prices. Thus while prices rise during an upward swing of the business cycle, the downward phase is not accompanied by a commensurate fall in prices. Moreover, the downward inflexibility of prices implies that changes in relative prices generally result in rising overall price level.

The developed market economies are vulnerable to price-wage spirals whenever a surge of demand or any other factor drives up the cost of living. Kosters (1978)[21] observed that without a parallel reduction in average wage increases, inflation can be suppressed only temporarily. Wages in the less unionized industries are more responsive to cyclical forces than among the highly unionized industries. This difference in responsiveness and timing of its effects are influenced by the spread of cost-of-living escalator provisions in

multi-wage contracts.

Stressing the role of labor unionism on the inflationary process, the author maintains that the labor market environment will always raise the risk that an expansionary aggregate economic policy will largely be translated into higher inflation and smaller increases in employment and production than intended. In conclusion, "clearly no more than a temporary reduction in inflation can be achieved without a parallel reduction in the rate of wage increases. The apparent insensitivity of average wage increases to cyclical changes in output and employment"[22] simply spells a sustained inflationary phenomenon.

In spite of the above structural considerations, no inflation can persist indefinitely unless it is validated by sufficient expansion of aggregate money expenditure to maintain high levels of resource utilization. In the O.E.C.D. countries, then, inflation cannot be regarded as simply institutional or market structure phenomenon. But to a larger extent, it is also a monetary phenomenon. The present-day concern of the less developed nations is that inflation is becoming an acute international phenomenon and price pressures are being transmitted from country to country in a variety of ways.

Chapter 2

THE MONETARIST MODEL

The monetarist hypothesis contends essentially that the various rates of inflation in various countries can be best explained by the respective rates of growth of money supply per unit of income. Thus according to this school, inflation is basically a monetary phenomenon. Therefore, there could never be a rapid rise in the rate of inflation without a significant increase in money supply. Without substantial monetary restraints there could never be a lasting solution to a serious inflation problem.

A simplistic monetarist model was developed in 1963 by Harberger[23] to analyze the causes of inflation in Chile. Harberger's model specified that

$$P_t = b_0 - b_1 Y_t + b_2 M_t + b_3 M_{t-1} + b_4 A_t + b_5 W_t \quad (2.1)$$

where P_t = rate of change in the price level

Y_t = rate of change in real output

M_t = rate of change in money supply

A_t = expected rate of change in the price level

W_t = rate of change in the wage rate.

The Harberger model was subsequently used by Carlos Diaz-Alejandro and Adolfo Diaz[24] to study the inflation in Argentina; later on, in 1974, Vogel[25] extended the model to the 13 Latin American countries. In Vogel's study the estimated equation is given as follows:

$$P_t^1 = k + dm_t^1 + em_{t-1}^1 - (1 + a)Y_t^1 + b[P_{t-1}^1 - P_{t-2}^1] \qquad (2.2)$$

where $[P_{t-1}^1 - P_{t-2}^1]$ = Proxy for ΔP_t^e.

In this chapter, the Harberger model will be empirically tested and analyzed. In the next chapter another version of the monetarist model will be tested and analyzed for the Nigerian economy to assess, more strictly, the relationship between money supply and prices in Nigeria. The model to be used in this chapter will be the one developed by Holden and Peel[26] in 1978 to study the relationship between money and inflation in Latin American countries.

Theoretical Framework

The central core of this study is the explanation of movements in the rate of inflation. Both annual and quarterly rates of inflation will be considered. This study will thus seek to explore the dynamic process by which monetary expansion has its effects upon the level of prices; to study the role of past acceleration of inflation upon current rate of price changes and to some extent, the effects of wage changes on the inflationary process in Nigeria.

The variable to be explained in this study is the rate of changes in prices. This variable has been chosen over the general price level (C.P.I.) because there exists a strong coefficient of determination between the quantity of money and the price index. The simple explanation of the phenomena is

that there is a strong upward trend in both variables. Thus the use of variations in the rate of inflation as the dependent variable represents a more challenging task and can better establish a more dependable line of causality between the variable to be explained, and its explanatory variables.

The Use of Annual and Quarterly Data

During the period under study, the estimation of the model based on annual data showed a general upward trend in price changes. But the existence of substantial serial correlation is rather disturbing and one may begin to wonder whether some explanatory variables might not achieve statistical significance because their broad movements are similar in shape to those of the rate of inflation rather than because of any systematic relationship.[27] Although the use of quarterly did substantially reduce the problem of serial correlation was substantially reduced the coefficients of determination and the goodness of fit was very poor. The time path of the quarterly data was very bumpy. This could be interpreted as signifying seasonal variations in the rate of inflation which could substantially reduce the explanatory power of the variables. One explanation for the poor fit associated with the quarterly estimate could be the unavailability of data. There are no quarterly data on G.N.P. for Nigeria. Several methods were tried to link the annual rate of change

in G.N.P. to some steady variables that were available on quarterly basis. One such effort was based on the assumption that the real rate of growth of G.N.P. was best proxied by the rate of growth of industrial production. This was tested by regressing the annual rate of growth of industrial production against the annual rate of growth of G.N.P. and the result was as follows:

$$y = a + bX \qquad (2.3)$$

where y = real rate of growth of GNP
a = intercept
b = constant
X = rate of growth of industrial production.

This result was then applied in estimating the quarterly GNP. But the fit of the model on quarterly dates was poor.

In another effort, the quarterly estimates of GNP by the Central Bank of Nigeria was applied. But the problem with these figures is that they cover only the period 1963 to 1972. This excluded the most crucial period of this study, which is the period 1970-78. The estimation of the model based on this estimate of GNP showed a poorer fit and higher serial correlation. It might therefore be concluded that due to inadequacies associated with data collection the model could not be satisfactorily tested on a quarterly basis. Although the use of quarterly data did not improve our quest for higher level of significance of the explanatory powers of the independent variables, it at least satisfied the natural urge

in the study of dynamic movements, which is to have explanation which applies to short spans as well as long ones.[28]

Allowance for the Effects of Past Changes in Money Supply on Current Prices

It is a generally accepted dictum of the monetarists that the effects of increases in money supply on the price level do not occur instantaneously. In this respect, money supply with different lag periods are introduced as explanatory variables to capture the lag-patterns of money supply. We may then write that

$$P_t = b_0 + b_1 M_t + b_2 M_{t-2} + b_3 M_{t-3} + \cdots + b_i Z_{t-i} \qquad (2.4)$$

where: P_t = percentage rate of changes in prices during the period (t)

M_t = percentage rate of change in money supply during the period (t)

M_{t-1} = percentage rate of change in MS for the previous period

Z_i = all other variables.

In measuring the speed of adjustment of the inflationary process to changes in money supply, we examine the coefficients b_1, b_2, b_3 in the above specifications. If $b_1 > b_2$ this could be interpreted to mean that much of the adjustment takes place during the current time period and vice versa. The time period taken for coefficient of lagged MS to approach unity measures the time period necessary for variations in MS to express its full impact on prices. If $b_1 + b_2 + b_3 = 1$, then it may be said that it takes 3 years, using annual data,

penditure on real assets will increase and this leads to the bidding up of already increasing prices. Therefore when cost of holding cash P^e↑→real cash balance↓→Md.↓and expenditure ↑→P↑.

Allowance for the Effect of Wages

The effect of wage changes on the inflationary process is a subject of controversy among experts in the field. On the one hand it could be argued that wages simply responded passively to inflationary forces that were essentially monetary in origin. The other contention is that wages played a more active role in the inflationary process. Thus the line of causality ran from wages to inflation.

Recalling the central monetarist proposition that inflation is essentially a monetary phenomenon, wages from this point of view play only a passive role in the inflationary process, and once monetary variables have been adequately taken into account, variations in wage rate will not play any significant role as an explanatory variable of the inflationary process. On the other extreme, believers of the cost-push theory would claim that wages represent the single most important variable cost element in the production process. Based on this, variations in wage rate are viewed as the principal explanatory variable of price increases. Further arguments on this issue will be reserved for the experts on the subject. It will suffice to note in the empirical study

The problem encountered in the estimation of W.1 and W.2 was in the data collection. The only source of data for wages in Nigeria was the Year Book of Labor Statistics 1979, p. 400. Data here were given in average wage rate per day. The figures were then multiplied by 360 to obtain the annual wages. Periodic variations in wage rate (W^t) were calculated by extracting the percentage rate of change. The figures obtained represent (W_t) in the above equation. The estimations of equations W.1 and W.2 showed the following results:

$$W_t = 2.12 + .15P_{t-1} \qquad W.1'$$

$$W_t = 6.7 + .62P_{t-1} + .25P^e_t \qquad W.2'$$

The fit of the above regressions is rather poor. Using such results in estimating wages for the model during the period in which data for wages are not available represents a rather serious problem. The same problem manifested itself in the calculation of the quarterly rate of change in wages. It is therefore noted here that the variable (W_t) in the model represents estimated wages, based on just a few data points. Based on this, its explanatory power of the inflationary process could be greatly diminished. However, in the absence of further information on the variable, it is concluded that the predictive power of the model as a whole could be significantly improved should more dependable date become available.

Allowance for Variations in Income

It is generally an accepted fact among economists that variations in real GNP should influence the rate of inflation in an opposite direction. One of the most difficult problems in this study was to specify and estimate an equation for the GNP in Nigeria on a quarterly basis. Several attempts were made, but the estimated equations gave estimated data with a poor fit in the general model.

In a final effort to resolve the situation it was decided to estimate some of the important multipliers in the Nigerian economy with the hope that some variables with a steady relationship with the GNP might be found, whole figures are available on a quarterly basis. The method used was based on a similar work on Kenya by Puffer and Kantarelis.[30] The results of this work are shown in tables 1 and 2.

Although this work did not shed any appreciable light into the estimation of the quarterly real GNP, it does contribute significantly to the understanding of the Nigerian economy, and the behavior of major economic variables.

Data

The data used are those reported in the International Financial Statistics. The observation period was 1952 to 1978, giving 26 observations. The quantities are expressed in Nairas, the national currency of Nigeria. The method of estimation is ordinary least squares.

TABLE 1

TRANSPOSE OF THE INVERSE MATRIX OF THE COEFFICIENTS OF THE ENDOGENOUS VARIABLES

Predetermined variables in the equations	Y_t	Y_t^P	Y_t^d	C_t^P	I_t^P	M_t	T_t^P	T_t^a
K_{Y_t}	2.17515	2.10315	1.6964	1.22819	0.50724	0.56030	0.40674	0.07199
$K_{Y_t^P}$	1.21537	2.17515	1.75447	1.27024	0.52608	0.57947	0.42067	0.04023
$K_{Y_t^d}$	1.50679	1.45619	2.17515	1.57481	0.65040	0.71841	0.28177	0.04987
$K_{C_t^P}$	2.0812	2.01231	1.62313	2.17515	0.89833	0.99228	0.38918	0.06889
$K_{I_t^P}$	0.64776	0.62632	0.50519	0.36576	0.84894	1.13095	-0.12113	-0.02144
K_{M_t}	-2.17515	-2.10315	-1.6964	-1.22819	-0.50724	0.43971	-0.40675	-0.071997
$K_{T_t^P}$	-1.50679	-1.45691	-2.17515	-1.57481	-0.65039	-0.71841	0.71823	-0.04985
$K_{T_t^a}$	-1.21537	-2.17515	-1.75447	-1.27024	-0.52461	-0.57947	-0.42067	0.95977

TABLE 2

MULTIPLIERS IN THE NIGERIAN ECONOMY

MULTIPLICAND	GNP	PERSONAL INCOME	DISPOSABLE PERSONAL INCOME	CONSUMPTION	PRIVATE INVESTMENT	IMPORTS	INCOME TAX
Government Expenditure on goods and services	2.175	2.103	1.694	1.228	0.507	0.567	0.407
Government Investment	-0.64776	-0.626	-0.505	-0.366	0.849	1.131	-0.121
Exports	2.081	2.013	1.623	2.175	0.898	0.992	0.389
Income Tax	-1.215	-2.175	-1.755	-1.270	-0.524	-0.580	-0.421

The estimation of the Harberger Model for Nigeria gives the following results:

$$P_t = 14.6 + .20M_t + .24M_{t-1} + .18M_{t-2} + .19M_{t-3} + .52P_t^e - 5.7W_t - .10Y_t$$

(2.36) (3.6) (2.6) (1.8) (2.6) (2.1) (2.1) (1.8)

Det. = .005 DW = 1.7 R^2 = .87

where P_t = annual rate of change in price level

M_t = annual rate of change in money supply

M_{t-1} = annual rate of change in MS with one-year lag

M_{t-2} = variations in MS lagged 2 years

M_{t-3} = variations in MS lagged 3 years

P_t^e = expected cost of holding cash

W_t = annual rate of change in wage rate

Y_t = annual rate of change in real income

(t) values in parenthesis

D.W. = Durbin Watson Statistic

Det.=Determinant which measures the level of serial correlation.

In this regression, the intercept of 14.6 is rather high. This means if the impact of all other variables are frozen, inflation will increase by 14.6% per year. All the variables carry the expected signs except wages. The wage coefficient which stands at 5.7 is very high, and the (t) value of 2.1 is significant at 97.5% confidence level. The problem with the estimated wage rate due to absence of data (previously explained) must have accounted for the unexpected sign. All

other variables are statistically significant at 90% confidence level. Other regressions with the Harberger model are given below.

H.1 $P_t = 1.1 + .17M_t + .18M_{t-1} + .09M_{t-2}$

(0.78) (2.91) (2.5) (1.5)

Det. = .37 DW = 1.8 R^2 = .77

H.2 $P_t = 2.12 + .21M_t + .18M_{t-1} + .05M_{t-2} - .12Y_t$

(1.5) (3.6) (2.6) (0.9) (2.0)

Det. = .28 DW = 1.8 R^2 = .81

H.3 $P_t = 1.4 + .22M_t + .18M_{t-1} + .004M_{t-2} + .08M_{t-3} - .10Y_t$

(.99) (3.85) (2.67) (.06) (1.38) (1.87)

H.4 $P_t = 1.49 + .23M_t + .14M_{t-1} + .02M_{t-2} + .09M_{t-3} + .12P^e_t - .11Y_t$

(1.01) (3.87) (1.57) (2.48) (1.51) (0.71) (1.90)

Det. = .08 DW = 2.05 R^2 = .83

H.5 $P_t = 5.9 + .20M_t + .20M_{t-1} + .12M_{t-2} + 14P^e_t - 1.6W_t - .12Y_t$

(.48) (3.1) (1.85) *1.04) (0.62) (0.64) (1.97)

Det. = .05 DW = 1.7 R^2 = .81

H.6 $P_t = 14.6 + .20M_t + .24M_{t-1} + .18M_{t-2} + .19M_{t-3} + .52P^e_t - 5.7W_t$

(.236) (3.6) (2.6) (1.8) (2.6) (2.1) (2.1)

$- .10Y_t$

(1.8)

Det. = .005 DW = 1.7 R^2 = .87

Equation (H.1) attempts to estimate changes in price level in terms of variations in money supply and lagged changes in money supply. All money supply components are significant at 90% confidence level. But the R^2 is rather low at .77. When the real GNP variable is introduced in (H.2), M_{t-2} loses its significance, and its coefficient is much lower. The introduction of a third period lag in money further reduces the significance of M_{t-2} while M_{t-3} itself is significant only at 90% level of confidence. And the R^2 is improved from .81 in (H.2) to .83 in (H.3).

The introduction of wages (W_t) and acceleration of prices P_t^e as explanatory variables improved considerably the level of significance of all the variables. They are all significant above 95% confidence interval.

The explanatory power of the equations is good; however, the coefficients of real income are significantly different from (-1) which can be interpreted to mean that a 1% increase in real income will generate a less than proportionate reduction in price level. The coefficient of both current and lagged changes in money supply are statistically significant and their sum is not significantly different from one. This can be interpreted to mean that a one percent increase in the quantity of money would cause approximately one percent increase in prices. This confirms the central core of the monetarist hypothesis embodied in the Quantity Theory.

Measuring the Speed of Adjustment

From the Harberger Model and its estimated equation restated here for the purpose of clarity:

$$P_t = a + bM_t + b_1M_{t-1} + b_2M_{t-2} + b_3M_{t-3} + \cdots + b_iZ_i$$

where Z_i = all other variables.

$$P = 14.6 + .20M_t + .24M_{t-1} + .18M_{t-2} + .19M_{t-3} + \cdots \quad (H.7)$$

it can be observed that

$$b < b_1 > b_2 < b_3 \quad (H.8)$$

$$(b + b_1) > (b_2 + b_3) \quad (H.9)$$

$$b + b_1 + b_2 + b_3 = .81 \quad (H.10)$$

The expression (H.8) indicates that the greatest response of prices to variations in money supply takes place at the end of the second year. It declines at the end of the third period, but however becomes slightly higher at the end of the fourth year. (H.9) indicates that the greater overall adjustment takes place within the first two years. From (H.10) the sum of the coefficient is .81. This means that the three-year lag period does not capture the full impact of monetary changes on prices. Further extension of the lagged period to M_{t-4}, of M_{t-5}, might bring the sum of the coefficient closer to unity. Since .81 is not significantly different from (1.00) it could be concluded here that it will take approximately four years for variations in the money supply to exert full impact on prices.

Using quarterly figures for the period 1963 to 1973, the regression equations were reestimated. Data were collected from the fourth quarter of 1963 to the fourth quarter of 1973. This gives a total of 37 observations. This period was chosen because it is the period covered by Central Bank quarterly data on the Nigerian GNP. The results are as follows:

$$P_t = 1.3 + .003M_t + .13M_{t-1} - .08Y_t \qquad \text{(H.11)}$$

(2.5) (.05) (2.6) (1.7)

Det. = .73 DW = 1.7 R^2 = .21

$$P_t = 1.0 + .02M_t + .10M_{t-1} + .10M_{t-2} - .05Y_t \qquad \text{(H.12)}$$

(1.9) (34) (2.3) (2.1) (1.1)

Det. = .60 DW = 1.4 R^2 = .30

$$P_t = .98 + .03M_t + .11M_{t-1} + .09M_{t-2} + .15P_t^e - .14Y_t \qquad \text{(H.13)}$$

(1.8) (0.6) (2.2) (1.9) (1.0) (0.9)

Det. = .44 DW = 1.6 R^2 = .33

$$P_t = 1.7 - .02M_t + .12M_{t-1} + .22P_t^e - .17W_t - .06Y_t \qquad \text{(H.14)}$$

Det. = .34 DW = 1.9 R^2 = .25

But the explanatory power of the above equations is extremely low. The highest R^2 is .33. The R^2 for the complete Harberger Model given by equation (H.14) is .25. However, the high level of multicollinearity defined by low deter-

minants in the annual data has been appreciably reduced. Due to the poor performance of these equations a different method of estimating the GNP on quarterly basis was considered.

There is some agreement among economists that the index of industrial production is a good proxi for real GNP. When this was tested for Nigeria, the regression result showed:

$$Y = 3.93 + .53X$$
$$(.49) \quad (2.1)$$

where Y = rate of change in real GNP

X = annual rate of change in industrial production

$$n=12 \quad DW = 1.8 \quad R^2 = .31$$

The result of the above regression is not encouraging. However, for the sake of academic curiosity the rate of growth of industrial production was used as a prox variable for quarterly GNP. The estimation of the model based on this assumption is given below in equation (H.15).

$$P_t = .87 + .05M_t + .17M_{t-1} + .07M_{t-2} + .48W_t - .12Y_t \qquad (H.15)$$
$$(.29) \quad (1.1) \quad (3.2) \quad (1.3) \quad (.45) \quad (1.1)$$

Det. = .5 DW = 1.9 R^2 = .45

In general, the quarterly study gives no appreciable relationship between the rate of price changes and the explanatory variables represented in the model. The results here are similar to the findings of Harberger on the Chilean inflation. Further studies on the quarterly figures will be a subject of further research when better data on quarterly

GNP should be available.

Conclusion

In this chapter the inflationary process in Nigeria has been studied using a simple monetarist model formulated by Arnold Harberger for the Chilean economy in 1963.

The Harberger Model has done reasonably well in explaining the inflationary process in Nigeria. But for the quarterly study which lacked adequate data, the explanatory power of the equations is good and the results are reasonable. A comparison of the empirical results in the study with that originally obtained by Harberger for Chile[31] shows great similarities.

$$P_t = 14.6 + .20M_t + .24M_{t-1} + .18M_{t-2} + .19M_{t-3} - .52P^e_t - 5.7W_t - .10Y_t$$
$$(2.36)\quad (3.6)\quad (2.6)\quad (1.8)\quad (2.6)\quad (2.1)\quad (2.1)\quad (1.8)$$

$$R^2 = 0.87$$

Harberger's estimate for Chile showed:

$$P_t = -1.15 - .89Y_t + .70M_t + .29M_{t-1} + .16A_t + .13W_t$$
$$(9.56)\quad (.32)\quad (.18)\quad (.18)\quad (.14)\quad (.22)$$

$$R^2 = 0.87$$

The R^2s are surprisingly identical. The student (t) values are generally higher in this study than in the Chilean case. The quarterly estimation of the model display the same close similarity of empirical results. These similarities in empirical results confirm the generality of the model and its broad applicability to developing economies.

Chapter 3

THE RELATIONSHIP BETWEEN MONEY SUPPLY AND PRICES

In chapter 2 the basic monetarist model of inflation was presented and empirically tested for the Nigerian economy. The model used was one constructed by Arnold Harberger for Chile in 1963. The regression results were generally good and reasonable, confirming the basic tenets of the monetarist thesis. Some of the criticisms leveled against the Harberger Model are that it includes some variables that are not strictly monetarist in nature. Vogel (1974) argued that the wages variable was structuralist in nature and its exclusion from the model could not significantly alter empirical results. Another problem with the Harberger Model is that money supply was treated as an exogenous variable. But in a country like Nigeria where economic development is a major policy objective of the government and where deficits are financed for the most part by the Central Bank through money creation, the assumption of an exogenous money supply could not be totally justified. In view of the above, further study of the relationship between money supply and inflation in Nigeria could be useful.

In this chapter the relationship between the rate of inflation and variations in the rate of monetary expansion in Nigeria will be examined. The results obtained here will be

compared with the empirical results reported earlier. The analysis presented here is based on a model developed by Holden and Peel (1979). The leading spokesman of the monetarist school, Milton Friedman[32] (1968, 75) reflected that once inflation is fully anticipated, then the rate of inflation will fully reflect changes in money supply. Thus the central core of the monetarist proposition is that "in the long run when actual and expected rates of inflation are equal, the rate of inflation will be independent of real forces in the economy and will be given by the rate of monetary expansion net of income elasticity of real balances times the trend (assumed constant rate of real output change)."[33] The monetarists also believe that it does take some appreciable period of time for monetary changes to manifest themselves in price changes. Thus in the short run there may be no significant relationship between inflation and money supply per se. However, in this model the nature of the short-run relationship has been derived as a reduced form from the monetarist model of the economy.[34]

The Demand for Money

It is a well-known fact among economists that when prices are expected to rise, then the opportunity cost of holding money is expected to increase because of the anticipated deterioration in the purchasing power of money. Harberger (1963) then postulated that the opportunity cost of holding

money is best proxied by the expected rate of inflation. The same idea was adopted by Diaz (1970) and Vogel (1974). Based on this empirical foundation the demand for money equation is given by:

$$M_t^d = P_t - \lambda_1 \Delta P_t^e + \lambda_2 Y_t \qquad (3.1)$$

where: M_t^d = proportionate rate of change of money demanded

P_t = proportionate rate of change in prices

ΔP_t^e = proportionate rate of change of expected prices

y_t = proportionate rate of change in real output

λ_1, λ_2 = constants.

The Augmented Phillips Curve

It is a simple matter of economic logic to note that changes in nominal income could occur as a result of changes in the rate of inflation or changes in real output or both. Thus, according to the authors, the Augment Phillips Curve represents an element in the monetarist theory which gives the split of nominal income changes between inflation and output. Thus, when the actual and expected rates of inflation are equal, output is equal to its trend level. Hence output change is independent of the inflation rate. Output will deviate from its trend level only when there is unanticipated inflation.[35] The Augmented Phillips Curve[36] is given by the equation

$$P_t = \log\left[\frac{Y}{\bar{Y}^*}\right] = P_t^e \qquad (3.2)$$

where: Y = level of real output

Y* = level of trend output

Y* = percentage rate of change in the level of trend real output and is assumed constant

h = positive constant.

Expectation is assumed to be adaptive expectation specified as:

$$P_t^e = \emptyset[P_{t-1} - P_{t-1}^e] \qquad (3.3)$$

where: $\emptyset$ = memory coefficient.

Equation 3.3 implies that the expected rate of inflation is a weighted average of past actual rates. Used initially by Cagan [37] (1956), Harberger (1963), Vogel (1974).

If, like Vogel (1974), we assume a non-instantaneous adjustment of demand and supply of money, then the adjustment mechanism will be specified as:

$$\Delta \log \frac{[M^s]}{PY} = \pi[\log \frac{M^d}{(PY)_{t-1}} - \log \frac{M^s}{(PY)_{t-1}}] \qquad (3.4)$$

where: P = level of prices

M^d, M^s = levels of money supply and demand

π = positive constant

log = natural logarithms

Equation (3.4) implies that when the ratio of desired cash balances (or velocity) exceeds the actual cash balances the actual cash balances will adjust in the desired direction.

A combination and manipulation of equations 3.1-3.4

and money supply and their lagged components. For the purpose of completeness, quarterly regressions were also examined. Price changes are measured in terms of changes in the Consumer Price Index (CPI). The money supply component used in this study is M_1. All quantities are expressed in Nairas, the national currency of Nigeria. The source of data is the International Financial Statistics (Year Book 1980). The method of estimation is ordinary least squares. The regression results are given below.

The estimation of (3.5)[1] is given by

$$P_t = .78 + .15M_t + .21M_{t-1} + .17M_{t-2} - .14P_{t-1} - .26P_{t-2} + .27P_{t-3} \quad (3.6)$$

(.47) (2.6) (2.0) (1.4) (-0.5) (-1.0) (1.6)

n=24 Det.=.02 DW=2.2 R^2=.80

In the regression equation (3.6) the intercept is very low and insignificant. The given 24 degrees of freedom M_t and M_{t-1} with (t) statistics of (2.6) and (2.0) are significant at approximately 95% level of confidence while M_{t-2} with a (t) statistic of (1.4) is not so significant. Variations in previous years' prices P_{t-1} and P_{t-2} are both negative and insignificant. P_{t-3} is positive but insignificant at 90% level of confidence. There is some degree of multicollinearity measured by the low determinant of (.02) with an R^2 of .80 which means 80% of the annual variations in prices can be explained by the above equation.

When a third period lag in money supply (M_{t-3}) is introduced, the result shows that

$$P_t = 1.9 + .17M_t + .26M_{t-1} + .21M_{t-2} + .27M_{t-3} - .43P_{t-1} - .54P_{t-2} - .16P_{t-3} \quad (3.7)$$

$$(1.2)\ (3.0)\ (2.6)\quad (2.0)\quad (2.2)\quad (-1.5)\quad (-2.0)\quad (-0.7)$$

$$R^2 = .84$$

In (3.7) the (t) statistics for the money supply variables are all significant at above 95% level of confidence. The sum of the MS coefficients is .91 which is not significantly different from 1.0. This can be interpreted to mean that it will take approximately 4 years for prices to adjust fully to monetary impulses and the greatest adjustment takes place in the fourth year. The slowest adjustment takes place in the first year. This confirms the monetarist proposition that in the short run, there may be no close correspondence between monetary expansion and the rate of inflation per se. The R^2 improved (from .80 in (3.6)) to .84. Other regressions using this model are given below.

$$P_t = .96 + .17M_t + .19M_{t-1} + .09M_{t-2} \quad (3.8)$$

$$(.69)\quad (2.9)\quad (2.6)\quad (1.5)$$

Det. = .36 DW = 2.0 R^2 = .77

$$P_t = .26 + .18M_t + .19M_{t-1} + .03M_{t-2} + .10M_{t-3} \quad (3.9)$$

$$(.18)\quad (3.2)\quad (2.7)\quad (3.6)\quad (1.7)$$

Det. = .21 DW = 2.1 R^2 = .79

$$P_t = .78 + .17M_t + .21M_{t-1} + .05P_{t-1} + .12P_{t-2} \qquad (3.10)$$

(.48) (2.6) (1.9) (1.9) (0.7)

Det. = .11 DW = 2.0 R^2 = .75

$$P_t = 1.3 + .16M_t + .21M_{t-1} + .13M_{t-2} - .09P_{t-1} - .08P_{t-2} \qquad (3.11)$$

(.78) (2.5) (1.9) (1.1) (-.3) (-.3)

Det. = .02 DW = 2.0 R^2 = .77

$$P_t = .56 + .17M_t + .25M_{t-1} + .05M_{t-2} + .11M_{t-3} - .22P_{t-1} \qquad (3.12)$$

(.38) (2.9) (2.4) (.65) (1.7) (-.77)

Det. = .03 DW = 2.0 R^2 = .80

$$P_t = .15 + .17M_t + .25M_{t-1} + .21M_{t-2} + .21M_{t-3} - .37P_{t-1} - .52P_{t-2} \qquad (3.13)$$

(1.1) (3.0) (2.6) (2.6) (2.7) (-1.4) (-2.0)

Det. = .006 DW = .20 R^2 = .84

The regression results using quarterly data were very poor. The R^2s were very low. The (t) values for both monetary and price variables were generally insignificant. These poor results can be interpreted to mean that in the short run monetary impulses may not exert significant impact on price level. It takes some time for variations in money supply to produce an appreciable impact on prices. This represents another confirmation of the monetarist proposition that in the short run there may be no close correspondence between

the rate of price changes and the rate of monetary expansion.

Some of the results using quarterly data are given below.

$$P_t = 1.3 - .02M_t + .07M_{t-1} + .13M_{t-2} - .07M_{t-3} \qquad (3.14)$$

(2.2) (-0.3) (1.6) (2.7) (-1.5)

Det. = .82 DW = .14 R^2 = .32

$$P_t = 1.9 + .01M_t + .06M_{t-1} + .10M_{t-2} - 1.0M_{t-3} + .30P_{t-1} - .14P_{t-2} + .13P_{t-3} \qquad (3.15)$$

(1.9) (-.2) (1.1) (1.9) (-1.8) (1.6) (-0.7) (0.7)

Det. = 27 DW = 1.7 R^2 = .39

$$P_t = 1.1 + .01M_t + .09M_{t-1} + .11M_{t-2} + .15P_{t-1} - .20P_{t-2} \qquad (3.16)$$

(1.7) (.36) (2.0) (2.1) (.90) (-1.1)

Det. = .59 DW = 1.7 R^2 = .31

The stability of the estimates of equation (3.5) can be examined by setting

$$A = K + \lambda_3 M_t + \lambda_4 M_{t-1} + \lambda_5 M_{t-2} \qquad (HP.1)$$

By solving the difference equation

$$P_t = A + \lambda P_{t-1} + \lambda_1 P_{t-2} + \lambda_2 P_{t-3} \qquad (HP.2)$$

where K, λ, λ_1-λ_5 are estimates of the constant term λ, λ_1-λ_5 in equation (5). The general solution of equation (HP.2) for a constant rate of change in money supply (A) will be of the form:

$$P_t = k_0 + k_1 a^t + k_2 a_2^t + k_3 a_3^t \qquad (HP.3)$$

where a, a_2, and a_3 are roots of the difference equation. In the special case where the roots are complex, then (HP.3) becomes

$$P_t = k_0 + k_1 a_1^t + b^t[B_{cos}ct + D_{sin}ct] \qquad \text{(HP.4)}$$

where B, D, and c are constants. From this analysis (HP.4) indicates that for a policy of constant rate of change in money supply the rate of change in prices will be cyclical in the short run, and the size of the fluctuation will depend upon the relative sizes of the constants. k_0 can be easily shown to be proportional to A; thus if a, b, and c have modulus less than unity, then in the long run the growths of prices will be related to the rate of change in the money supply. We now present an empirical estimate of the above equations for the Nigerian economy.

For the purpose of simplicity we shall be using a 2nd order homogeneous difference equation instead of a third order equation as stated above.

The equation to be estimated in this case is given by (3.13).

$$P_t = 1.5 + .17M_t + .25M_{t-1} + .21M_{t-2} + .21M_{t-3} - .37P_{t-1} - P_{t-2} \qquad \text{(HP.5)}$$

(1.1) (3.0) (2.6) (2.0) (2.7) (1.4) (2.0)

$$R^2 = .84$$

$$\text{Setting } k = .17M_t + .25M_{t-1} + .21M_{t-2} + .21M_{t-3} \qquad \text{(HP.6)}$$

Substituting the values of r_1 and r_2 in the complementary equation,

$$y_c = A_1R_1^t + A_2R_2^t = A_1[1 + v_i]^t + A_2[1 - v_i]^t \quad (14)$$

where $(1 + v_i)^t = R^t[\cos\theta t + i \sin\theta t]$ (15)

and $(1 - v_i)^t = R^t[\cos\theta t - i \sin\theta t]$ (16)

The general solution will be given by

$y_c + y_p$

$$= A_1R^t[\cos\theta t + \sin\theta t] + A_2R^t[\cos\theta t - i \sin\theta t] + \frac{k}{1.89} \quad (17)$$

$$= A_1R^t\cos\theta t + A_1R^t i \sin\theta t + A_2R^t\cos\theta t - A_2R^t i \sin\theta t + \frac{k}{1.89} \quad (18)$$

$$= R^t_{\cos\theta t}[A_1 + A_2] + R^t_{i \sin\theta t}[A_1 - A_2] + \frac{k}{1.89} \quad (19)$$

From equation (19)

let $A_1 + A_2 = A_3$ (20)

and $(A_1 - A_2)i = A_4$ (21)

Then equation (19) becomes

$$P_t = R^t[A_{3\cos\theta t} + R^t A_{4\sin\theta t}] + \frac{k}{1.89} \quad (22)$$

But $R = \sqrt{b_2} = \sqrt{1^2 + v^2} = \sqrt{\frac{b_1^2 + 4b_2 - b}{2}}$ (23)

$$1 = \frac{-b_1}{2}, \quad v = \sqrt{\frac{4b_2 - b_1^2}{2}} \quad (24)$$

for $R = \sqrt{b_2} = \sqrt{.52}$ $\underline{.72}$ (25)

since $b_1 = .37$, $b_2 = .52$.

$$v = \frac{\sqrt{4b_2 - b_1^2}}{2} = \frac{\sqrt{2.1 - .14}}{2} \tag{26}$$

$$1 = -\frac{b_1}{2} \quad -\frac{.37}{2} = \underline{\underline{-.19}} \tag{27}$$

$$\sin\theta = \frac{v}{R} = \frac{.74}{.72} = \underline{\underline{1.03}} \tag{28}$$

$$\cos\theta = \frac{1}{R} = -\frac{.19}{.72} = .26 \tag{29}$$

$$\sin\theta = 1.03 \simeq 1$$
$$\cos\theta = -.26 \simeq 0 \qquad \therefore \theta = \frac{\pi}{2} \tag{30}$$

From equation (22)

$$P_t = R^t[A_{3\cos\theta t}] + [R^t_{\sin\theta t}] + \frac{k}{1.89}$$

given that

$$P_t = 1.5 + .17M_t + .25M_{t-1} + .21M_{t-2} + .21M_{t-3} - .37P_{t-1} - .52P_{t-2}$$

$$\text{and } 1.5 + .17M_t + .25M_{t-1} + .21M_{t-2} + .21M_{t-3} = k \tag{31}$$

for a constant rate of change in money supply, then

$$M_t = M_{t-1} = M_{t-2} + M_{t-3} = \lambda \tag{32}$$

$$\therefore \quad k = 1.5 + .17\lambda + .25\lambda + .21\lambda + .21\lambda$$
$$= 1.5 + .84\lambda, \tag{33}$$

Assuming a 25% annual rate of increase in money supply,

$$\text{then} \quad = .25$$

$$\text{and } k = 1.5 + .84(.25) = \underline{\underline{1.71}} \tag{34}$$

Substituting the value of k in equation (22),

$$P_t = R^t[(A_{3\cos\theta t}) + A_4(\sin\theta t)] + \frac{1.71}{.89} \tag{35}$$

$$P_t = R^t[A_{3}\cos\theta t + A_{4}\sin\theta t) + 1.92$$

A^t $t = 0$ $P_0 = .72^t[A_3(\cos\frac{\pi t}{2}) + A_4(\sin\frac{\pi t}{2})] + 1.92$ (39)

P_0 $=30$

But $t = 0$ and equation (30) becomes

$$.72^0[A_3 \underset{=1}{\cos\theta} + A_4 \underset{=0}{\sin\theta}] + 1.92 \quad (40)$$

$\therefore\ P_0 = A_3 + 1.92.$

But $P_0 = 30$ (given)

$\therefore\ 30 = A_3 + 1.92$

$A_3 = 28.08$

A^t, $t=1$, then $P_1=.72^1[A_3(\cos\frac{\pi t}{2})+A_4(\sin\frac{\pi t}{2})]+1.92$ (41)

$P_1=40$ $P_1 = .72[A_3 \underset{=0}{\cos\theta} + A_4] + 1.92$ (42)

$= A_4 + 1.92$

$\therefore\ 40 = A_4 + 1.92$

$A_4 = 38.08$

Substituting the values of A_3 and A_4 in the general solution, equation (22) becomes

$$P_t = .72^t[21.9\cos\frac{\pi t}{2} + 39.1\sin\frac{\pi t}{2}] + 1.92 \quad (43)$$

could give rise to self-generating inflation. The estimation of the second order difference equation with complex roots given by:

$$P_t = R^t[(A_{3\cos\theta t}) + A_4 \sin\theta t)]; \quad R^t < 1 = .72.$$

So the time path is stable and the adjustment process will be slower, the larger the absolute value of R. With an R = .72 the speed adjustment can be evaluated by examining how long it will take for R^t to be less than 0.1. In this case, it will take 8 years. Thus an increase in the rate of growth of money supply will cause a proportionate increase in the rate of inflation after 8 years (after 8 years, $R^t = .71^8 = .07$).

If the modulus of R was greater than one ($|R| > 1$), then the adjustment path could have been typified by dynamic instability and the process of inflation could have been described as self-generating as in the case of Artentine with $R = .98 \simeq 1$.

The problem of multicollinearity shown by low determinants in the regressions casts some degree of uncertainty on the estimate of (R). As a result, the precise conclusion on the adjustment is at best to be regarded as illustrative.

Chapter 4

THE STRUCTURALIST APPROACH TO INFLATION

The structuralist theory is based on the premise that developing countries are characterized by various rigidities associated with inelasticity of agricultural output and bottlenecks in imports. Another aspect of the structuralist theory hinges on the belief that there exists a struggle between confliting interests--between government, business, and labor. This aspect generates inflation via the cost push, profit push, and money supply hypothesis.

Under the agricultural lag hypothesis the demand for food supply is a function of population growth, the growth in per capita income and the degree of urbanization. For a number of reasons the agricultural sector does not respond adequately to the rising demand for food products. Consequently excess demand for food products exists. In the absence of price controls, food prices will rise, thus setting the stage for a- inflationary spiral.

The import bottleneck hypothesis stipulates that, other things being equal, developing countries will experience difficulties with their balance of payments over the long run. This is due to the fact that their exports consist essentially of primary products and thus subject to low income elasticity of demand. Their imports from the industrialized nations on the other hand are of high income elasticity of demand. The

decline in their external position provokes import restriction and domestic import substitution. Thus via the mechanisms of excess demand associated with import restriction and demand shift associated with import substitution the inflationary situation is greatly accentuated.

Instability in the foreign sector of developing countries creates inflationary pressure in two ways: (1) improvement in the foreign sector raises per capita income and thus generates demand-pull inflation, (2) deterioration in the sector exerts cost-push inflationary pressures. Both types of inflation are said to exist in developing countries.

Another important building block of the structuralist school is the Sectoral Demand Shift Theory of Inflation. This theory maintains that in a growing economy demand keeps shifting from one sector to another and that prices rise readily in the sector to which demand has shifted but do not fall as readily in the sector from which demand has shifted. Consequently, there could be a general process of escalation of prices based on neither cost-push nor the pull of general excess demand.

On the relationship between structural inflation and growth, some experts believe that a certain level of inflation is necessary to encourage investment which is so vital as a foundation for steady growth, especially for the developing nations. Bernstein and Patel[38] observed that "the normal operation of the economy should result in distributing and

using income in such a way as to produce a close equivalence between aggregate demand and the cost of producing total output including profit and taxes."[39] However, in practice this does not always happen, as government, business, or labor sometimes attempts to secure a larger part of the national output than would ordinarily be their share. If other sectors are not prepared to acquiesce in this increase in the share of output by one sector, then all of the other sectors together will be vying against each other to get a larger share of the national output than production will provide. This, according to the authors represents the basic framework for an inflationary process, when aggregate demand for all purposes like consumption, government expenditure, investment, etc., exceeds the supply of goods at current prices.

For sustained growth to take place, the government must provide adequate infrastructure and a general economic climate attractive to both domestic and foreign investment. In order to accomplish this government expenditure will necessarily increase more than taxes and public loans can accommodate. Consequently they may have to borrow, as they usually do, from the commercial banks and from the central bank. If other economic sectors, namely, labor and business, are unwilling to contract their expenditure and investment by the amount of these loans, then an inflationary process will be initiated. Similarly, whenever investment by businessmen ex-

ceeds savings and public loans and the additional investment is to be financed by bank loans, other sectors, labor, in particular, must be willing to contract its consumption by the amount of this additional investment or else an inflationary process will be initiated.

If, on the other hand, labor were prepared to acquiesce in a reduction of consumption and allow a shift in total output going into investment, then there will be an initial impact towards inflation so prices will rise. With wages and other non-profit incomes unchanged, consumption of the non-profit earners will decline. Prices will rise and there will be a tendency for total consumption to decline to the extent necessary for the additional resources that businessmen are using for investment. When this happens, national income will be distributed in favor of the investing public. This will enable the businessmen to maintain thereafter the expanded scale of investment without any further rise in prices. In this circumstance, the economy should have established a tenuous stability that might not be easily upset. This could result in rising profits beyond the expected, which encourages further investment and expansion.

The only way inflation could be initiated in a system like this is that increasing investment will have the effect of generating competition among producers for labor, thus bidding up wages. If wages rise, then the expansion of in-

vestment will tend to subside. In this case, the distribution of income will revert approximately to its original pattern and the inflation might have resulted in a once-for-all expansion of investment. On the other hand, if wages are "forced" to remain unchanged despite rising profits, then there will be a tendency for prices to fall.

The Structuralist Model: Theoretical Foundation

The foundation of the model to be used in this study is based on the work done by Garcia[40] (1964). Garcia subdivides the economy into five sectors:

1) Agriculture
2) Manufacturing
3) Urban Labor Market
4) Foreign Trade
5) Government and Monetary Institutions.

The fivefold classification has been made to focus on the contribution of each sector to the inflationary process. The basic model is described below:

General Price Level Equation:

$$P_t = P_{At} + BP_{It} + P_{Mt} \qquad (4.1)$$

Agricultural Price Equation:

$$P_{At} = P_t + A_t \qquad (4.2)$$

Industrial Price Equation:

$$P_{It} = aW_{t-1} + bP_{Mt-1} + c \qquad (4.3)$$

Industrial Wage Equation:

$$W_t = k + {}_jP_{t-1} \tag{4.4}$$

Import Price Equation:

$$P_{mt} = q_t + f_t \tag{4.5}$$

Foreign Exchange Price Equation:

$$f_t = P_t + F_t \tag{4.6}$$

where P_{At} = rate of change of agricultural price

P_t = rate of change of general price level

A_t = rate of change of real agricultural prices in response to real phenomena

P_{It} = rate of change of industrial prices

W_t = rate of change of industrial wages

P_{mt} = rate of change of import costs

q_t = rate of change of prices in foreign currency

f_t = rate of change of the exchange rate

F_t = rate of change of the real exchange rate in response to factors such as the terms of trade and growth of foreign or domestic income.

Combining equations 4.1-4.6, we have a non-homogeneous second order difference equation,

$$P_t - bP_{t-1} - ajP_{t-2} = S \tag{4.7}$$

where S, the R.H.S. constant, is defined by:

$$S_t = ak+c+(\tfrac{\alpha}{B})A_t+(\gamma/B)[(q_t+F_t)+b(q_{t-1}+F_{t-1})] \tag{4.8}$$

Taking S_t as a given parameter independent of t, Garcia

the only relevant parameter in S.

Lioi's Model

The model to be estimated in the study is based on Garcia's theoretical formulation and the empirical work of Lioi[41] (1974). In Garcia's formulation:

$$P_t = P_{At} + P_{It} + P_{Mt} \tag{4.10}$$

Lioi assumes P_{At} and P_{Mt} to be exogenous.

Pricing method consists of mark-up over variable cost.

$$P_I t = \lambda TVC \tag{4.11}$$

where TVC = total variable cost.

$$TVC = ULC_t + UIMC_t + UDMC_t \tag{4.12}$$

ULC_t = Unit labor cost

$UIMC_t$ = Unit imported material cost

$UDMC_t$ = Unit domestic material cost

$\lambda - I = u$ = Mark-up coefficient

The industrial price equation may be written as:

$$P_{It} = ULC_t + UIMC_t + UDMC_t + R_t \tag{4.13}$$

where R_t = residual.

Taking the first difference of equation 4.3 with respect to time, we have:

$$\dot{P}_{It} = \dot{ULC}_t + \dot{UIMC}_t + UDMC_t + U_t \tag{4.14}$$

Assuming fixed coefficients for the above variables (see Cauas (1978)), equation 4 becomes:

$$\dot{P}_{It} = g_1\dot{ULC}_t + g_2\dot{UIMC}_t + g_3\dot{UDMC}_t + \dot{U}_t \tag{4.15}$$

In studying the behavior of the mark-up variable through

time we hypothesize that firms acting rationally would assume that a reasonable mark-up is determined by demand pressures in the market. We can say that:

$$U_t = F(\frac{D_t - Q_t}{Q_t})$$

where D_t = demand for industrial products

Q_t = supply for industrial products.

We can rewrite equation 3.15 as:

$$\dot{P}_{It} = g_1\dot{ULC}_t + g_2\dot{UIMC}_t + g_3\dot{UDMC}_t + F(\frac{D_t - Q_t}{Q_t}) \qquad (4.16)$$

If we assume that the rate of change in unit domestic raw material cost is the same as the rate of change in industrial prices (Lioi), Equation (4.6) then becomes:

$$P_{It} = g_1ULC_t + g_2UIMC_t + F(\frac{D_t - Q_t}{Q_t}) \qquad (4.17)$$

Assuming further that the unit imported material cost is best proxied by foreign price level, then we can say that:

$$\dot{P}_{It} = g_1\dot{ULC}_t + g_2\dot{PM}_t + F(\frac{D_t - Q_t}{Q_t}) \qquad (4.18)$$

The next problem is to find a quantitative measure of the excess demand variable. One method would be to approximate it by the excess capacity function. But in this case data collection will be difficult. Another method is to use changes in the money supply or in the rate of unemployment. But it is a country like Nigeria that is characterized by a serious phenomenon of underemployment; unemployment becomes an illusive term and cannot represent a reliable proxi for

excess demand. Stein[42] suggests that excess demand is determined by the rate of unemployment and money stock per unit of capital, the expected rate of inflation, government expenditure, and a wealth variable. Laidler[43] suggests that excess demand is derived from money supply, real growth, and by lagged values of excess demand. There is a general consensus among experts in the field that money supply is a good proxi for excess demand.

In this study monetary variables, i.e., money supply and its lagged components, will be introduced as a proxi variable for excess demand; thus the excess demand variable (C_t) in the next equation will be proxied by money supply.

The final equation for the estimation of industrial prices now becomes:

$$\dot{P}_{It} = g_1\dot{ULC}_t + g_2\dot{PM}_t + C_t \qquad (4.19)$$

If we replace ULC_t by W_t we have an equation for industrial prices similar to that of Garcia, given by:

$$\dot{P}_{It} = g_1\dot{W}_t + g_2\dot{PM}_t + C_t \qquad (4.20)$$

$$W_t = k + jP_{t-1} + j_1P^e_t \qquad (4.21)$$

To summarize the empirical model, we would state that:

$$\dot{P}_t = \dot{P}_{At} + \dot{P}_{It} + \dot{P}_{Mt} \qquad (4.10)$$

where $\dot{P}_{Mt}$ is an exogenous variable

$$\dot{P}_{It} = g_1W_t + g_2\dot{P}_{Mt} + \dot{C}_t \qquad (4.20)$$

$$\dot{W}_t = k + jP_{t-1} + j_1 P^e_t \qquad (4.21)$$

$$\dot{P}_{At} = a + a_1\dot{L}_t + a_2\dot{U}_t + a_3\dot{Z}_t + a_4\dot{E}_t \qquad (4.22)$$

where: $\dot{L}_t$ = population growth rate

$\dot{U}_t$ = change in the rate of urban population growth

$\dot{Z}_t$ = proxi for changes in income redistribution

$\dot{E}_t$ = changes in aggregate level of education.

Empirical Estimation of the Structuralist Model

The empirical structuralist model is given by the equation: $P_t = P_{At} + P_{It} + P_{mt}$

where P_{At} = prices in the agricultural sector

P_{It} = prices in the industrial sector

P_{mt} = import prices.

Import Prices

In this model, import prices is taken as exogenously determined. The empirical problem here is that we do not have import price statistics for Nigeria during the period under study. The method of calculation was the same as one used in calculating the C.P.I. The formula can be summarized as

$$P_{mt} = \Sigma^{n}_{i=1} P_i W_i \qquad (4.23)$$

where P_i = F.O.B. export prices of each country

W_i = the proportion of imports from each country to total imports.

To carry out this calculation ten major exporting countries

to Nigeria were selected. These countries include: United Kingdom, Hong Kong, India, U.S.A., Canada, France, Netherlands, West Germany, Italy and Japan. These countries together provide over 80 percent of Nigeria's imports Studies show that the major exporter to Nigeria is the United Kingdom, which accounted for 38 percent of all imports to Nigeria in 1965 and 28 percent in 1978. The next major exporter to Nigeria is West Germany which supplied 13 percent of Nigerian imports in 1965 and 19 percent in 1978. The United States had maintained a steady flow of exports to Nigeria. In 1965 the U.S. supplied 15 percent of Nigerian imports. In 1978, U.S. imports accounted for 13 percent of total imports. Imports from Japan were 11 percent in 1965 and 13 percent in 1978. The percentage of total imports from each country and the corresponding F.O.B. export price index is given in Table II. Table III shows the computation of import prices given by the formula $\sum_{i=1}^{n} W_i P_i$. Most of the countries have 1975 as the base year for their export price index except India whose base year is 1976.

Prices in the Industrial Sector

For analytical purposes, industrial prices were studied under two headings, namely, cost-push factors and demand-pull (excess demand) factor. From our empirical model, industrial prices were specified as follows:

Weighted Imports from Each Country (W_i) and Their Corresponding Price Index (P_i)

TABLE III

	1965		1965		1967		1968		1969		1970		1971		1972		1973		1974		1975		1976		1977		1978	
	W_1	P_1	W_1	P_1	W_1	P_1	W_1	P_1	W_1	P_1	W_1	P_1	W_1	P_1	W_1	P_1	W_1	P_1	W_1	P_1	W_1	P_1	W_1	P_1	W_1	P_1	W_1	P_1
U.K.	.38	40	.37	42	.37	42	.47	46	.45	47	.38	51	.39	53	.36	56	.34	64	.32	82	.29	100	.29	120	.28	142	.28	156
HONG KONG	.02	—	.01	—	.01	—	.02	57	.01	60	.02	64	.02	69	.02	72	.02	85	.02	103	.02	100	.02	110	.02	117	.02	118
INDIA	.02	38	.02	34	.02	53	.01	52	.01	50	.01	53	.02	54	.01	60	.01	73	.01	73	.01	91	.01	100	.10	104	.01	118
U.S.A.	.15	49	20	50	.16	51	.15	52	.15	54	.19	56	.17	58	.13	60	.13	70	.18	73	.14	100	.14	103	.14	107	.13	114
CANADA	.01	50	.02	52	.01	54	.01	55	.01	57	.01	58	.01	58	.01	60	.01	68	.01	92	.01	100	.01	103	.01	120	.01	143
FRANCE	.05	53	.07	55	.05	54	.05	54	.04	58	.05	64	.05	67	.07	69	.09	75	.09	95	.10	100	.93	109	.09	120	.09	126
NETHERLANDS	.07	65	.05	65	.06	64	.07	64	.97	65	.05	68	.04	69	.06	70	.05	74	.07	95	.05	100	.06	106	.05	109	.05	107
W. GERMANY	.13	74	.14	73	.14	72	.14	72	.14	73	.16	71	.15	74	.17	76	.18	79	.21	92	.18	100	.20	104	.20	107	.19	105
ITALY	.06	46	.06	46	.06	46	.09	46	.07	47	.06	50	.05	53	.05	53	.05	61	.08	83	.08	100	.07	122	.09	146	.08	156
JAPAN	.12	59	.07	59	.11	61	.05	61	.05	64	.08	68	.10	68	.12	67	.12	72	.13	96	.12	100	.12	99	.13	98	.11	92

Import Prices in Nigeria = $\sum P_i W_i$

TABLE IV

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
U.K.	15.28	15.54	15.58	18.77	21.06	19.89	20.67	20.16	21.76	26.57	28.88	39.80	19.19	42.90
HONG KONG	——	——	——	.91	.72	1.28	1.38	1.44	1.7	2.06	2.00	1.98	1.79	2.83
INDIA	.544	.51	.95	.62	.45	.53	1.08	.6	.73	.73	.73	.90	6.14	.71
U.S.A.	7.301	10.15	8.11	7.8	8.26	10.08	9.86	7.8	9.3	15.31	13.8	14.01	14.98	15.62
CANADA	.45	.78	.54	.33	.29	.58	.58	.6	.68	1.29	.80	.72	.48	.57
FRANCE	2.86	3.85	2.92	2.60	2.44	2.56	3.35	4.83	6.75	8.84	10.30	10.14	10.44	11.72
NETHERLANDS	4.29	3.12	3.90	4.54	4.75	3.40	2.76	4.2	3.7	6.17	5.3	6.04	5.67	5.56
W. GERMANY	9.84	9.86	10.30	10.37	9.86	11.36	11.1	12.92	14.22	19.5	18.2	20.8	20.68	20.26
ITALY	2.62	2.90	2.81	4.28	3.29	3.0	2.65	2.65	3.05	6.53	7.6	9.03	12.85	13.1
JAPAN	6.79	4.07	6.53	2.93	3.14	5.44	6.8	8.04	8.64	1.27	12.30	11.48	13.03	12.33
$P_m = \sum P_i M_i$ =	49.97	50.78	51.64	53.15	54.26	58.10	60.23	63.20	70.33	88.27	99.91	109.91	125.25	172.04

$$P_{It} = W_t + P_{mt} + C_t \qquad S.1$$

$$W_t = b + b_1 P_{t-1} + b_2 P_t^e \qquad S.2$$

The cost-push factors are represented by W_t and P_{mt}. C_t represents excess demand function. Import prices are exogenously determined and have already been calculated. The wage equation was estimated in the monetarist section. The estimated equation showed that

$$W_t = 6.7 + .62P_{t-1} + .25P_t^e \qquad S.3$$

As already explained in the monetarist model, equation S.3 is less than satisfactory. The estimation was based on only seven data points. The reason for this is that there are no data on wages in Nigeria. Should adequate data be available, the estimated wages should be more reliable and the explanatory power of the variable in the model should be better and the estimation of the model as a whole should improve. Our a priori expectation of the wage variable in the model was that it should be positive and significant because of the rapid increase in income, oil revenues and increase in cost of living couples with vigorous labor union activities. It is disappointing that there are no empirical data to validate this stance and the impact of wages cannot be accurately expressed in the empirical work. However, in the absence of adequate data, the estimated wages showed up poorly in both the monetarist and structuralist models. Our a priori ex-

pectation was not satisfied because wages were shown to be insignificant in both models. In some instances wages were both negative and insignificant.

Determination of Prices in the Industrial Sector

In this study the general price index is divided into two components, namely, prices in the industrial sector and food prices. Figures on food prices are available, but data on industrial prices are not. The industrial price equation can then be written as:

$$P_{It} = P_t - W.PP_t \qquad (4.24)$$

where: P_{It} = prices of industrial products

P_t = C.P.I.

$W.PF_t$ = weighted average change in food prices

W = Ratio of food production to GNP $(\frac{\text{Food Production}}{\text{GNP}})$

The computation of (W), the ratio of food supply to GNP, has been very difficult due to lack of data on the money value of food production. The rationale behind this expression is that figures for agricultural production are readily available. But food production is different from agricultural production because the bulk of Nigerian agricultural production is cash crops and other agricultural raw materials for exports. Figures for agricultural exports are also available. Figures for food imports into Nigeria are also available.

Equation 4.25 then means that we can estimate the total food supply in Nigeria by subtracting agricultural exports from the total agricultural production and by adding food imports of food supply for Nigeria. The only information on food supply are indexes of food production for the period 1963 to '73 from the Central Bank of Nigeria and 1968 to '78 from the F.A.O. Year Book, 1979.

In the absence of any data on estimated food supply, we use the United Nations [F.O.A.] method for estimating food available for consumption in a particular country. A formula to summarize this method can be written as

$$F_t = Z_t - X_t + MF_t \tag{4.25}$$

where: F_t = total food supply during the period (t)

Z_t = total agricultural production

MF_t = total food imports.

From equation (4.2) I may write that

$$Z_t - X_t = FH \tag{4.26}$$

where: FH = domestic production of food available for human consumption.

The importance of this distinction is that if any part of $(Z_t - X_t)$ is used for domestic industrial purposes, animal feeds, etc., then the food available for human consumption (FH) will be smaller than expected. The assumption here is that the proportion of agricultural production diverted to these purposes is insignificant.

The food supply in Nigeria for the period 1968 to 1978 will now be estimated. The source of data is the Central Bank of Nigeria Financial and Economic Review, 1976.

Agricultural Industry: 1970

Total Production: Agriculture, Fishing and Forestry	1,887.7M
Less forestry (non-food)	129.2M
Total agricultural production	1,758.5M
Less exports (cash crops and other agricultural raw materials)	239.3M
Domestic production of food (FH)	1,519.2M
Add imported foods	56.6
Total food supply for the year (F_t)	₦1,575.8M

This procedure could be carried out for the 20-year period under study to estimate the food supply. But since the index of food production has already been estimated by the U.N. (F.A.O.) 1968-78 as well as the C ntral Bank of Nigeria 1960-75, it will not be duplicated here. The U.N. index of food production was preferred to the Central Bank index because the Central Bank did not account for portions of agricultural products exported. Considerable quantities of palm oil and palm kernels are exported each year. As for ground nut oil, and cake, Nigeria is the world's largest exporter. To obtain the quantity of food supply in the domestic market, such exports must be taken into consideration. Based on this, their index was slightly different from the F.A.O. index. From the latter index, 1969=100 and 1970=102,

which means that ₦1575.8M represents 102 percent of the base year's production. Therefore production in base year (1969) = $\frac{100}{102}$ x 1575.8 = ₦1,544M. Applying the index from 1959 to 1978, item 3 on table IV was determined.

TABLE IV

Determination of Weighted Food Price Index, and Rate of Change of Industrial Prices

Year	Index of Food Supply	Estimated Food Supply	Ratio of GNP	$\dot{\Delta P}_f$	$W\dot{\Delta P}_f$	$\dot{P}_t$	$\dot{P}_{It}$
1	2	3	4-3÷GNP	5	6=4x5	7	8=7-6
1959*	70	₦ 952M	.49	5.0	2.5	4.0	1.5
1960*	80	1120	.47	4.7	2.2	6.7	4.5
1961*	92	1256	.53	8.1	4.2	5.7	1.5
1962*	92	1256	.55	6.0	3.3	4.2	0.9
1963	103	1406	.47	-7.2	-3.4	0.1	3.3
1964	102	1393	.46	.01	.05	2.5	2.0
1965	105	1434	.38	2.1	.80	4.0	3.2
1966	94	1284	.36	17.8	6.4	8.3	1.9
1967	95	1298	.45	-10.3	-4.6	-3.8	0.8
1968	99	1374	.48	- 3.5	-1.7	1.0	2.7
1969	100	1544	.40	21.1	8.4	10.0	1.6
1970	102	1575	.28	23.6	6.6	13.3	6.7
1971	98	1513	.21	26.2	5.5	13.5	8.0
1972	100	1544	.20	1.5	0.3	2.9	2.6
1973	94	1451	.16	- 2.3	.37	3.6	3.2
1974	103	1590	.09	19.9	1.8	16.9	15.1
1975	106	1636	.08	42.9	3.4	31.6	28.2
1976	109	1683	.06	22.0	1.3	23.9	22.6
1977	115	1776	.06	18.7	1.1	16.5	15.4

*Central Bank Index, U.N. figures unavailable.

Item (8) in table IV represents the estimation of equation 4.1, the growth rate of prices in the industrial sector. It

might be noted (en passant) an interesting observation in item #4 of the table shows the trend in the relationship between food consumption and the GNP. This shows a steady decline from approximately 50 percent of GNP in 1959 to only 6 percent in 1978, a confirmation of Angle's Law which generalizes that as income increases the percentage expended on food is bound to fall.

As already explained in the empirical model, it is very difficult to estimate an excess demand function for a country like Nigeria. The degree of industrial capacity utilization could not be used because the data are not available. To estimate will be meaningless because industrial production is closely linked to the petroleum industry. The level of operation in the petroleum industry is exogenously determined and is subject to erratic periodic fluctuations. The level of unemployment could not be used because unemployment is an illusive term in developing countries. This is so because developing countries are subject to a significant level of underemployment in the rural sector. The rural population of Nigeria exceeds 80 percent of the total population. This means that the rate of unemployment can only be computed based on 20 percent of the population who might register at the employment in the urban centers. Even so, most of the unemployed would not register because of the widespread belief that it is a waste of time to register because experience

shows that most of those who register never receive any help. Based on the above, the rate of unemployment will be very poor proxi for excess demand. The only logical alternative left is the changes in the money supply. Since we have good data on money supply, it was only logical that the best proxi for excess demand should be money supply. Money supply and its lagged components were used. Thus excess demand was specified as follows:

$$C_t = M_t + M_{t-1} + M_{t-2} + M_{t-3} \tag{4.27}$$

The industrial price equation can be rewritten as

$$P_{It} = W_t + P_{Mt} + M_t + M_{t-1} + M_{t-2} + M_{t-3} \tag{4.28}$$

Empirical Results

The empirical estimation of equation S.5 is given by the following regression results.

$$P_{It} = \underset{(-1.1)}{-4.2} + \underset{(3.6)}{.37P_{Mt}} + \underset{(.92)}{1.4W_t} + \underset{(3.1)}{.16M_t} + \underset{(.81)}{.08M_{t-1}} \tag{4.29}$$

n=20 Det. = .11 DW = 2.3 R^2 = .86

$$P_{It} = \underset{(.62)}{-1.47} + \underset{(1.5)}{.25P_{Mt}} \underset{(.08)}{-2.14W_t} + \underset{(3.30)}{.18M_t} + \underset{(1.30)}{.12M_{t-1}} + \underset{(0.57)}{.04M_{t-2}} + \underset{(0.77)}{.06M_{t-3}} \tag{4.30}$$

n=20 Det. = .017 DW = 2.3 R^2 = .88

$$P_{It} = -1.40 + .34P_{Mt} + .004W_t + .17M_t + .11M_{t-1} + .06M_{t-2} \quad (4.31)$$
$$(0.60)\ (3.17)\ (0.2)\ \ (3.30)\ (1.20)\ \ (1.20)$$
$$\text{Det.} = .064 \quad DW = 2.3 \quad R^2 = .87$$

$$P_{It} = -.95 + .37P_{Mt} + .15M_t + .15M_{t-1} \quad (4.32)$$
$$(.77)\ \ (3.60)\ \ (3.30)\ \ (3.10)$$
$$\text{Det.} = .52 \quad DW = 2.3 \quad R^2 = .85$$

Analysis of Empirical Results

Equation (4.29) shows an interval of -4.2 with a (t) value of (-1.1). This means that if all variables remained unchanged, industrial prices will fall by 4.2 percentage points. But the (t) value of 1.1 is rather insignificant. Wages have a coefficient of 1.4, but it is statistically insignificant because of the low (t) value of (.92). One period lag in money supply (M_{t-1}) is also statistically insignificant. Although this equation can estimate 86 percent of industrial prices, the probabilities are rather low. Only import prices and current changes in money supply are significant above the 95 percent confidence interval. When further lags in money supply were introduced to capture to a greater extent the impact of money supply on industrial prices, equation (4.30) shows that import prices now decline in significance. Wages become negative and very insignificant. M_t retains its high level of significance above the 99 percent

confidence interval. M_{t-1} increases in significance but not up to the 90 percent confidence level. M_{t-2} and M_{t-3} are both statistically insignificant. This can be interpreted to mean that more than one period lag in money supply will not produce any significant changes in industrial prices. Although the R^2 has improved, it is obvious that the explanatory power of the variables are rather weak.

In equation (4.31) the third period log in money supply was eliminated. P_{Mt} regained its significance, wages became positive but insignificant. M_{t-1} and M_{t-2} are more significant, but not at the 90 percent confidence level. The R^2 falls from .88 to .87.

Finally, the industrial price equation was reduced to an equation with only three variables, namely, P_{Mt}, M_t and M_{t-1}. From equation (4.32) the intercept is negative and statistically insignificant. This means that if all three variables were held constant, there will not be any appreciable change in industrial prices. All three variables P_{Mt}, M_t and M_{t-1} are positive and significant at above 99 percent level of confidence. This can be interpreted to mean that the equation can predict 85 percent of industrial prices in Nigeria with a probability of 99 percent. Equation (4.32) is then chosen to represent our industrial price equation.

From this result, the conclusion is that the prices of industrial products in Nigeria are determined principally by

changes in the price of imported raw materials and excess demand proxied by changes in money supply during the current year plus the previous year's change in the money supply.

Prices in the Agricultural Sector

From the empirical model, changes in prices in the agricultural sector are specified as a function of excess demand, assuming a constant marginal cost in the industry. Agricultural prices could then be specified as

$$P_{At} = f(\ddot{Y}) \tag{4.33}$$

where $\ddot{Y}$ = excess demand for agricultural products

P_{At} = prices in the agricultural sector.

$$(\ddot{Y}) = f(DA-SA) \tag{4.34}$$

where DA = demand for agricultural products

SA = supply in agricultural sector.

If DA = SA, then excess demand does not exist and prices will be stable.

If DA > SA, then excess demand exists and prices will rise.

But the agricultural industry in Nigeria is a very large industry. It encompasses the production of cash crops like cocoa and cotton, which will have no appreciable impact on excess demand for food. Instead, it might increase the excess demand as the marginal land which could have been used in the cultivation of food crops is now used in the production of cash crops for export. Prices of agricultural raw

materials are exogenously determined by supply and demand conditions in the world market. Changes in such prices will have no direct impact on domestic food prices. It will have a secondary impact on domestic prices only if farmers are able to shift factors of production readily from the production of food crops to cash crops and vice versa, whenever there is a change in price on either side of the market. However, experience shows that such elasticity does not exist. And so inelasticity of food supply remains a dominant factor in the structuralist theory. It therefore becomes necessary to redefine our variables.

Let $P_{At} = P_{Ft}$

where P_{Ft} = rate of change in food prices in year t.

Then excess demand for food ($\ddot{w}$) = f(Fd - Fs) (4.34)'

where Fd = demand for food

Fs = supply of food.

If Fd > Fs, then excess demand for food exists and food prices will rise.

The excess demand function for food can now be defined.

$$\ddot{w} = F[L_t + U_t + Z_t + E_t - F_s] \qquad (4.35)$$

where L_t = population growth rate

U_t = changes in the rate of urbanization

Z_t = proxi for changes in income redistribution

E_t = changes in aggregate level of education

F_s = food supply

Since $P_{Ft} = F(\ddot{w})$, the rate of change in food prices can be written as

$$P_{Ft} = a + a_1L_t + a_2U_t + a_3Z_t + a_4E_t - a_5F_s \quad (4.36)$$

The empirical estimation of equation (4.36) remains a great problem due to lack of data. There is no data on income redistribution. In place of income redistribution, the rate of change in real GNP was used. The rationale for this substitution is that in developing countries where the real per capita income is so low, as income increases, most people will tend to increase the quality of their diet and general food consumption will necessarily rise and excess demand will increase.

There are no steady data for urban population growth and aggregate level of education over a period long enough to be used in this study. Based on this, the two variables were dropped from the equation.

Food Supply

There are no data for food supply in Nigeria. Studies by Olayide[44] estimated the rate of growth of food production in Nigeria from 1963 to 1973. The FAO year book 1979 provides estimates of the rate of growth of food production from 1968 to 1978. Since the rate of growth of food production is known, actual food production can be estimated as well as the growth rate of per capita food production. This estimate has

already been presented during the studies of industrial prices.

Equation (4.36) can now be rewritten in terms of available data as

$$\dot{P}_{Ft} = a + a_1\dot{L}_t + a_2\dot{y}_t + a_3M + a_4M_{t-1} + a_5F_s \qquad (4.37)$$

where $\dot{y}_t$ = rate of change of real GNP

M_t = rate of change in money supply

M_{t-1} = rate of change in MS in the previous period.

Changes in the money supply and its lagged component has been introduced because money supply is a very important proxi for excess demand. Although the structuralist theory does not accept changes in the money supply as having a direct impact on price changes, they would also admit that it is a matter of sound theory to include money supply variables. According to the structuralists, money supply represents a viable transmission mechanism and hence a good prox variable for excess demand.

The empirical estimation of the rate of change in food prices will now be presented. The data on food prices were obtained from the Year Book of National Accounts. Figures for rate of growth of food production was from the F.A.O. Year Book 1979 and the Central Bank of Nigeria Economic and Financial Review 1977. The money supply is M_1 obtained from the International Financial Statistics. Population and GNP figures are also from the I.F.S. The method of estimation is

O.L.S. and the period of observation is 1959-1978 (20 years).

The a priori expectation is that a_1, a_3, a_4, a_5 will be positive. The rationale of this a priori expectation for a_5 is that an increase in food supply must be accomplished by higher levels of investment in agriculture. If such additional investments are attained by savings or borrowing from the public, then there will be a corresponding contraction of consumption expenditure, and there will be no need for any increase in money supply or credits to finance the increase in investment. In this case, prices are expected to be stable and increase in food production will not result in substantial increases in food prices, assuming that the supply of farm labor is abundant (large scale underemployment in the rural sector) and farm wages remain unchanged. But this is hardly the case. In 1973, the Universal Free Primary Education was established in Nigeria. This meant that every child had a chance of going to school, and since farm labor is always regarded here as a job only for the illiterates, the supply of farm labor has been considerably reduced. This means that farm wages must rise in the face of increasing underemployment. By 1975 all high schools were taken over by the government and fees reduced to the lowest minimum. By 1978 the number of universities had been increased from 2 in 1960 to 18, with free tuition to all qualified candidates. This meant that the level of education should substantially

rise and rural population decline and farm labor be considerably reduced. The result of this will be a sharp rise in the wages of farm workers. Investment increased. Farm products have increased, but at higher marginal cost.

On the financing side, most farm investments have been financed by bank loans. According to the analysis of Bernstein and Patel[45] when an increase in investment is accompanied by an increase in credits and money supply, because of the unwillingness of labor to acquiesce in the additional investment by contracting their consumption, then such an increase in investment will be accompanied by an increase in the aggregate demand in excess of output and the stage will be set for an inflationary process to begin. In addition to this, the shortage of farm labor has created additional elements in the inflationary process, namely, increases in wages, due to substantial gains by active unions in other sectors.

In conclusion, investment in the agricultural sector has increased; actual food supply has increased and food prices have risen considerably. Thus in this case, other things being equal, our a priori expectation of a positive (a_5) should be empirically validated. The regression results are as follows:

$$P_{Ft}=-5.0+.27M_t+.31M_{t-1}+2.3L_t + .05F_{st} - .06y_t \qquad (4.38)$$

(.22) (2.3) (2.8) (.26) (.20) (.52)

n = 20 Det. = .50 DW = 2.3 R^2 = .72

$$P_{Ft}=-7.2+.29M_t+.22M_{t-1}+.11M_{t-2}+2.6L_t+.09F_s-.35y \qquad (4.39)$$

(.31) (2.4) (1.7) (1.0) (.30) (.37) (.30)

Det. = .26 DW = 2.2 R^2 = .74

$$P_{Ft}=-8.9+.25P_{mt}+.27M_t+.25M_{t-1}+3.5L_t+.05F_{st}-.09y_t \qquad (4.40)$$

(.39) (1.0) (2.4) (2.1) (0.4) (0.2) (0.8)

Det. = .36 DW = 2.3 R^2 = .74

An examination of regression results (4.8-4.40) shows a rather high but negative and statistically insignificant intercept. Surprisingly, none of the structuralist variables is of any statistical significance. Only monetary variables are significant at above the 95 percent level of confidence. The best R^2 is .74. This means that the equation can only explain at best 74 percent of the rate of increase in food prices. The a priori expectation of the signs of the coefficients has been empirically validated. Maybe some improvements in data collection will make some difference in some future studies. The conclusion from the empirical study is that the explanatory power of the equations is less than satisfactory.

$$P_t = -.19 + .38P_{Mt} + .07W_t + .24M_t + .13M_{t-1} + 2.3L_t - .13Y_t \quad (4.41)$$
$$(.04)\ (3.2)\ \ (0.4)\ (4.2)\ (1.2)\ \ (1.7)\ \ (2.2)$$
$$\text{Det.} = .06 \quad DW = 2.3 \quad R^2 = .88$$

$$P_t = -5.6 + .69P_{Mt} + 4.1L_t + .07F_{st} - .07y_t \quad (4.42)$$
$$n=20 \quad \text{Det.} = .92 \quad DW = 1.4 \quad R^2 = .41$$

$$P_t = -15.5 + .47P_{Mt} + .32M_t + 1.1L_t + .16F_{st} - .17y_t \quad (4.43)$$
$$(1.2)\ \ (4.0)\ \ \ (6.2)\ \ (1.4)\ \ (1.2)\ \ \ (3.0)$$
$$\text{Det.} = .73 \quad DW = 2.2 \quad R^2 = .84$$

$$P_t = -12.4 + .38P_{Mt} + .25M_t + .12M_{t-1} + 4.9L_t + .17F_{st} - .13y_t \quad (4.44)$$
$$(1.1)\ \ (3.2)\ \ \ (4.4)\ \ (2.1)\ \ \ (1.2)\ (1.4)\ \ (2.3)$$
$$\text{Det.} = .36 \quad DW = 2.5 \quad R^2 = .88$$

$$P_t = -12.8 + .35P_{Mt} + .25M_t + .10M_{t-1} + .05M_{t-2} + 4.9L_t \quad (4.45)$$
$$(1.1)\ \ (2.8)\ \ \ (4.4)\ \ (1.4)\ \ \ \ (0.7)\ \ \ \ (1.1)$$
$$\text{Det.} = .17 \quad DW = 2.5 \quad R^2 = .89$$

$$P_t = -15.2 - .18W_t + .56P_{Mt} + .22M_t + .11M_{t-1} + .10M_{t-2} - .12M_{t-3} \quad (4.46)$$
$$(1.3)\ (.55)\ (2.4)\ \ (3.7)\ (1.0)\ \ \ (1.4)\ \ \ (1.1)$$
$$6.6L_t + .17F_{st} - .16y_t$$
$$(1.4)\ \ \ (1.4)\ \ \ \ (2.2)$$

$$P_t = .27 - .11W_t + .34P_{Mt} + .24M_t + .14M_{t-1} + .06M_{t-2} + .27F_{st} - .12y^*_t \quad (4.47)$$
$$(.10)\ (.37)\ (2.8)\ \ (3.9)\ (1.4)\ \ \ (0.9)\ \ \ (1.8)\ \ (1.4)$$
$$\text{Det.} = .03 \quad DW = 2.2 \quad R^2 = .89$$

*$\overline{F_{st}}$ = real capita food supply; y^*_t = real capita real GNP.

Analysis of Empirical Results

The results for structuralist variables are not as impressive as the monetarist variables. Two structuralist variables, namely, import prices (P_{Mt}) and population growths rate (L_t) show up with some significance. (P_{Mt}) performs very well in this study. In all the regression the variations in import price variable are significant at above the 95 percent level of confidence. Its lowest coefficient is 0.34 with a 95 percent level of confidence in equation (41.6). Its highest coefficient is 0.56 with a 95 percent level of confidence, suggesting that there is a strong tendency for increases in import prices to influence the rate of inflation in the same direction. The variable for population growth rate performed fairly. Its coefficient is significantly greater than one in all the regressions, but it occasionally barely misses statistical significance. This suggests that there is some slight tendency for population growth rate to be inflationary. This can be interpreted to mean that as population growth rate increases, the rate of increase of excess demand will increase and so the rate of inflation will rise.

Wages perform persistently badly and occasionally with the wrong sign. This, however, cannot be interpreted to mean that there is no significant causal relationship between variations in wage rate and variations in the rate of infla-

tion. The poor performance of the wage variable (W_t) in this study should be attributable to lack of data for an accurate estimation of the rate of growth of wage rates in Nigeria.

The food supply variable has performed only fairly in this study. It has the right sign (positive, a result rationalized in an earlier discussion), but like the (L_t) variable, it barely misses statistical significance occasionally. The persistently positive sign of this coefficient suggests that increases in the food supply in Nigeria can only be attained at higher marginal cost. Since farmers will often pass on additional costs in the form of higher prices to the consumers, increases in the food supply have some slight tendency to result in higher rates of inflation.

The rate of change in real income (y_t) has the right sign. It is persistenly significant statistically. However, its coefficients are significantly different from one suggesting that variations in the rate of growth of real GNP will not bring about a proportionate reduction in the rate of inflation.

A regression with the structuralist variables alone gave an R^2 of 0.41 (equation 41.1). This can be interpreted to mean that the structuralist variables by themselves can determine only 41 percent of the rate of inflation. But when monetary variables were introduced in equation (41.2) the R^2 increased to .84 and .88 in equation (41.3), suggesting that

a combination of the monetary and structuralist variables are necessary for an appreciable interpretation of inflationary trends in Nigeria.

The monetary variables performed very well. In every case the addition of monetary to structuralist variables improved the results substantially. The monetary variables used were variations in the money supply and its lagged components (M_t, M_{t-1}, M_{t-2}, M_{t-3}). The third period lag in the money supply performed very poorly and with the wrong sign. This can be interpreted to mean that the impact of variations in the money supply on the rate of inflation will be fully expressed by the end of the second year. M_{t-2} has the right sign, a low coefficient, and is statistically insignificant. The important money supply variables in this model are M_t and M_{t-1}. They both have persistently high coefficients and are statistically significant. M_t coefficients are persistently higher than M_{t-1} coefficients; the confidence level of M_t is persistenly above the 99 percent interval, while that of M_{t-1} is occasionally within the 95 percent level. This can be interpreted to mean that in this model the variations in the money supply will produce their greatest impact on the price level within the first year. In equation (41.0) for example, the sum of the coefficients of M_t and M_{t-1} is 0.37. This suggests that variations in the money supply will not generate proportionate changes in the price level as the monetar-

ists would claim.

If the computed rate of inflation behaved properly, the constant term should approximate zero and the R^2 should be one.

In our results, equations, 41.0, 41.4, 41.5 and 41.6 have R^2s of 0.88, 0.89, 0.91 and 0.89 respectively and they approximate one. But the intercepts are significantly less than zero. However, the probabilities are rather low, and thus the intercept is of no statistical significance.

CONCLUSION

This thesis has presented a quantitative analysis of the inflationary process in Nigeria, using a general monetarist model developed Harberger, a strict monetarist model to study the relationship between prices and the money supply, and a general structuralist model.

The best results of each model are summarized below:

Harberger's General Monetarist Model

$$P_t = \underset{(2.36)}{14.6} + \underset{(3.6)}{.20M_t} + \underset{(2.6)}{.24M_{t-1}} + \underset{(1.8)}{.18M_{t-2}} + \underset{(2.6)}{.19M_{t-3}} + \underset{(2.1)}{.52P_t^e} - \underset{(2.1)}{5.7W_t} - \underset{(1.8)}{.10y_t}$$

$$DW = 1.7 \qquad R^2 = .87$$

Relationship between Money Supply and Prices

$$P_t = \underset{(1.1)}{.15} + \underset{(3.0)}{.17M_t} + \underset{(2.6)}{.25M_{t-1}} + \underset{(2.6)}{.21M_{t-2}} + \underset{(2.7)}{.21M_{t-3}} - \underset{(1.4)}{.37P_{t-1}} - \underset{(2.0)}{.52P_{t-2}}$$

$$DW = 2.0 \qquad R^2 = .84$$

The Structuralist Model

$$P_t = \underset{(1.1)}{12.4} + \underset{(3.2)}{.38P_{mt}} + \underset{(4.4)}{.25M_t} + \underset{(2.1)}{.12M_{t-1}} + \underset{(1.2)}{4.9L_t} + \underset{(1.4)}{.17F_{st}} - \underset{(2.3)}{.13y_t}$$

$$DW = 2.5 \qquad R^2 = .88$$

All these models give a very reasonable explanation of the inflationary process in Nigeria. The explanatory power of the equations as well as the coefficients of determination

and their probabilities are almost the same. Further analysis in this study has shown that the Nigerian inflationary process is not subject to a dynamic instability which could give rise to self-generating inflation. This study provides an understanding of the role that both structural and non-structural factors have played in the inflationary process in Nigeria.

In an attempt to distinguish between the two main families of inflationary theories as they apply to the Nigerian case, it seems reasonable to conclude that the monetarist models have the great and apparent advantage of theoretical and empirical simplicity. From the standpoint of anti-inflationary policies the monetarist model has the commanding advantage of political simplicity, which is invaluable to politicians who have to propagandize and explain the policies they wish to follow.

The structuralist theory has the operational and theoretical advantage of distinguishing between basic causes and propagation mechanisms. But it has some serious disadvantages, too. One such disadvantage is that it proved extremely difficult to devise appropriate indicators of structuralist ideas. From the standpoint of anti-inflationary policies, it could prove extremely difficult both technically and politically for any government without absolute power to devise and maintain policies which will control inflation. The struc-

tural reconstitution involved could cause direct confrontations with social interest groups.

This thesis concludes in agreement with authors Turner and Jackson[46] that it is almost impossible to make an a priori choice between either group of theories. Inflation in any country could obviously be caused by large government expenditures for various purposes; lack of money controls or some apparent and inevitable structural imbalances. Inflation in many underdeveloped nations was probably initiated by monetary excesses and could be stopped by sufficiently severe monetary and credit restraints. The reader must bear in mind the present-day inflationary process has become a very complex and confusing "affair with multiple mechanisms, involving forces which have become virtually independent of the original sin, and which no simple theory could now completely embrace."[47]

FOOTNOTES

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[28]Ibid., p. 222.

[29]Ibid., p. 226.

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[33]Holden and Peel, "Relationship between Prices and Money Supply," p. 446.

[34]Ibid.

[35]Ibid., p. 447.

[36]Ibid.

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[44]Bernstein and Patel, "Inflation in Relation to Economic Development."

[45]Central Bank of Nigeria, Economic and Financial Review, 1977, p. 12, "Food Supply in Nigeria."

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[47]Ibid., p. 16.

APPENDIX

THE NIGERIAN ECONOMY

Nigeria occupies an area of approximately 356,000 square miles. It is located on the West Coast of Africa. Its population has grown from 56 million in 1963 to 79 million in 1973, and an estimated 95 million for 1978. The gross domestic product has grown from ₦2,400M in 1960 to ₦5,621M in 1970 and ₦28,900 in 1978. (Between 1970-1977, the average annual growth rate was 6.2 percent as compared to 3.1 percent for 1960-1970.) The money supply has grown steadily from ₦241M in 1960 to ₦6143M in 1979. The Consumer Price Index has risen from 179 in 1972 to 427 in 1977, taking 1960 as the base year. The average annual rate of inflation for the period 1960-1970 was 2.6 percent against 15.2 percent for the period 1970-1977.

Per capita GNP in 1977 was $420 and the average annual growth rate of per capita GNP for the period 1960-1977 was 3.6 percent. The degree of urbanization is 20 percent, the active labor force is 40 percent of the urban population and 21 percent for the rural population for the 1969/70 fiscal year. The rate of unemployment in 1977 was 8 percent.

A striking feature of the Nigerian economy since independence has been the steady decline in the contribution of the agricultural sector of the economy to the GNP. In 1960,

the agricultural sector accounted for 63 percent of GNP; in 1970 it was only 34 percent and is still declining. Between the period 1960-1970 the growth rate of the agricultural sector was -.5 percent and during the period 1970-1977 it deteriorated to (-1.5%). In 1960 Nigeria depended on its four traditional products, namely, cocoa, palm oil, palm kernels, and groundnuts for 70 percent of its export earnings. Crude oil production accounted for only 1.7 percent. By 1965 crude oil share of total exports rose to 25 percent and reached the 94 percent mark in 1976. In 1961 the estimated food available for consumption was ₦1342M, accounting for 55 percent of the GNP. By 1978 it barely increased to ₦1776M accounting for only 6 percent of the GNP. The declining productivity of the agricultural sector lends credence to the structuralists' agricultural lag hypothesis as the most serious inflationary agent in developing countries. According to this hypothesis, the stagnation of the agricultural sector, in the face of increasing demand for food (due to urbanization, rising income and a fast-growing population) could only lead to a drastic rise in food prices which will be transmitted to the other sectors of the economy. An attempt to avoid high food prices by importation of foodstuffs would bring about different kinds of problems, namely, foreign exchange scarcity and imported inflation. In effect, severe import restrictions were imposed during this period but the flames of inflation continued to

spread. The emergence of petroleum, which tremendously expanded the export earnings, as a savior to the foreign exchange problem, has generated, however, a different type of inflationary pressure--demand-pull inflation.

In the public sector, government revenues have risen from ₦1,404 million in 1972 to ₦6,300M in 1977/78, then fell to ₦5,200M in the 1978/79 fiscal year. In 1975, for example, government revenues grew by 68 percent over the previous year. But in 1976/77 it grew by a staggering 9 percent. The increase in government revenues came as a result of the increase in oil revenues. During the 1976-77 period, oil revenues accounted for 75 percent of government revenues. In 1977/78 it fell to 68 percent, but is expected to bounce back to the 75 percent mark during the 1979/80 fiscal year.

During the 1975/76 fiscal year, government spending rose at a record rate of 68 percent over its previous year. Also during this period the money supply rose by nearly 40 percent. The annual rate of inflation during this fiscal year was 30-40 percent. This correspondence between the rate of growth of the money supply and the rate of inflation is evidence, as monetarists claim, that inflation is a monetary phenomenon.

In the monetary and banking sector, the Central Bank of Nigeria is the only currency-issuing authority in the nation. Its functions are very similar to those of the Bank of England or the Federal Reserve system. Nigeria does not have a

developed money market, however. Thus government deficits are financed mainly through borrowing from the Central Bank. In the commercial banking sector, Nigeria follows the Brank Banking System where a dozen or so banks with multiple branches throughout the country run the banking industry. Accordingly, the bank concentration ratio is very high.

Prior to independence in 1960, the Nigerian currency was the pound. It was issued by the West African Currency Board which was under the direct control of the Bank of England. It had a par value with the British pound sterling. Following its independence, this currency was replaced by the Nigerian pound (£N), although its par value with the British sterling was retained. Following the end of the civil war in 1970 and the financial crisis associated with it, the currency was changed again. The new currency was called the Naira (₦) and N = N½ or more simply, N1 = ₦2. In March, 1973, the Naira was devaluated by 10 percent against gold when the United States devalued the dollar. ₦1 = $1.6 (US).

The variation in the rate of inflation is given by variations in the index of consumer prices, and is defined by:

$$\dot{P} = 100 \frac{(P_t - P_{t-1})}{P_{t-1}}$$

where P_t=price index this year; P_{t-1}=price index previous year.

Variation in money supply (M) is given by changes in M_1. This monetary quantity was chosen over M_2 or M_3 because of the well-known fact that there is a strong correlation between the monetary variables. Consequently, using any of the quantities is not likely to exert any significant influence on the empirical results. Moreover, since M_1 is a more precise definition of money and its data are more reliable and easily obtainable given the state of data collection of the counties being studied, M_1 was considered as the best alternative. Variations in the money supply were defined as:

$$\dot{M} = 100 \frac{(M_t - M_{t-1})}{M_{t-1}}$$

Variations in wages were defined as:

$$\dot{W} = 100 \frac{(W_t - W_{t-1})}{W_{t-1}}$$

while variations in income were given by changes in the real GNP and defined as:

$$\dot{Y} = 100 \frac{(Y_t - Y_{t-1})}{Y_{t-1}}$$

Data

The observation period was 1952 to 1978, giving 26 observations. The quantities are expressed in Nairas, the national currency of Nigeria. The method of estimation is ordinary least squares.

In the quarterly regression, the rate of change in prices was given as:

$$P_t^e = 100 \frac{(P_t - P_{t-1})}{P_{t-1}}$$

where t = present quarter; t-1 = previous quarter.

Changes in money supply were similarly given as:

$$M_t = 100 \frac{(M_t - M_{t-1})}{M_{t-1}} \; ; \; M_{t-1} = 100 \frac{(M_{t-1} - M_{t-2})}{M_{t-2}}$$

and $$M_{t-2} = 100 \frac{(M_{t-2} - M_{t-3})}{M_{t-3}}$$, etc.

Quantity changes in real income and (y) expected prices (P^e) were similarly specified. Due to difficulty in collecting data for the GNP on a quarterly basis, two sets of regressions were done with quarterly figures. The first estimation of the model uses quarterly GNP obtained from the Central Bank Economic and Financial Review.

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