

**ECONOMIC SYSTEMS ENGINEERING, POVERTY, UNEMPLOYMENT  
AND UNDER-DEVELOPMENT: A QUEST FOR SOLUTION AND  
IMPERATIVES FOR DEVELOPING THE NIGERIAN ECONOMY**

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## INAUGURAL LECTURE

### ECONOMIC SYSTEMS ENGINEERING, POVERTY, UNEMPLOYMENT AND UNDER-DEVELOPMENT: A QUEST FOR SOLUTION AND IMPERATIVES FOR DEVELOPING THE NIGERIAN ECONOMY

#### ABSTRACT

*Nigeria is a developing country desperate to join the ranks of the developed world. About thirteen (13) different regimes including the Military, have ruled over the country since Independence in 1960. However, the planning and management of the economy has been defective. Indeed, by 2014, the Nigerian economy slid into a recession. It will seem that this poor track record is due to poor understanding of the socio-economic system and defective planning. This work presents an alternative paradigm to help plan, manage and control the economy. It attempts to answer the festering question, "what shall we do or what should we have done to get out of the quagmire in which the economy finds itself?" A combination of approaches including econometrics, input-output analysis and linear programming, under the pseudonym of economic systems engineering, were brought to bear on the contemporary problems of the Nigerian economy. Our model predicted the recession of 2014 and it was found that to reverse the recession, in 2015 it would have been necessary to increase the prime lending rate by 1.7% and systematically adjust it to 29.42% by 2018 in order to attract foreign investors who have the technology the economy needed so badly. The country should also have borrowed additional \$30.5 billion in 2015 and increase it to \$56.4 billion by 2018 in order to develop infrastructure, agriculture, industry and services. While taxation and money supply did not feature as incremental options, the country should still be promoting oil export. Special attention should have been given to promote non-oil exports in 2016. It is recommended that Nigerian statistical agencies should endeavor to be up to date with statistical data and Nigeria should return to development planning using rational or scientific planning methods, a paradigm that has not occurred for about thirty (30) years..*

## **BACKGROUND**

My background is Forestry which I studied in the Department of Forest Resources Management, University of Ibadan, Ibadan, where I graduated B.Sc Forestry 2<sup>nd</sup> Class Honours (Upper Division) in 1974. It is worthy of note that Forestry is not an exact science and it is the management of a renewable natural resource (the Forest), using business and economic principles. In order to achieve this, the Forest manager has to study not only Forest economics and Forest management, but also Forest Engineering, Forest Policy and Administration, Forest Utilization, Forest Law among others. This background has provided the impetus I needed to explore the world at large.

My first contact with Economic Systems Engineering was in 1976 when I went to the University of Edinburgh to study Forest Economics, under Professor W. E. S. Mutch. There I was exposed to Operations Research by Professor Williams in the Department of Business and also to Econometrics in the Department of Economics, University of Edinburgh. Of course these exposures and in addition to the extensive literature afforded me by the University Library, worked

together in concert to fuel my ambition of becoming an Economic Systems Engineer.

My Systems modeling skills was further exposed under the tutorage of Professor Eytayo Lambo who systematically and practically taught me Operations Research in the Department of Economics, University of Ibadan, during my Masters programme in the Department of Forest Resources Management in 1985. Also, the one year I spent in the University of California, Davis in 1991 under the Hubert H. Humphrey North South Fellowship Programme, helped to consolidate these skills further.

It was not until 1990 for the first time, that I gave expression to this skill when for my Ph.D degree, I submitted my thesis titled "SYSTEMS APPROACH TO DEVELOPMENT PLANNING: A CASE STUDY OF THE FORESTRY SECTOR OF THE NIGERIAN ECONOMY" (see Aruofor, 1990, 1997). This established the platform for the series of researches which has cumulated and crystallized in academic publications. My research focus had always been to harmonize, reconcile and rationalize the tool kit of the economic systems engineer, in order to harness their individual strengths more optimally, apart from developing new approaches, for the solution of economic problems and development planning.

Indeed, the tools of Economic Systems Engineering was brought to bear on the following development problems by the author in his research effort. Aruofor (1990 and 1997) developed a Linear Programming model of the Forest Sector of the Nigerian economy to plan the optimal utilization of the existing timber resources between end uses. An econometric model was used to forecast wood products demand from 1987 to year 2010 and fed directly into the linear programme. The objective was to maximize sectoral net revenue subject to wood availability, installed capacities and demand constraints. The result indicated that exploitation of the natural high forest of Nigeria be kept as near as possible to 80,000 hectares per annum, to ensure optimum use, maximum extension of the life of the reserved natural high forest and maximum profitability.

In Aruofor (2003, 2009, 2001a and 2001b) the deforestation situation in the West African sub-region with particular emphasis on Nigeria was investigated. We attempted to minimize the deforestation pressure in order to achieve a balanced land-use policy for Nigeria. The country lacks a proper land-use policy.

In another development, Aruofor (2001a and 2001b) used Markov Chains based on remote sensing data to analyse land-use in Nigeria and found that the interface between agricultural crop land-use and

other land-uses, especially Forestry was a source of concern given the very fragile nature of Nigerian land-use.

Still on development planning, Aruofor (2004) attempted the planning of the Nigerian economy through Ecostatometrics and found that corruption was the bane to economic development in Nigeria. The conclusion was that corruption and indiscipline, were not only inimical but demanded a ruthless war requiring political will.

Several other studies have been carried out on poverty reduction, poverty and education, poverty and devaluation, as well as poverty and environment, (see Aruofor, 2005, 2007a and 2007b) also Aruofor et al (1991) and Aruofor and Erhi (2007)

On HIV/AIDS and health dynamics, (see Aruofor 2003 and 2009), it was found that the maximum life expectancy for those with HIV was 54 years and that the devastating menace of AIDS, dysentery and malaria needed to be curbed.

Aruofor (2003, 2014) have developed methods of estimating transition matrices and input-output technology matrix respectively from aggregate time series data. Also, Aruofor (2007) evolved methods for empirical evaluation of governance. The study extolled the Obasanjo-Atiku's regime for their contribution to poverty reduction and development.

Before going to the lecture proper, a few words about the Department of Economics, Banking and Finance, Benson Idahosa University would be appropriate. When I came on board in February, 2003, there were only four (4) staff as I took over as the Head of Department. We had to rely heavily on associate lecturers most of that time. In retrospect, I wish to state that the Department has come a long way due to hard work and dedicated staff members. Many qualified staff came on board and our undergraduate programmes were all accredited by the National Universities Commission (NUC). Today, the curriculum has been further developed to include postgraduate studies. The department has a very strong empirical and quantitative base especially in modern econometrics, statistics and mathematics. Indeed, the Department now produces Ph.Ds, Masters and Diplomas. To all staff, I say keep up the good works.

## **INTRODUCTION:**

Coming to our concerns for today, it is pertinent to state that since Independence in 1960, Nigeria has implemented four development plans and has implemented various policy regimes in a quest to develop. Even though, some measure of infrastructural development and economic transformation has taken place in the period under review, the development has not translated into the social emancipation of the Nigerian People. Indeed, the pervasive and high incidence of poverty, ignorance, disease, squalor, poor diet and poor shelter and the attendant incidences of labour unrest, political instability, inflation, bankruptcy, war and revolution are a testimony that the planning and management of the Nigerian economy are defective (Aruofor, 1990; 2001a; 2004 and 2005). This could be the result of poor understanding of the socio-economic system or to the limitations of the existing planning tool kits or both.

The topic of my lecture is titled, Economic Systems Engineering, Poverty, Unemployment and Under-Development: A Quest for Solution and imperatives for developing the Nigerian Economy. The key words in this topic are Economic Systems Engineering, Poverty,



Under-Development, and the Nigerian Economy. In view of the above I intend to structure my lecture as follows:

- First we shall begin with a definition of the general problems of the Nigerian economy
- Next we discuss Economic Systems Engineering?
- We then proceed to present a full blown simulation model of the Nigerian economy in an attempt to find solutions to festering problems.
- Finally we draw some conclusions and make recommendations as to the way forward.

## **THE REVIEW OF THE NIGERIAN ECONOMY IN SUMMARY**

The review and analysis of data in this work was done in terms of current values. The reason being that in real life all economic transactions of buying and selling are carried out in the current values of currency and not in constant values. More so, our objective is to predict the working of the Nigerian economy in current values. However, because money illusion is not complete, some form of deflator is necessary hence we included the price index directly as a variable as well as real income. At this juncture, what does the data or statistics say? (The complete data used in this study is presented in Appendix I).

Nigeria is essentially a developing country but desperate to join the ranks of the developed. However, the Nigerian economy is plagued by a host of problems. First the growth rate in national income (nominal GDP) in the last few years had declined from 9.1% in 2011 to 4.4% in 2013. The economy is largely dependent on petroleum with the non-oil sectors contributing only 25% of total revenue in 2012 and this increasing to only 33% in 2013. The economy is import dependent with imports reaching N15.79 trillion in 2013 in nominal terms and a corresponding growth rate of 42%. The corresponding growth rate of

non-oil exports was only 17%. Unemployment rate is high, reaching 27.4% in 2012 and declined to 24.7% in 2013. The inflation rate is high reaching an all time high of 76.7% in 1994 and has gradually declined to 10.38% in 2013. This is still a cause of concern. The problem of the Nigerian economy is exacerbated by exchange rate problem resulting in sliding (depreciating) value of the naira (Aruofor, 2005; 2007). The naira depreciated against the US dollar by as much as 55.7% growth rate as a result of the Structural Adjustment Program (SAP), introduced by the Federal Government in 1986 and by 1999 the depreciation rate had reached 76.3%. Indeed, the naira has depreciated from N0.61/US \$ in 1981 to N157.29/US \$ in 2013 and by 2016 the naira had depreciated to N375.00/US \$, without a corresponding export growth to show for it. Economic theory need to be modified to take account of such a case.

The relative poverty rate is about 99.2% in 2012. Population is large (162.14 million people in 2013) and investment which is only N3.2 trillion as at 2013, is not high enough to absorb the teeming population. Though the economy is relatively modern in outlook, with a fairly high level of literacy, the economy is not truly dynamic with institutions that can respond and adjust in systematic fashion to changes in economic policies. Infrastructures are quasi modern but

the institutions are static and suffer from a state of inertia. Serious problems are still being experienced in power (electricity) generation with attendant crippling effect on manufacturing and industrial production.

Various past governments in Nigeria (including the Military) have pursued different policies in Nigeria with differing degrees of success but the measure of development in real terms has been low. This may have been the result of poor understanding of the socio-economic system, and/or defective planning. This phenomenon is a major concern of this lecture.

Indeed, the performance of any Government(s) can be measured in terms of the degree of social emancipation achieved in the domestic economy. Growth that does not touch the lives and standard of living of the citizenry of a country, cannot be considered as development in real terms. In the above connection, real development must not only reduce the level of poverty of a nation, but also the poverty rate of its citizens.

## **THE NEED FOR ECONOMIC SYSTEMS ENGINEERING**

Engineering is one of the oldest activities of civilization; it is the conscious application of science to produce useful things or machines. Indeed it has provided many of the foundations that have made modern civilization possible.

Today, engineering includes not only concrete utilitarian devices and equipment but also, the preparation of designs, plans and instructions for producing functional systems and structured activities. In this wise, an abstract empirical model of an economy will qualify as an engineering design. Engineering applies a systematic, scientific and mathematical approach to the design problem and herein lies its strength.

We have to emphasize that not until economics, especially applied economics is approached as an engineering discipline, would rapid strides of professional progress be achieved and the problem of underdevelopment overcome.

The approach to the analysis and solution of economic problems in the contemporary setting is anything but organized. Elegant mathematical analyses in economics which mystify rather than clarify

have been known to start from nebulous assumptions and this has not helped the development planning process.

Rapid strides of professional progress will only be made possible when the structure of economic problems and the principles of economics and allied disciplines can be identified and taught in a systematic manner as a legacy for beginners. This is the motivation for Economic Systems Engineering, which may be defined as a systematic presentation of the art and science of building, estimating, analyzing and using empirical mathematical economic systems models.

Systems engineering is a unifying approach to problem formulation, estimation and solution. It is an interdisciplinary approach which draws from all the fragmental approaches to economic analysis, using mathematics as a medium. It is not a distinct branch of economics nor is it a new subject but rather an attempt at convergence and synthesis of analytical and empirical methodologies. Its synonym, is the Systems Approach but the only reason for talking Systems Engineering rather than Systems Approach is that the assumptions are different. While both Systems Approach and Systems Engineering are based on the holistic, interdisciplinary approach to problem solving, in Systems Approach, modeling is an abstraction from reality while in Systems Engineering, modeling is an abstraction of reality. In the case

of the Systems Approach, reality is considered too complex and impossible to understand completely, so that only the important features of reality may be abstracted or modeled to solve a prospective problem. Systems engineering on the other hand, assumes that, though reality is complex, we must strive to understand and represent it as far as possible. This is so that modeling then becomes one of replicating reality with a view to exhibiting the essential features of the system for the sole purpose of solving an economic problem that we are faced with.

The two definitions may appear to be coincident at some point but the approaches are different. While in the Systems Approach, some form of idealization, often encompassing some simplification of details is implied, in Systems Engineering, idealization means imitation of the idealized system or reality with a view to exhibiting its characteristics as closely as possible. Simplification of details is not a prerequisite but only a last resort.

By and large, whichever way we choose to define a model or approach its building, it essentially represents a substitute representation of reality, and the emphasis, is that a model must be as realistic as possible and should represent a well structured view of reality.

Models feature widely in mathematics and represent the fulcrum or cornerstone of economic systems engineering. They permit a holistic approach to problem solving. They can increase the understanding of reality and can aid in the development of theory. They also provide a framework for experimentation. A model can aid the organization of data, structure experience and sensitize our perception. They often lead to quantitative predictions.

Models are not without disadvantages. First, a model is as good as the data with which it is estimated and the inherent assumptions if any. A model based on wrong premise can lead to misleading results. As a mode of transport, the results of a bad model can be compared to a motor accident as in the case of a bad driver. Even a good model has disadvantages because it provides specific case results and requires replication to produce more general results. Moreover, the construction of a model require a lot of effort and know-how.

There is the added fear that they could be abused. These fears need not be a major cause for concern as the prescriptions of an economic systems engineer are not and should not be intended as a *fait accompli* but are, at best, only as guide to aid policy and decision makers. However, it is necessary to add at this juncture, that large models are difficult to validate other than establishing mere superficial similarities between the model and the referent system.



However it will appear that there is more to be gained in modeling and it will seem worth the time and resources invested in learning mathematics.

Indeed, according to Aruofor, (2001a), a good model is not necessarily an abstraction from reality but an abstraction of reality. It should represent a well structured view of reality. A good model should not only produce unique and consistent estimates of parameters, but should be logically coherent, economically feasible and technically practicable. It should be based on reasonable and realistic assumptions if any and aggregation of data (variables) must not only be realistic but convincingly sensible. Definitions of variables in the model must be unequivocal, clear, decisive and concise. Equations should not be nebulous or mystifying but capable of simulating and replicating real life situation in a way that can be easily explained and readily followed. A good model should be amenable to analysis, be computationally feasible and also be able to generate consistent and interpretable results.

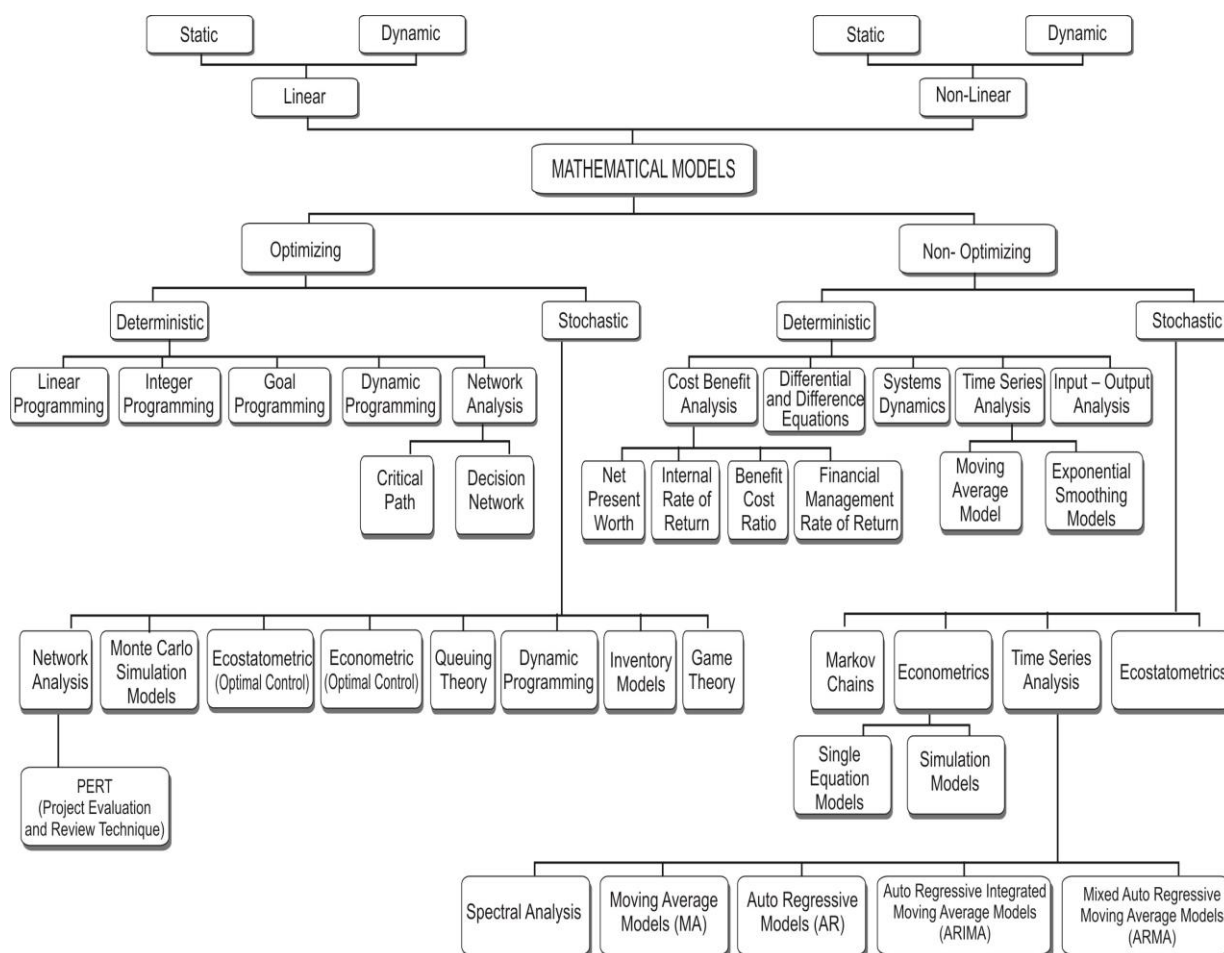
Systems Engineering, in a broad sense, is a philosophy for solving problems (economic or otherwise), especially if such problems have structure and can be represented by magnitudes. The reason for qualifying Systems Engineering by Economic, is that it serves to emphasize that the main focus is on the analysis and solution of

economic problems. The concepts are applicable to other disciplines as well.

## THE SCOPE OF SYSTEMS ENGINEERING

The scope of systems engineering, is the extent of the coverage of mathematical models and related techniques in economics. Mathematical models in economics can be classified in various ways. A classification (Aruofor, 2001a) of models and techniques in economics is presented in Fig. 1.

FIG. 1: A CLASSIFICATION OF MATHEMATICAL MODELS.



Source: Aruofor (2001a).

Models have been widely used in economics to study complex phenomena, with a view to understand the obscure behavioral characteristics of economic systems in order to aid decision making. Accordingly, models therefore can be **static** or **dynamic**. A static model does not represent situations that change with time. Time does not enter explicitly into model formulation and so the time that it will take for model parameters to adjust to solution values are usually not apparent. A dynamic model, on the other hand, deals with how variables interact and change with time. Time enters explicitly into model formulation and the time it will take economic variables to adjust to certain levels or magnitude can be calculated.

Models may also be **linear** or **non-linear** and can be classified as such. A linear model is one where the rate of change of the variables are constant with respect to time or some other variable of interests. Characteristically, such models do not incorporate exponents or powers. These are the most commonly used models in applied economics because they are simple and their economic meaning can readily be conveyed, while their structures lend themselves to easier mathematical manipulation. Non-linear models, on the other hand, are more complex and represent situations where the rate of change of a variable varies with time or in relation to another variable(s). Too often, it is not usually obvious how non-linearity arise in real life

except for very simple or trivial cases. It must be stated, that the economic interpretation of non-linear models are not as easy as their linear counterparts and in addition, non-linear systems are more difficult to estimate and solve. They may in fact have no solution at all!

Models too, can be classified as either **optimizing** or **non-optimizing**. Optimizing models are those that seek the singular best solution to an economic problem in the face of all constraints and possibly an objective. A variant of optimizing models is a '**satisficing**' model, which seeks a best solution given conflicting objectives in the face of constraints. Such a solution may be inferior to a strictly optimizing one and hence may be termed sub-optimal. Non-optimizing models, on the other hand, do not seek the best solution. Their prescriptions are usually based on the state of existing technologies. They are usually for understanding and prediction. However, such models can also be linear or non-linear and the earlier observations about non-linear models hold.

Models can also be **deterministic** or **stochastic** i.e. probabilistic. A deterministic model is one in which randomness in data used for model estimation is not given expression. Such a model assumes well-behaved and predictable systems. A stochastic model on the other hand, takes random fluctuations into consideration. Such systems are assumed to be erratic and transient in nature.

Consequently, a mathematical model may incorporate any combination of the above classification with corresponding complexity and therefore the attendant difficulties of finding a solution.

A close look at Fig. 1, will reveal at once the interdisciplinary nature of systems engineering. It is also evident that some of the tools can be associated with such disciplines and sub-disciplines as Operations Research, Systems Analysis, Econometrics, Cost-Benefit Analysis, Simulation, Time Series Analysis, Mathematics and Statistics. A technique that has been classified as a deterministic model may also pass as a stochastic one because such analytical techniques or models can be used to solve both deterministic and stochastic problems. It may therefore, not be surprising that a modeling approach classified in Fig. 1 as deterministic also qualifies as stochastic and vice versa.

Systems engineering, requires the specification of all relevant sub-systems and all environmental variables, the determination of the existence, degree and form of relationships among them and the utilization of that information to construct a model of the system, which can be solved and analyzed for understanding or for optimizing the system. The scope of systems engineering therefore, covers model formulation, estimation, solution, analysis, interpretation and use.

The models in Fig. 1, are for recurring problems but are capable of varying degrees of integration. Apart from being models, they can also be termed quantitative techniques. Most of these models or techniques are useful in planning, where almost the full lists of models are relevant. Programming methods or techniques are useful for solving allocation, distribution and assignment problems, while Monte-Carlo simulation, Queuing models, Networks and Dynamic programming, are suitable for solving waiting line (queuing), sequencing and routing problems. Game theory, Linear Programming and Monte-Carlo methods, are important for evolving strategy and solving competition problems. Inventory models, Dynamic programming and Linear Programming, play important roles in inventory decisions and are useful for solving economic lot size and order time. Cost-benefit analysis is useful in making investment decisions and especially for evaluating investments; while Time series and Econometric methods, play significant role in prediction and forecasting. Econometrics is also very important in policy analysis and can be very useful for optimal control of dynamic economic systems and the evolution of appropriate policies. Ecostatometrics extends the theme of Econometrics.

System engineering techniques have come under varying names in the literature. For example, Operations Research, a term used to describe

a sub-discipline of systems engineering in Europe, is termed Management Sciences in the United States of America. Other synonyms are Systems Analysis and Econometrics of enterprise. Other subsets of systems engineering, which have been given credence in the literature and elaborated upon in international seminars, to give them the status of a sub-discipline, include Simulation, Econometrics, Input-Output Analysis, Time Series Analysis, Cost-Benefit Analysis and Systems Dynamics. Texts and Literature abound on them (see next section).

Most of these techniques, on close study, will reveal overlaps in terms of content and scope and while they can be said to have individual applications, there exists a considerable scope for blending and harnessing their strengths. As a tool kit of the systems engineer, they are more complementary than otherwise.

By far the greatest correspondence between these techniques is their dependence on matrix algebra, in particular, matrix inversion, calculus and probability theory. These concepts play very significant roles in systems engineering.



## **METHODOLOGY**

### **THE THEORETICAL AND PHYSIOLOGICAL FRAMEWORK OF THE MODEL.**

The need for a holistic approach to development planning has been widely recognised in the literature (Suits, 1962; Miernyk, 1965; Evans, 1969; Meier, et al. 1969; Porter, 1969; Todaro, 1971; Johnston, 1972; Packer, 1972; Brennan, 1973; Chow, 1975; Taha, 1976 ; Koutsoyiannis, 1977; Hartley, 1980 ; Pindyck and Rubinfeld, 1981; Gujarati, 2003 and Verbeek, 2004) but the problem seems to be that no successful methodology has been invented for achieving it (see Gilbert and Qin, 1999 and 2006). This simulation model, presents another such channel for taking a holistic view of the development problems and the aim is to test it on the Nigerian economy and demonstrate how it can be applied to its planning.

The approach is a paradigm shift in development planning and has been discussed by Aruofor (2001a, 2004). It is nothing really new but the practical approach to the total differential modeling (see Lewis, 1977 and Chiang, 1974). It assumes and rightly so, that in the real world situation, every economic variable is interrelated in an intricate web and that every variable or subsystem depends on and is

depended upon by other variables or subsystems. A schematic representation of the above theory is presented in Fig. 2.

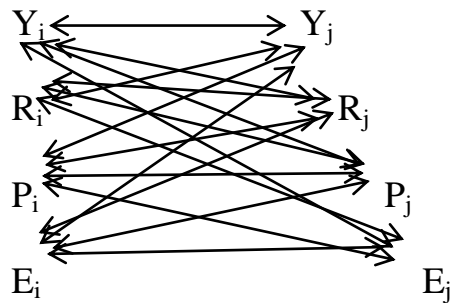


Fig: 2: The True Socio – Economic Causal Chain

- Y = Production variables;
- R = Primary Factors;
- P = Policy instruments;
- E = Environmental variables.

This theory was first mooted by Walras as early as the 1874; even though the Walrasian model was not developed beyond the conceptual stage (see Newman, 1952).

It is a blend between the traditional Input Output Analysis and Econometrics and assumes the structure of programming models. The theory behind it is that an economy is not truly dynamic but only dynamically static. It is the change that occurs in an economy in the current year (t) that determines where the economy (the endogenous variables) will be at the end of the current year (t) and not in the next

year (t+1). This model is a departure from the normal econometric approach, where the structure of the economy is determined by combinations of economic theories. The true structure of an economy is so complex that economic theory will be self-defeating. (***Indeed, Adeyaju (1975) had rightly noted that “ the unstable nature of population and its growth, national income and its distribution, investment capacity, employment opportunities, balance of payments and raw material base often lead to conflicting theories of economic development”***). Thus, we do not need any elaborate theories to explain the working of an economy. To see this, when a simple regression is run between two variables, we have:

$$Y_t = a + \hat{b}X_t$$

$b$  is the marginal change in  $Y$  due to  $X$ . However if we differentiate the above function with respect to  $X$ , we have:

$$\frac{dY}{dX} = \hat{b} \quad \text{so that} \quad dY = \hat{b}dX$$

This reduces to differential specification and  $dY$  and  $dX$  become incremental changes and  $b$  the derivative,  $\frac{dY}{dX}$ . The differential

expression becomes  $dY = \frac{dY}{dX}dX$ .

If we can estimate all the independent relationships among the variables of the economy taken two at a time, (depending on whether they are statistically significant) and classify the significant coefficients into a matrix, then we would have,

$$dY = \hat{B}dY \quad \text{or} \quad \Delta Y = \hat{B}\Delta Y$$

If however the independent Ys are segregated into endogenous and exogenous variables as in econometrics, then we have,

$$\Delta Y = \hat{B}\Delta Y + \hat{C}\Delta X$$

Where, Y=endogenous and X=exogenous variables. The fact that the relationships are not estimated by multiple regressions means that the issue of simultaneous equation bias is by-passed. We can view the whole economy at a glance and the structure of the economy is determined automatically. The solution of the above model becomes:

$$\Delta Y = [I - \hat{B}]^{-1} \hat{C}\Delta X \quad \text{Or} \quad \Delta Y = Z\Delta X$$

Where:  $Z = [I - \hat{B}]^{-1} \hat{C}$

This last equation is the reduced form or the incremental change impact multipliers. This is a static model of the economy but goes a long way to describe the working of the economy. It is static because if the exogenous variables change, the endogenous variables will

change too. However if the change in the exogenous variables are within the limits that are realizable within one year, then the endogenous variables will equally change by the same amount. Also by extension, if the anticipated change in the endogenous variables are within the limits that are realizable within one year, then a commensurate change in the exogenous variables can be predicted to bring about such a change.

The above static model can be transformed into:

$$Y_t = Z\Delta X_t + Y_{t-1}$$

That is, the state of the economy in the current year is determined by the change in the exogenous variables in the current year plus the state of the economy in the previous year (penultimate year). The above appears to be consistent with observation in real life. We cannot discard the change in the current year as in dynamic models.

At this point, we recall that two schools of thoughts exist as to how to view the relationships in a model:

- Either as a convex polyhedral cone (attributable to the protagonists of Linear Programming)
- Or as orthogonal hyper plane (attributable to the protagonists of Econometrics).

However, it appears that there is a meeting point, as the economy can be expressed either as:

- $\Delta Y_t = Z\Delta X_t$     or
- $Y_t = ZX_t - ZX_{t-1} + Y_{t-1}$

The former is static but very useful for optimization and targeting the future and the latter, dynamically static but also useful for simulation and forecasting (whether it is orthogonal is a different matter). These are the two formulations exploited in this work.

## THE EMPIRICAL MODEL OF THE NIGERIAN ECONOMY.

The basic simulation model of the Nigerian economy in matrix notation is given as follows:

$$dY = BdY + CdX$$

$$[I - B]dY = CdX$$

$$dY = [I - B]^{-1} CdX$$

$$\Delta Y = [I - B]^{-1} C\Delta X$$

$$Y_t = [I - B]^{-1} C\Delta X + Y_{t-1}$$

Therefore, 
$$Y_t = [I - B]^{-1} CX_t - [I - B]^{-1}[C]X_{t-1} + Y_{t-1}$$

Where  $Y$  = Endogenous Variables

$X$  = Exogenous Variables

$B$  = Square Matrix of Endogenous Regression Coefficients

$C$  = Exogenous Coefficients Matrix

The model of the Nigerian economy, used in this lecture, consisted of thirty two (32) endogenous variables and fifteen (15) exogenous variables and the legend of acronyms are as follows in tables 1 and 2 below.

The data was assembled from the Central Bank of Nigeria, and CBN Statistical Bulletin (2013) and the time series ranged from 1981 to 2013. The regression was carried out by a package, termed ESM-LAB 4.0. It was designed jointly by the author and Microcraft Nigeria Limited.

When the model is estimated, the statistically significant coefficients are automatically classified into a matrix or matrices. It is this structural relationship that is exploited in the following analyses.

S.No.	ACRONYM	LEGEND	UNIT
1	AGRIC	Agricultural GDP	(N million)
2	INDUST	Industrial GDP	(N million)
3	BLDCON	Building & Construction	(N million)
4	TRADE	Trade	(N million)
5	SERVIC	Services	(N million)
6	GDP	Nominal GDP	(N million)
7	RGDP	Real GDP	(N million)
8	GROWT	Growth Rate	(%)
9	CONS	Consumption	(N million)
10	INVST	Investment	(N million)
11	CAPITAL	Capital Accumulation	(N million)
12	INFLT	Inflation Rate	(%)
13	UNEMPL	Unemployment Rate	(%)
14	XCHFLUC	Exchange Rate Fluctuation	
15	DINCOM	Disposable Income	(N million)
16	COLIVN	Cost of Living	(N million)
17	POOR	Poor	(Million )
18	ABPOOR	Absolute Poor	(Million)
19	RPOVRT	Relative Poverty Rate	(%)
20	CPI	Consumer Price Index	
21	DDMONY	Demand for Money	
22	DDMOPR	Money Demand Pressure	
23	IMPDD	Imports Demand	
24	IMPDDPR	Imports Demand Pressure	
25	XPOTDD	Exports Demand	
26	OILREV	Oil Revenue	(N million)
27	NOILREV	Non Oil Revenue	(N million)
28	FDI	Foreign Direct Investment	(N million)
29	EXTRES	External Reserve	(N million)
30	DBTBDN	Debt Burden	
31	BOT	Balance of Trade	
32	BOP	Balance of Payments	



S.No.	ACRONYM	LEGEND	UNIT
33	GEXPDN	Government Expenditure	(N million)
34	TAX	Tax	(N million)
35	PRIMELR	Primary Lending Rate	(%)
36	INTSAV	Intrest Rate	(%)
37	M1	Money Supply	(N million)
38	M2	Broad Money Supply	(N million)
39	EXTDBT\$	External Debt	(US \$ million)
40	EXCHRT	Exchange Rate	(N/US \$)
41	XPORT	Exports	(N million)
42	XPOTOIL	Oil Export	(N million)
43	XPTNOIL	Non Oil Export	(N million)
44	IMPORT	Imports	(N million)
45	POP	Population	(Million)
46	OILPRC	Oil Price	(US \$/barrel)
47	USGDP	United States GDP	(US \$ million)

Some variables are derived from existing data as follows:

- $GROWT \text{ RATE} = ((\Delta GDP) / GDP_t) * 100$
- $XCHFLUC = \Delta EXCHRT$
- $DINNCOM = GDP - TAX$
- $COLIVN = (CONS_{t-1} * ((1 + (INFRT_t / 100))))$
- $POOR = POP / ((RGDP / EXCHRT) / \$720)$
- $ABPOOR = POP / ((RGDP / EXCHRT) / \$360)$
- $RPOVRT = (1 - ((RGDP / EXCHRT) / RGDP) * 100)$
- $DDMONY = (\Delta M1)_{-1}$
- $DDMOPR = ((\Delta M1)_{-1} / POP)$
- $IMPDD = (\Delta IMPORT)_{-1}$

- $IMPDDPR = ((\Delta IMPORT)_{-1} / POP)$
- $XPOTDD = (\Delta EXPORT)_{-1}$
- $DBTBDN = (EXDBT / (GDP / EXCHRT))$

The rationale for the derived variables, can be found in Aruofor (2006) and Aruofor (2007a).

The exogenous variables or instruments represent the supply side while the endogenous variables represent the demand side of the economy. Once the multiple simple regressions of the variables are run by ESM LAB, the statistically significant coefficients (at 5% level of significance of the asymptotic t-ratio) are classified into a matrix and the structure of the economy is automatically determined. The controllable policy variables and uncontrollable environmental variables comprise the exogenous variables. If it was possible to predict (to know) the changes in the exogenous variables in advance, then there would have been no difficulty in planning the economy but regrettably this is not possible at present for two reasons:-

First, planning is defective because statistics are not abreast of the frontiers of the economy. Indeed statistical agencies are usually behind with their data with a backlog of two to three years. This need not be so.

Secondly and unfortunately, we cannot predict these changes in advance, more so because it is impossible to predict the future with certainty and also the changes occur in concert and not just individually. Even if we believe that they can occur individually and want to do a conditional analysis (conditional forecast), the possibilities are infinite and serves no useful purpose. However, if we know where we want the economy (the endogenous variables), to be (aspiration levels) by the next year, and we have a clear and analyzable welfare function (objective, e.g. growth rate) then we can use Linear Programming (Six Pap) to determine the incremental policy adjustments required given the tradeoffs and conflicts in the economy. Therefore, the economy can be controlled and planned appropriately. This is the approach adopted.

The advantages of the approach adopted over existing paradigms are that it bypasses multicollinearity and it presents (and we can see) the whole economy at a glance, both structurally and also in the reduced form (i.e. our knowledge of the economy is complete and not shrouded in a maze of equations). More importantly, it does not require elaborate and complicated theories to explain the structure of the economy and by-passes all the problems associated with multiple linear regression, including non stationarity since we live in a non-stationary world. Indeed, any attempt to correct for non-stationarity

by prior differencing, distorts the economic meaning of our data and interpretation of our results. Besides, the model is completely identified both by the order and rank conditions.

## **DISCUSSION OF RESULTS.**

The reduced form of the Nigerian economy is presented in Table 3. This is the incremental impact multiplier and describes the impact of the exogenous variables on the endogenous variables. This reduced form hides the complex inter-dependencies that exists within the economy. Indeed, these inter-dependencies are intractable by inspection but by targeting the future, it is possible to chart a way forward using linear programming (SixPap). However, the figures in Table 3 are such that positive entries indicate short term incremental impact while negative entries indicate delayed incremental impact.

TABLE 3: REDUCED FORM OF THE NIGERIAN ECONOMY

	GEXPDI	TAX(t)	PRIMELF	INTSAV	(M1(t)	M2(t)	EXTDB1	EXCHR1	XPORT	(XPOTI	XPTNOI	IMPORI	POP(t)	OILPRC	USGDP(t)
AGRIC	-0.179	-0.042	63570	-9811.9	-0.044	-0.048	10.25	-1409	0.135	-0.099	0.012	0.104	-854	-11593	-10.33
INDUST	-0.251	-0.046	61132	3138.2	-0.077	-0.065	16.42	-3301	0.111	-0.168	0.017	0.08	-3206	-13378	-28.49
BLDCOI	-0.003	-0.001	-357.41	-4565.3	-0.002	-0.002	-0.484	-68.6	0.008	-0.003	0.006	0.006	-215.9	-200.1	-1.535
TRADE	-0.034	-0.011	-6142.3	-53912	-0.011	-0.012	-8.846	-1323	0.095	-0.043	0.088	0.083	-2941	-2084	-20.36
SERVIC	-0.062	-0.011	17293	-441.26	-0.011	-0.012	0.474	-1073	0.05	-0.041	0.023	0.041	-1357	-3256	-9.523
GDP	-0.587	-0.109	169908	-12149	-0.145	-0.144	27.78	-7322	0.379	-0.366	0.1	0.298	-7117	-33359	-60.52
RGDP	0.26	0.511	394573	-348614	0.481	0.015	-64.61	27802	0.89	-0.137	0.703	0.814	63876	-15601	425.3
GROWI	1E-06	-4E-07	0.439	-0.1846	-4E-07	-2E-07	1E-04	-0.001	5E-07	4E-07	3E-07	3E-07	-0.032	0.047	-2E-04
CONS	-0.334	-0.09	131136	14982	-0.072	-0.088	17.83	-3754	0.289	-0.249	0.081	0.22	-2818	-24336	-26.9
INVEST	-0.031	-0.009	-11192	-28119	-0.009	-0.008	-6.901	-1569	0.041	-0.047	0.054	0.038	-2851	-887.6	-20.07
CAPITA	-0.007	-0.111	9702.2	52166	-0.119	-0.048	47.18	3399	-0.139	0.031	-0.142	-0.172	-1845	-4121	-21.98
INFLT	-7E-08	1E-07	-1.3743	-1.4076	1E-07	-1E-07	-7E-04	-0.103	2E-06	-1E-06	2E-06	2E-06	-0.055	0.017	-4E-04
UNEMF	-6E-07	-3E-07	-0.0908	0.0487	-3E-07	-7E-09	5E-05	0.001	-3E-07	-8E-09	-7E-07	-2E-07	-0.03	-0.004	-2E-04
XCHFLU	1E-06	3E-06	2.0217	-1.7862	2E-06	8E-08	-3E-04	0.142	5E-06	-7E-07	4E-06	4E-06	0.327	-0.08	0.002
DINCOI	-0.484	-0.112	144673	-6164.9	-0.129	-0.125	26.4	-5599	0.297	-0.301	0.027	0.226	-4646	-28797	-43.59
COLVNI	-0.245	0.118	227314	-23024	0.134	-0.035	7.225	-2319	0.518	-0.376	0.694	0.475	7246	-21345	35.52
POOR	1E-06	-4E-08	-0.7722	-1.1991	9E-09	2E-09	-2E-04	0.003	4E-07	3E-07	1E-06	4E-07	-0.033	0.064	-2E-04
ABPOO	1E-06	-4E-08	-0.7722	-1.1991	9E-09	2E-09	-2E-04	0.003	4E-07	3E-07	1E-06	4E-07	-0.033	0.064	-2E-04
RPOVR	6E-06	4E-06	10.836	0.1539	4E-06	-4E-06	0.001	0.415	7E-06	6E-07	3E-06	4E-06	1.053	-0.685	0.006
CPI	1E-06	-8E-07	4.1001	1.1792	4E-07	-1E-06	0.001	0.272	1E-06	3E-07	-2E-06	-6E-07	0.429	-0.292	0.003
DDMOI	-0.016	-0.029	-34882	20424	-0.026	0.004	0.077	-2545	-0.059	-0.035	-0.04	-0.04	-4909	1833	-31.89
DDFLT	-1E-04	-2E-04	-238.34	141.75	-2E-04	2E-05	0.004	-16.79	-4E-04	-2E-04	-3E-04	-4E-04	-32.99	12.15	-0.215
IMPDD	-0.145	-0.249	-112603	30416	-0.245	-0.072	-1.825	-181.2	-0.314	0.219	-0.821	-0.336	-11357	306.9	-74.83
IMPDDI	-9E-04	-0.002	-715.29	196.86	-0.002	-5E-04	-0.008	-0.192	-0.002	0.001	-0.005	-0.003	-70.97	1.455	-0.469
XPOTDI	-0.34	-0.454	-274726	34357	-0.48	-0.12	26.2	-14396	-0.617	0.205	-1.513	-0.573	-27757	3277	-177
OILREV	-0.115	-0.013	38833	12860	-0.036	-0.035	10.77	-1284	0.06	-0.08	0.033	0.034	-1355	-5392	-10.8
NOILRE	-0.012	-0.003	-422.3	-25020	-0.004	-0.007	-2.109	-169.1	0.04	-0.017	0.034	0.036	-806.4	-1073	-6.028
FDI	-0.021	-0.004	649.63	3516.8	-0.007	-0.004	0.783	-682.1	0.003	-0.021	0.007	0.004	-873.2	-631.7	-6.067
EXTRES	3E-04	2E-05	166.47	-157.17	3E-04	-5E-05	-0.115	0.086	8E-04	-5E-04	0.001	5E-04	3.385	-6.447	0.015
DBTBDI	2E-08	-2E-08	0.0074	-0.0056	-2E-08	-1E-08	4E-06	0.001	-2E-08	3E-08	-6E-08	-2E-08	3E-04	8E-05	6E-07
BOT	-0.119	-0.104	-10127	100904	-0.105	-0.024	26.58	-3772	-0.129	-0.01	-0.166	-0.139	-10330	-1747	-68.35
BOP	-0.057	-0.113	-87167	77014	-0.106	-0.003	14.27	-6142	-0.197	0.03	-0.155	-0.18	-14111	3447	-93.96

The ex-post simulation is presented in Appendix II. The ex-post forecasts are in Appendix III. The ex-ante forecasts are in Appendix IV and the structure of the linear programme (LP) is presented in Appendix V.

## **EX-POST SIMULATION**

The ex-post simulation was performed by ESM LAB4 and the result can be seen in appendix II. It is almost perfect. We can see how well our model tracks reality indicating that the model is robust and predicts well. The import is that the model is good enough for planning and policy making. As previously stated, the validation of the model cannot progress more than establishing mere superficial similarity and correspondence between the model and the referent system or economy. The highlights include, that relative poverty rate (RPOVRT), had been escalating essentially due to the depreciation of the naira. As at 2013, the average Nigerian was 100% as poor as his counterpart in the US. Non-oil export did not respond to the devaluation of the naira.

Unemployment has continued to increase unabated. The poor had been decreasing from an all time high of 91.9 million in 1993 to 4.5 million in 2013 and absolute poor who survive on \$1.00 or less a day from 45.9 million in 1993 to 2.2 million in 2013 given the size of the Nigerian GDP (National income) but this is deceptive because it assumes optimum distribution of income. This finding is not consonance with recent findings where single individuals are found to have embezzled billions and trillions of naira. The growth of the Nigerian economy has been checkered declining from an all time high

of 51.86% in 1995 to 4.4% in 2013. The other details are contained in the appendix II.

### **EX-POST FORECAST.**

This is given in Appendix III and it predicts that as at 2014, the Nigerian economy had slumped into recession as can be seen from the downturn of most of the relevant variables. All sectoral incomes declined while unemployment rate increased. At this time statistics are available up to 2014 from CBN. This is a major limitation in our planning which is not based on the frontiers of the economy. To all intents and purpose, in 2015 and 2016, the economy could be sliding deeper and deeper into recession.

### **OPTIMAL CONTROL AND EX-ANTE FORECAST**

This section gives the prescriptions of how we might have turned the fortunes of the economy around and nipped the recession on the bud in 2015 if we were planning at the frontiers of the Nigerian economy. If as at the end of 2014 or possibly at the beginning of 2015, the 2014 data were available, then our model should have alerted us about the



state of the economy and enabled us to take prompt action. Regrettably, this is not so.

What could we have done in 2015 to 2016 to get out of this quagmire if we were aware of the situation in 2014?

Our aspirations should have included the following:

- To reverse the 2014 recession which resulted in a negative growth of 13.1239%, by growing the economy by at least 18%.
- Constraining and driving the economy in the most desirable direction,
- Maximizing real income as our welfare function and
- Growing the economy by 10% annually subsequently.

The solution was obtained by navigating between ESM-LAB4 and Six Pap through the medium of Excel. The ex-ante forecast spanned from 2015 to 2018 (see Appendix IV) and the incremental policy prescriptions are as shown in Table 4.

- The interpretation of the prescription for 2015, says that in order to reverse the recession, the prime lending rate should be increased by 1.7%.
- We should borrow \$30.5 billion,
- Concentrate effort on increasing agricultural income by N447.00 billion,

- Industrial income by N517.00 billion,
- Services by N40.8 billion
- In addition, promoted oil export to the tune of 1.00 trillion barrels
- While population be allowed to grow at its annual rate of change of 5.67 million.

Table 4		INCREMENTAL POLICY PRESCRIPTIONS					
	S/No.	Variables	2015	2016	2017	2018	
POLICY	1	GEXPDN(t)			1.08E+06	1.00E+06	
	2	TAX(t)					
	3	PRIMELR(t)	1.7021	0.6144	6.2284	4.3265	
	4	INTSAV(t)					
	5	M1(t)					
	6	M2(t)					
	7	EXTDBT\$(t)	3.05E+04	4.65E+04	5.37E+04	5.64E+04	
	8	EXCHRT(t)				3.8753	
	9	XPORT(t)	1.00E+06	2.26E+06	2.54E+05	9.81E+05	
STRATEGY	10	XPOTOIL(t)	1..00e+06	1.58E+06	2.54E+05	9.81E+05	
	11	XPTNOIL(t)		6.82E+05			
	12	IMPORT(t)		5.95E+05		3.49E+05	
	13	POP(t)	5.67		5.67	5.67E+00	
	14	OILPRC(t)					
	15	USGDP(t)	424.8047		424.8047	4.25E+02	
	16	AGRIC	4.47E+05	7.33E+05	7.54E+05	7.30E+05	
	17	INDUST	5.17E+05	8.46E+05	9.47E+05	8..67e+05	
	18	BLDCON					
	19	TRADE					
	20	SERVIC	40,834.20	1.21E+05	5.62E+04	4.59E+04	
	21	GDP	1.00E+06	1.66E+06	1.75E+06	1.54E+06	
	22	CONS			4.18E+05		
	23	INVST					
	24	DINCOM	1.00E+06	1.66E+06	1.75E+06	1.54E+06	

The other years could be interpreted similarly. However, we note that increasing the prime lending rate may seem injurious to domestic

production which is not enough for our developmental needs. The prescription therefore makes the economy more attractive to foreign investors who have the technology we desperately need for our development. Indeed, the prime lending rate should be adjusted upwards to 29.42% by 2018. As we can see, taxation and money supply do not feature as incremental options. Devaluation should only occur in 2018. Special attention should be given to non-oil exports in 2016, while imports should be relaxed in 2016 and 2018 probably to bring in essential capital goods and equipment.

When the optimal prescription was adjusted for the oil price shock (aberration) and the exchange rate shock (stimuli), the economy could only grow by a net of 2.6861% in 2015. The prescribed strategy was that emphasis should be placed on increasing agricultural, industrial and services incomes. This is another way of saying the country should concentrate on developing the agriculture, industry and services sectors.

The prescriptions for 2016 to 2018 can be inferred from Table 4 but the above theme runs through. The full package of exogenous instruments is contained in Table 5.

Table 5: FULLY ADJUSTED EXOGENOUS INSTRUMENTS.

	GEXPDN	TAX	PRIMELINTSAV	M1	M2	EXTDBT	EXCHRT	EXPORT	XPOTOIL	XPTNOIL	IMPORT	POP	OILPRC	USGDP	
2013	4567282	7035384	16.72	2.17	6939501	15156223	7669.3	157.3	31425311	7194246	4701562	15793742	162.1	111.3	16212
2014	4596296	7119491	16.55	3.38	7096400	17680520	10372	157.3	12960500	12007000	953500	2215000	167.8	110.2	16637
2015	4596296	7119491	18.25	3.38	7096400	17680520	40872	157.3	13960500	13007000	953500	2215000	173.5	63.19	17061
2016	4596296	7119491	18.87	3.38	7096400	17680520	87372	375	16220500	14587000	1635500	2810000	179.4	44.4	17061
2017	5676296	7119491	25.09	3.38	7096400	17680520	141072	375	16474500	14841000	1635500	2810000	185	50	17486
2018	6676296	7119491	29.42	3.38	7096400	17680520	197472	378.9	17455500	15822000	1635500	3159000	190.7	50	17911

It must be noted that the prescriptions themselves cannot turn the economy around but by our response to the policy prescriptions. However, we see from Appendix IV that the performance of the economy did improve.

## **THE IMPERATIVES FOR DEVELOPING THE NIGERIAN ECONOMY**

Nigeria has one of the largest and vibrant consumers markets as far as the international community is concerned. International politics, would want the status quo to remain except Nigerians themselves do something about it. In that regard, Nigeria must start to look inwards and invest and develop all the potential areas of commensurate advantage, if not comparative advantage. By this, we mean areas of comparative needs which tie in with our development aspirations, such that if developed could result in import substitution if not comparative advantage.

Such areas will include:

### 1) Agriculture

- i. Review of land use policy
- ii. Mobilization of masses into agricultural production
- iii. Establishment and development of agricultural industries especially food processing.

### 2) Industry

#### a) Oil Industry

- i. Establish more refineries to satisfy domestic and regional markets
- ii. Develop the petrochemical industry to world standards

#### b) Solid Minerals

- i. Borrow and complete the Ajaokuta iron and steel mill
- ii. Establish flat sheets mills
- iii. Establish and develop machine tools and bolts and nuts industry

### 3) Services

- i. Expand, develop and modernize electric power generation and distribution.
- ii. Develop the infrastructure
- iii. Invest in qualitative education
- iv. Promote quality assurance research and technology.

The above prescriptions of our model seem to conform in part with what the present administration is doing but how organized they are in doing it is a matter to be seen. However, let technocrats, realists and practicality be appointed to occupy the drivers' seats in the planning and management of the Nigerian economy. They should be appointed into position where they could and would be held accountable and not through quota system as in the present disposition.

## **CONCLUSION AND RECOMMENDATIONS**

1. The planning and management of the Nigerian economy is defective because of poor understanding. Indeed the plans are based on obsolete and imaginary data which does not exist. The statistical agencies, including the Ministries need to work harder to reach the frontiers of the economy so that planning will be based on reliable data.
2. Some of the incremental policy prescribed external borrowing as possible option. In this regard, there is need to be clear about what the funds will be used for to make sure they add value instead of the existing paradigm where such funds end up in private pockets of unpatriotic Nigerians.
3. The prescriptions in this study are based on what we should have done to save our economy and not strictly what we should do. This is because the available data is behind the frontiers of the economy. The data for 2015 are needed to do so. It has only been demonstrated that the Nigerian economy can be better planned and controlled if the statistical agencies who are always behind the frontiers by 2 to 3 years can brace up and correct this anomaly.
4. That being as it may, the prescriptions indicate that if the economy were planned and controlled in this fashion, the

poor amongst us will reduce drastically. However, due to the sliding depreciation of the naira, the relative poverty which had reached 350% will continue to increase and all Nigerians will be worse for it. Depreciation does not promote our non-oil exports. Indeed, international demand for our export is falling. Nigeria does not have any comparative export advantage except for crude oil. Indeed the mistake of SAP is being repeated.

5. President Muhammadu Buhari's administration is targeting agriculture, solid minerals and power. This is good and is corroborated by this work but how coordinated is the effort, is yet to be seen. First, borrow to complete the Ajaokuta Iron and Steel mill and establish other complimenting and supporting components like Flat Sheets Mills, Machine Tools and Bolts Factories. Since World Bank will not support us in this quest, maybe the Public-Private- Partnership (PPP) approach will be useful in this regard.
6. The mining of solid minerals should not be for all comers artisanal mining as is being done now. It should be better organized by legislature and left to the organized private sector.
7. The oil sector should be developed further and not be abandoned. More refineries should be built to process crude oil to satisfy both domestic and regional markets. The petrochemical industry should be further developed and



expanded since Nigeria has comparative advantage in this area. All these will require political will.

8. Unemployment will continue to haunt the nation until appropriate infrastructure, industries and power are developed and established to meet the challenge.
9. The tools for planning, managing and controlling the economy have been developed further and is available to interested parties.

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APPENDIX I NIGERIAN ECONOMY TIME SERIES (ENDOGENOUS VARIABLES).

	AGRIC	INDUST	BLDCON	TRADE	SERVIC	GDP	RGDP	GROWT	CONS	INVST	CAPITAL	INFLT	UNEMPL	XCHFLUC	DINCOM	COLIVN
1981	19500	48500	5400	7400	13600	94400	5425.013		36159.2	18220.59	29061.82	17.40088	7.2		85345.4	
1982	22600	51100	4800	7600	14900	101000	14549.46	6.534653	38817.68	17145.82	46207.64	6.941839	4.7	0.062842	93267.6	38669.31
1983	26400	54700	4400	9500	15000	110000	2837.104	8.181818	44104.33	13335.33	59542.97	38.77193	10.2	0.051275	103707.5	53868.04
1984	33800	53100	3700	9800	15800	116200	5134.872	5.335628	51317.86	9149.76	68692.73	22.62958	8.9	0.0408	109035.4	54084.96
1985	38200	64900	3000	10500	18000	134600	130562	13.67013	58666.11	8799.48	77492.21	1.030928	6.1	0.128808	124701.2	51846.91
1986	39900	94700	3700	10500	18000	166800	12198.81	19.30456	60961.96	11351.46	88843.67	13.67347	5.3	1.126825	159158.3	66687.8
1987	57600	94700	4200	17000	19700	193200	19928.22	13.6646	84045.52	15228.58	104072.3	9.694794	7	1.997367	175920	66872.1
1988	86600	126100	4800	23800	22000	263300	4301.505	26.62362	117989.6	17562.21	121634.5	61.21113	5.3	0.518792	249262.8	135490.7
1989	120100	186000	5500	39100	31700	382400	8560.545	31.1454	138629.9	26825.51	148460	44.67005	4	2.854825	364072.1	170695.6
1990	122200	299600	5700	42400	32600	502500	139041.3	23.9005	191212	40121.31	188581.3	3.614035	3.5	0.64625	463952.8	143640
1991	144700	299600	9500	47900	44000	545700	23767.73	7.916438	222718.3	45190.23	233771.5	22.9597	3.1	1.871683	491799.3	235113.7
1992	217400	516000	11800	72300	57900	875400	17937.8	37.66278	406641.9	70809.16	304580.7	48.80198	3.4	7.388933	802451.3	331409.3
1993	350000	530300	15500	118100	75700	1089600	17785.83	19.65859	549571.7	96915.51	401496.2	61.26226	2.7	4.752633	1005352	655759.8
1994	529000	549700	19900	186600	114500	1399700	18235.03	22.15475	780009.4	105575.5	507071.7	76.75887	2	-0.16496	1319067	971416.6
1995	940300	1450000	26600	324100	166300	2907300	56356.61	51.85567	1630183	141920.2	648991.9	51.58756	1.8	0	2784439	1182397
1996	1275800	2094200	31000	423000	208400	4032400	281688.8	27.9015	2404656	204047.6	853039.5	14.31509	3.8	0	3847733	1863545
1997	1445100	1992400	36200	465000	250500	4189200	410129.7	3.742958	2468848	242899.8	1095939	10.21433	3.2	0	3997626	2650275
1998	1600600	1505100	48000	527000	308800	3989500	334894.8	-5.00564	2764875	242256.3	1338196	11.91269	3.2	0	3793647	2762954
1999	1704000	1968300	53100	575900	377000	4678300	20810849	14.7233	2686087	231661.7	1569857	0.224801	8.2	70.80725	4318397	2771091
2000	1801500	3757100	59100	625600	470400	6713700	462225.4	30.31711	2872325	331056.7	1900914	14.52473	13.1	9.411858	5944491	3076234
2001	2410100	3044900	78600	762700	598900	6895200	417982.1	2.632266	4090760	372135.7	2273050	16.4964	13.6	9.838117	5878537	3346155
2002	2847100	3212400	94400	916800	725000	7795700	639476.9	11.55124	6018479	499681.5	2772731	12.19074	12.6	9.026842	7014095	4589454
2003	3231400	4589700	118600	1094600	879200	9913500	416752.9	21.36279	7495035	865876.5	3638608	23.78748	14.8	8.386367	8783364	7450123
2004	3903800	4610100	166100	1484400	1246700	11411100	1140143	13.12406	9423551	863072.6	4501680	10.00848	13.4	4.143867	9737900	8245174
2005	4753000	6090500	215300	1930800	1621200	14610800	1259552	21.89955	12078162	804400.8	5306081	11.6	11.9	-1.3529	12061012	10516683
2006	5940200	7488700	250300	2741800	2143500	18564500	2184059	21.2971	13117981	1546526	6852607	8.5	12.3	-3.49667	15786047	13104805
2007	6757900	8085400	266500	3044800	2502800	20657400	3129909	10.13148	17777916	1915349	2191989	6.6	12.7	-2.81667	18172960	13983767
2008	7981400	9719500	306600	3503200	2785700	24296400	1609033	14.97753	18566710	2030510	2699616	15.1	14.9	-7.26787	20262114	20462381
2009	9186300	8071100	347700	4082400	3106800	24794300	2066192	2.008123	19365634	2442704	3310292	12	19.7	30.31388	21965806	20794715
2010	10310700	15194600	394700	4648700	3436200	33984900	2545685	27.04319	27001266	4012919	4561348	13.35	21.4	-20.6702	28492417	21950946
2011	11593400	16032300	456300	5385800	3942000	37409800	3091719	9.155088	19146085	3908280	4067899	12.1	23.9	0	30913584	30268419
2012	13413800	15825500	539700	6284900	4480200	40544100	3501218	7.730595	24388866	3357398	3259731	11.58	27.4	0	33822592	21363201
2013	14709100	14642800	627600	7288000	5129300	42396800	4084470	4.369905	32698854	3255501	3435607	10.38	24.7	29.08	35361416	26920430



APPENDIX I NIGERIAN ECONOMY TIME SERIES (ENDOGENOUS VARIABLES).

	POOR	ABPOOR	RPOVRT	CPI	DDMONY	DDMOPR	IMPDD	IMPDDPR	XPOTDD	OILREV	NOILREV	FDI	EXTRES	DBTBDN	BOT	BOP
1981	5.918459	2.959229	-63.9277	1.027985	303.7	4.154469	-2502.6	-34.2344	-1237.4	8564.4	4726.1	334.7	2441.6	0.023653	-1800	-3020.8
1982	2.501858	1.250929	-48.6179	1.099346	1233.8	16.42089	-3988.9	-53.0891	-1713.1	7814.9	3618.8	290	1043.3	0.087668	-2600	-1398.3
1983	14.18724	7.093622	-38.0945	1.525584	921.7	11.93912	-1623.1	-21.0246	1655.5	7253	3255.7	264.3	224.4	0.093019	-1400	-301.3
1984	8.510094	4.255047	-30.7289	1.870817	1063.7	13.40652	1043.2	13.14814	2579	8269.2	2984.1	360.4	710.1	0.120605	1900	354.9
1985	0.402171	0.201086	-11.8881	1.890104	-162.8	-1.99515	474.9	5.819996	-2670.3	10923.7	4126.7	434.1	1657.9	0.125523	4700	349.1
1986	10.01499	5.007495	50.50914	2.148547	1800.9	21.44516	9692.8	115.4221	20530.6	8107.3	4488.5	735.8	2836.6	0.309797	2900	-784.3
1987	12.552	6.276	75.11163	2.356844	6242.7	72.19832	2392.6	27.67099	1613.7	19027	6353.6	2452.8	7504.589	0.588882	12500	159.2
1988	67.62598	33.81299	77.95771	3.799495	4549	51.08079	7089.6	79.60923	28794.2	19831.7	7765	1718.2	5229.105	0.528849	9700	-2294.1
1989	57.02176	28.51088	86.47105	5.496731	11536.1	125.7724	20540.3	223.9408	49900.1	39130.5	14739.9	13877.4	3047.619	0.610538	27100	8727.8
1990	3.931396	1.965698	87.5588	5.695385	12130.8	128.4308	43770.3	463.4033	11647.6	71887.1	26215.3	4686	4541.448	0.52944	64200	18498.2
1991	29.19257	14.59629	89.90867	7.003028	26605.77	273.5897	53663	551.8217	84079.4	82666.4	18325.2	6916.1	4149.298	0.612511	32000	5959.6
1992	69.50517	34.75258	94.21913	10.42064	42783.13	427.3911	22478.2	224.5507	13152.1	164078.1	26375.1	14463.1	1554.607	0.544697	62500	-65271.8
1993	91.96043	45.98021	95.46507	16.80457	24023.54	233.1975	-4602.4	-44.6757	-12480.1	162102.4	30667	29675.2	3049.687	0.581192	53100	13615.9
1994	91.59065	45.79533	95.43089	29.70356	58637.53	553.2468	495495.2	4675.012	542083	160192.4	41718.4	22229.2	9009.11	0.460158	43300	-42623.3
1995	30.48052	15.24026	95.43089	45.02691	26049.96	238.9685	-93267.6	-855.588	561247.8	324547.6	135439.7	75940.6	1842.54	0.245298	195500	-195316
1996	6.269826	3.134913	95.43089	51.47255	41158.51	367.2276	182462	1627.977	-67953.2	408783	114814	111295	3403.91	0.152297	746900	-53152
1997	4.425942	2.212971	95.43089	56.73012	49953	433.6461	91702.1	796.0735	-489806	416811.1	166000	110452.7	7222.215	0.141518	395900	1076.3
1998	5.568694	2.784347	95.43089	63.48821	74502.88	629.5238	23106.6	195.2428	807442.8	324311.2	139297.6	80750.35	7107.5	0.157849	-85600	-220675
1999	0.389778	0.194889	98.92117	63.63093	244652.3	2012.903	-166904	-1373.22	1259499	724422.5	224765.4	92792.47	5424.6	0.555554	326500	-326634
2000	19.84482	9.922412	99.02062	72.87315	178976.5	1434.417	653845.2	5240.278	-779198	1591676	314483.9	115952.2	9386.1	0.43	960700	314139.2
2001	24.68967	12.34484	99.10669	84.8946	129545.8	1011.768	-79529.7	-621.137	148932.8	1707563	903462.3	132481	10267.1	0.460213	509800	24738.74
2002	17.88832	8.944162	99.17335	95.24388	279305.9	2126.652	1093660	8327.191	1042175	1230851	500983.6	225224.8	7681.1	0.480918	231500	-563484
2003	30.09384	15.04692	99.22694	117.9	105098.4	780.4784	-167630	-1244.84	1934437	2074281	500816.3	258388.6	7467.78	0.429516	1007700	-162298
2004	11.63424	5.81712	99.25094	129.7	210991.9	1528.916	302456.7	2191.699	1456159	3354800	585700	248224.6	16955.02	0.420523	2615700	1124157
2005	10.67799	5.338997	99.24327	144.7	738999.2	5227.93	314081.9	2221.921	933837.7	4762400	785100	654193.1	28279.06	0.185213	4445700	1488092
2006	6.137752	3.068876	99.2227	157.1	835623.2	5774.069	1529262	10567.04	-673640	5287567	677536	624520.7	42298.11	0.024563	4216200	1787558
2007	4.288863	2.144432	99.2053	167.4	1741040	11750.76	-1040671	-7023.78	2687448	4462910	1200800	759380.4	51333.15	0.02226	4397800	1127213
2008	8.04	4.02	99.15659	192.6	109969.7	725.6808	1748772	11540	-2134405	6530630	1335960	460222.6	53000.36	0.018155	4876500	196367.8
2009	8.037228	4.018614	99.32832	215.6	288618.2	1863.014	2566788	16568.47	4272200	3191938	1652654	572546.8	42382.49	0.023702	3285700	-1548404
2010	5.653581	2.826791	99.22003	110.15	746400.5	4787.38	2620518	16807.89	3115862	5396100	1907600	909212.8	36265.93	0.016683	4092100	-8841.84
2011	4.704955	2.352478	99.22003	122.05	597122.3	3789.328	-1126142	-7146.48	180262.2	8879000	2237900	1360300	32373.18	0.018786	4587400	254.39
2012	4.179188	2.089594	99.22003	136.75	340078.6	2145.471	6684709	42172.16	16422443	8026000	2628800	1113419	38770.19	0.019583	5651600	10058.6
2013	4.495604	2.247802	99.36423	147.95						6809200	2950600	875110	44949.23	0.028453	6032600	-3869.51



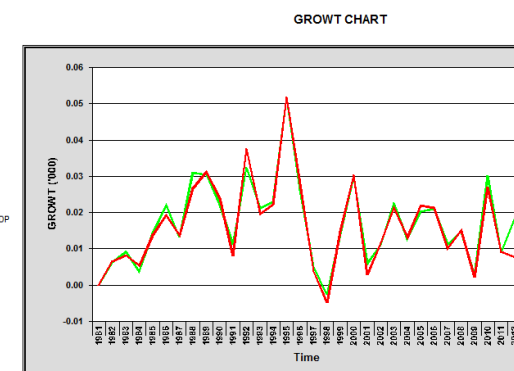
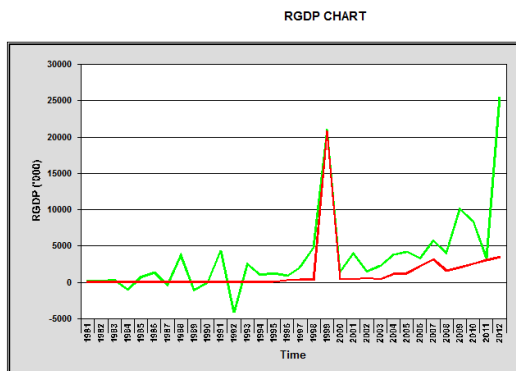
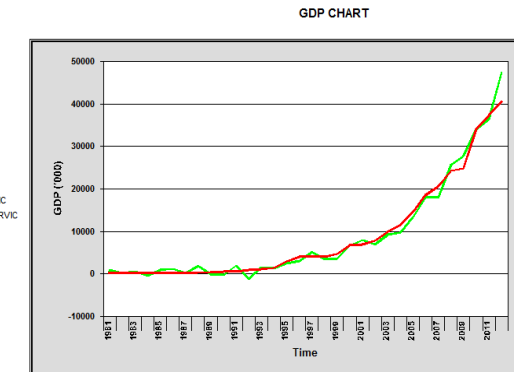
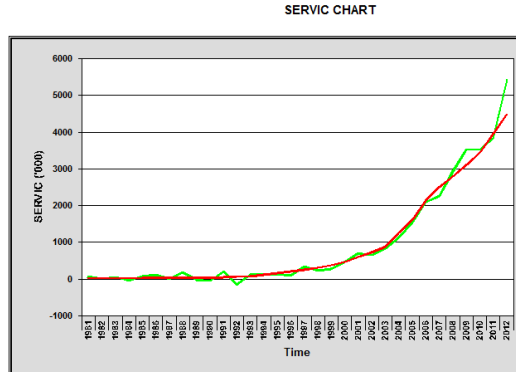
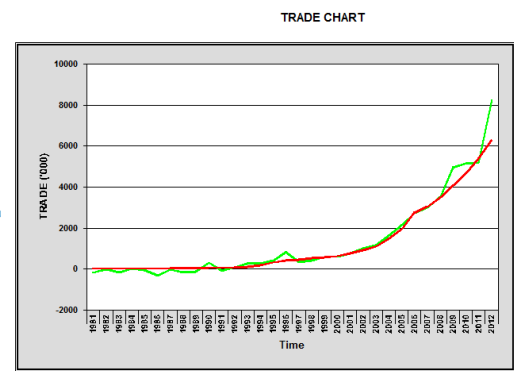
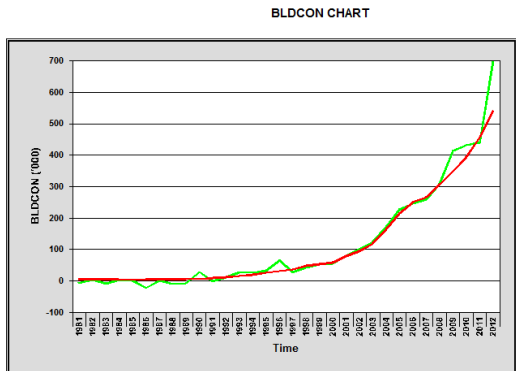
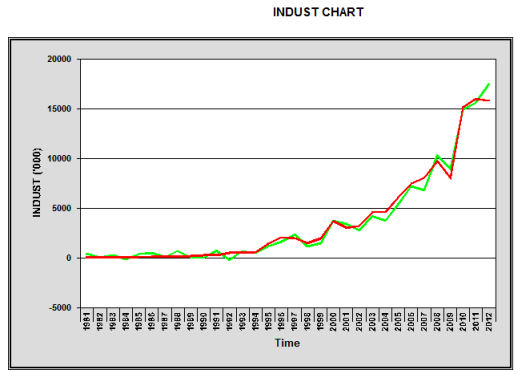
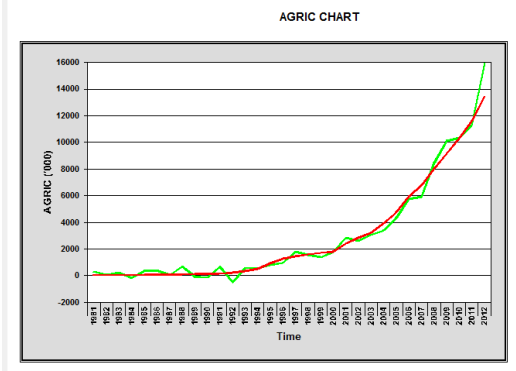
## APPENDIX I CONTD.

## NIGERIAN ECONOMY TIME SERIES (EXOGENOUS VARIABLES).

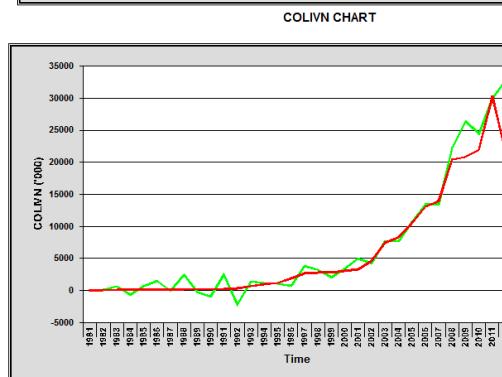
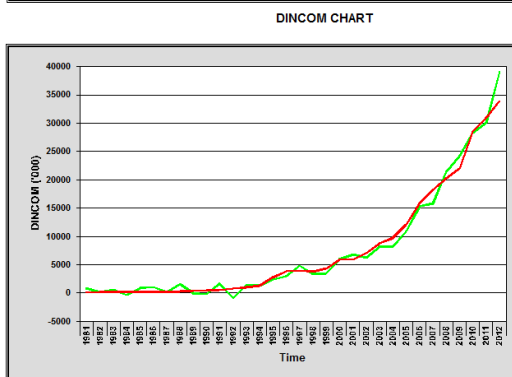
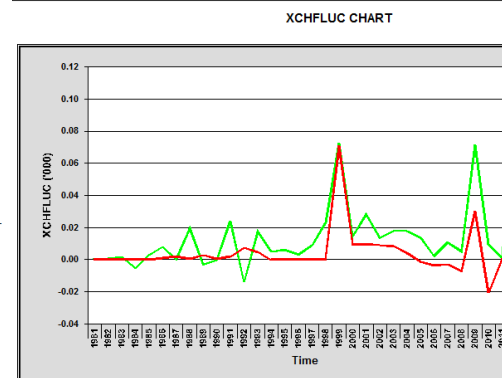
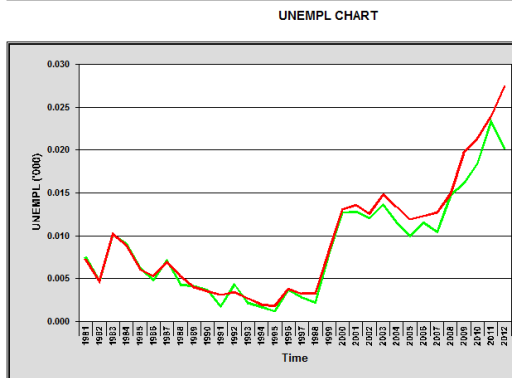
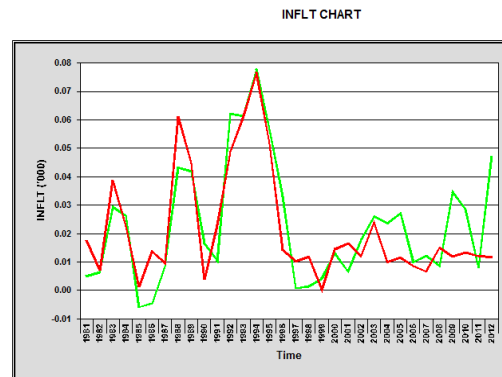
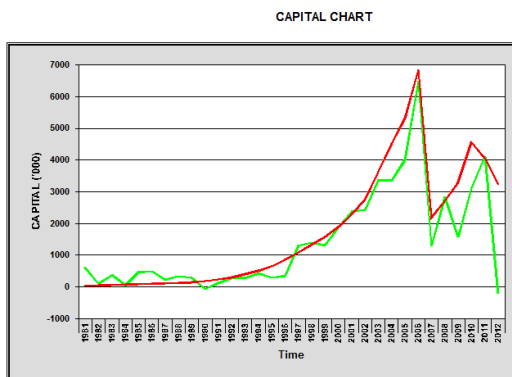
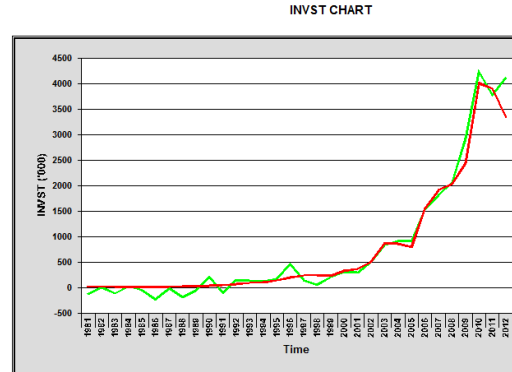
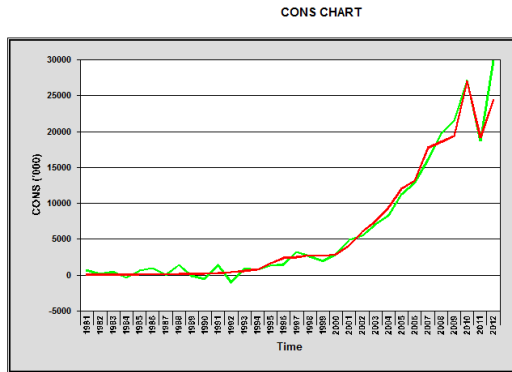
	GEXPDN	TAX	PRIMELRINTSAV	M1	M2	EXTDBT\$	EXCHRT	XPORT	XPOTOIL	XPTNOIL	IMPORT	POP	OILPRC	USGDP	
1981	11413.7	9054.6	7.75	6	9744.9	15541	3660.2	0.61	10433.8	10083.15	350.6509	12599.1	73.102	37.39	3126.8
1982	11923.2	7732.4	10.25	7.5	10048.6	16886.8	13159	0.6729	9196.4	9098.372	98.02847	10096.5	75.136	33.48	3253.2
1983	9636.5	6292.5	10	7.5	11282.4	19365.3	14130	0.7241	7483.3	7441.995	41.30464	6107.6	77.2	29.9	3534.6
1984	9927.6	7164.6	12.5	9.5	12204.1	21600.5	18321	0.7649	9138.8	8974.006	164.7941	4484.5	79.342	28.89	3930.9
1985	13041.1	9898.8	9.25	9.5	13267.8	23818.6	18904	0.8938	11717.8	10939.22	778.5786	5527.7	81.598	27.77	4217.5
1986	16223.7	7641.7	10.5	9.5	13105	24592.7	25574	2.0206	9047.5	8721.155	326.3447	6002.6	83.977	14.48	4460.1
1987	22018.7	17280	17.5	14	14905.9	32272.5	28316	4.0179	29578.1	25994.04	3584.061	15695.4	86.466	18.5	4736.4
1988	27749.5	14037.2	16.5	14.5	21148.6	42780.3	30693	4.5367	31191.8	29483.12	1708.682	18088	89.055	15.11	5100.4
1989	41028.3	18327.9	26.8	16.4	25697.6	46222.9	31586	7.3916	59986	56126.89	3859.11	25177.6	91.722	18.5	5482.1
1990	60268.2	38547.2	25.5	18.8	37233.7	64902.7	33099	8.0378	109886.1	101689.6	8196.548	45717.9	94.454	24.16	5800.5
1991	66584.4	53900.7	20.01	14.29	49364.5	86152.5	33730	9.9095	121533.7	119385.6	2148.062	89488.2	97.247	20.55	5992.1
1992	92797.4	72948.7	29.8	16.1	75970.27	129085.52	27565	17.298	205613.1	190128.5	15484.62	143151.2	100.1	19.95	6342.3
1993	191228.9	84248.1	18.32	16.66	118753.4	198479.1	28718	22.051	218765.2	210803.6	7961.559	165629.4	103.02	17.57	6667.4
1994	160893.2	80632.9	21	13.5	142776.9	242799.24	29429	21.886	206285.1	183042.7	23242.37	161027	105.99	16.21	7085.2
1995	248768.1	122861.2	20.18	12.61	201414.5	318763.47	32585	21.886	748368.1	708519.6	39848.53	656522.2	109.01	17.34	7414.7
1996	337217.6	184667	19.74	11.69	227464.4	370333.53	28060	21.886	1309615.9	1246305	63311.08	563254.6	112.08	21.24	7838.5
1997	428215.2	191574.1	13.54	4.8	268622.9	429731.33	27088	21.886	1241662.7	1177971	63691.81	745716.6	115.19	19.4	8332.4
1998	487113.4	195852.6	18.29	5.49	318575.9	525637.73	28774	21.886	751856.7	728556.7	23300.01	837418.7	118.35	13.25	8793.5
1999	947690	359903.5	21.32	5.33	393078.8	699733.71	28039	92.693	1559299.5	1543319	15980.48	860525.3	121.54	17.953	9353.5
2000	701059.4	769209.4	17.98	5.29	637731.1	1036079.5	28274	102.11	2818798.1	2801410	17387.66	693621.02	124.77	28.581	9951.5
2001	1018026	1016663	18.29	5.49	816707.6	1315869.1	28347	111.94	2039600.5	2004130	35470.13	1347466.2	128.04	24.839	10286
2002	1018156	781604.6	24.85	4.15	946253.4	1599494.6	30992	120.97	2188533.3	2017839	170694.6	1267936.5	131.34	25.203	10642
2003	1225966	1130136	20.71	4.11	1225559	1985191.8	32917	129.36	3230708	3114367	116340.7	2361596.5	134.66	29.042	11142
2004	1504171	1673200	19.18	4.19	1330658	2263587.9	35945	133.5	5165144.9	4514235	650909.4	2193967	138	38.726	11868
2005	1919710	2549788	17.95	3.83	1541650	2442588.9	20478	132.15	6621303.6	6252882	368421.4	2496423.7	141.36	54.975	12638
2006	2037961	2778453	17.26	3.14	2280649	4027901.7	3544.5	128.65	7555141.3	7006591	548550.2	2810505.6	144.72	66.668	13399
2007	2450933	2484440	16.94	3.55	3116272	5809826.5	3654.2	125.83	6881501.3	6395167	486334.1	4339767.6	148.16	74.963	14078
2008	3240800	4034286	15.14	2.84	4857312	9166835.3	3720.4	118.57	9568949.2	8751618	817331.3	3299096.6	151.54	101.02	14441
2009	3456925	2828494	18.99	2.68	4967282	10730793	3947.3	148.88	7434543.9	6284406	1150138	5047868.6	154.92	83.933	14256
2010	3229762	5492483	17.59	2.21	5255900	11034941	4422.2	128.21	11706744	4367320	2802566	7614656.2	155.91	80.9	14591
2011	3480151	6496216	16.02	1.41	6002301	12172490	5481.4	128.21	14822606	4761241	3878087	10235174	157.58	113.76	14987
2012	4031708	6721508	16.79	1.7	6599423	13895389	6192.8	128.21	15002868	5060211	3892539	9109032.5	158.51	113.72	15543
2013	4567282	7035384	16.72	2.17	6939501	15156223	7669.3	157.29	31425311	7194246	4701562	15793742	162.14	111.3	16212

APPENDIX II:

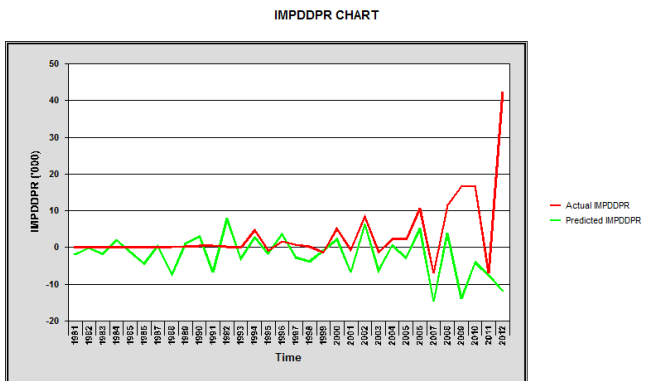
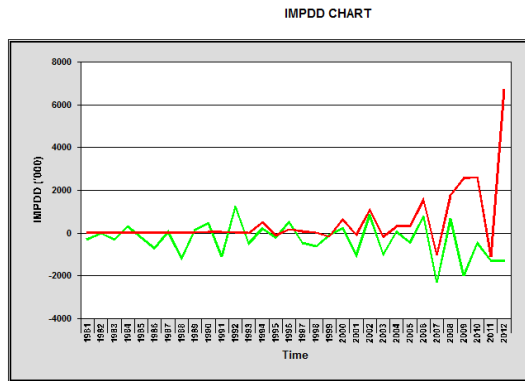
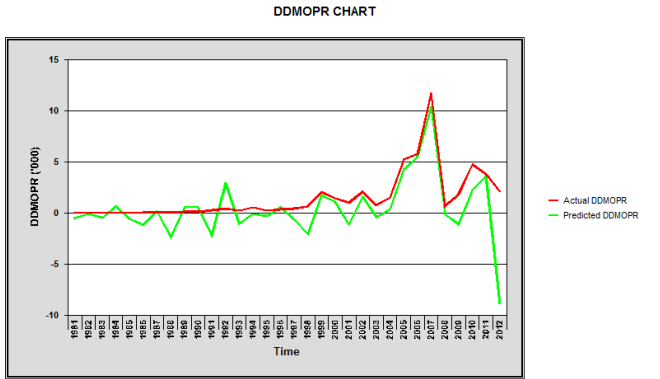
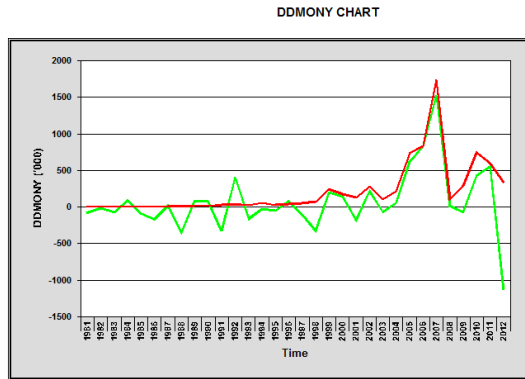
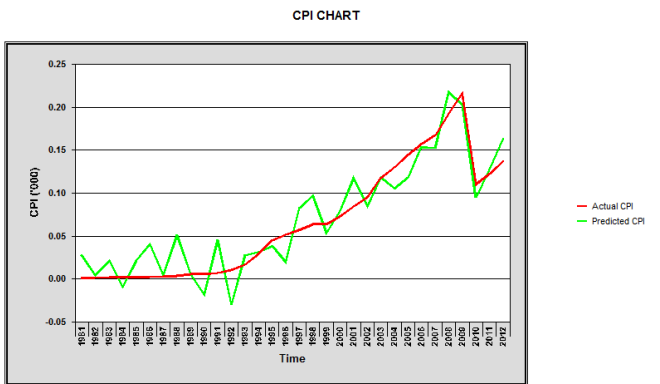
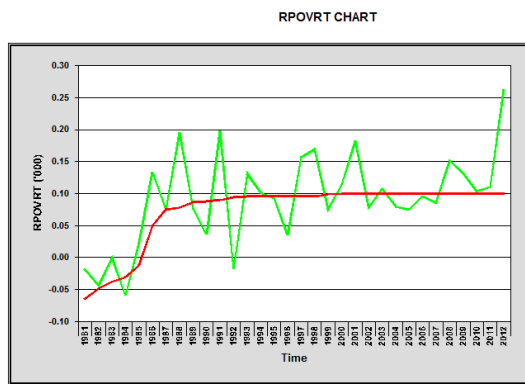
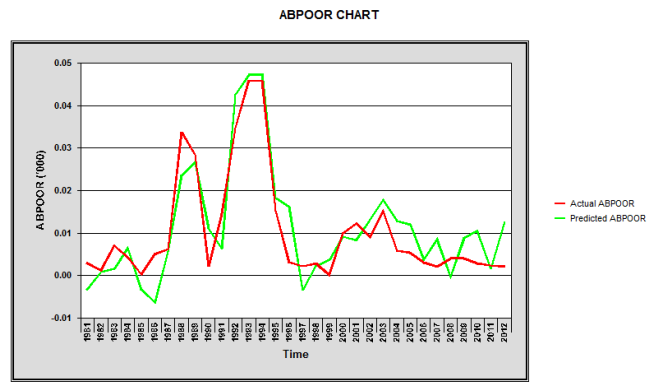
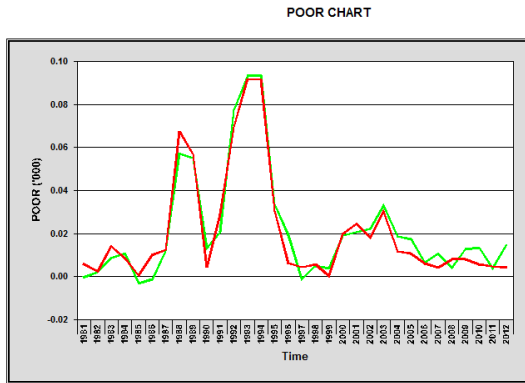
EXPOST SIMULATION OF THE NIGERIAN ECONOMY



# APPENDIX II CONTD: EXPOST SIMULATION OF THE NIGERIAN ECONOMY

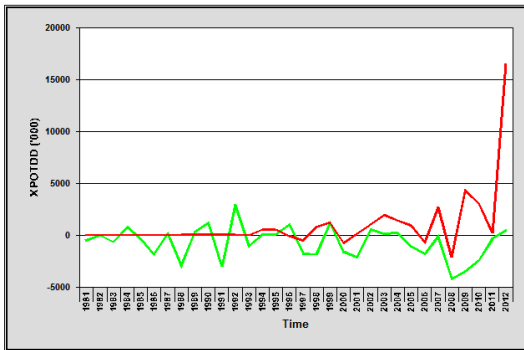


# APPENDIX II CONTD: EXPOST SIMULATION OF THE NIGERIAN ECONOMY

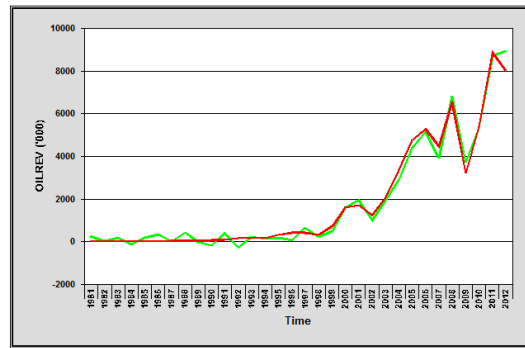


# APPENDIX II CONTD: EXPOST SIMULATION OF THE NIGERIAN ECONOMY

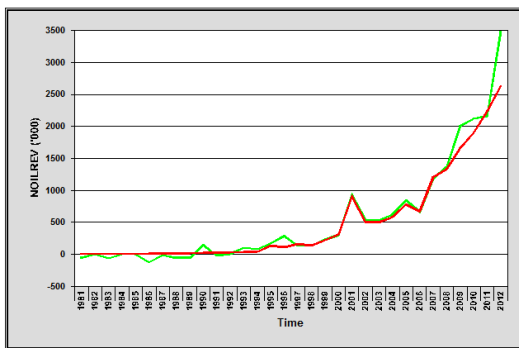
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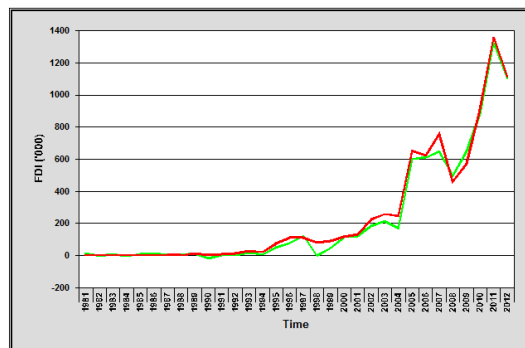
**OILREV CHART**



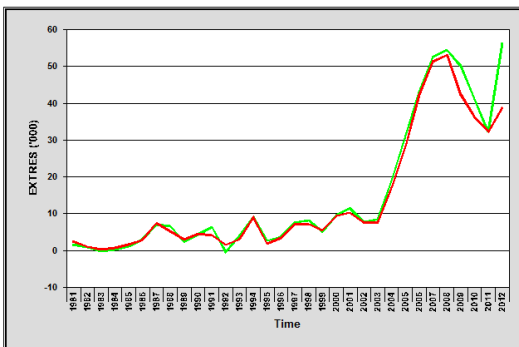
**NOILREV CHART**



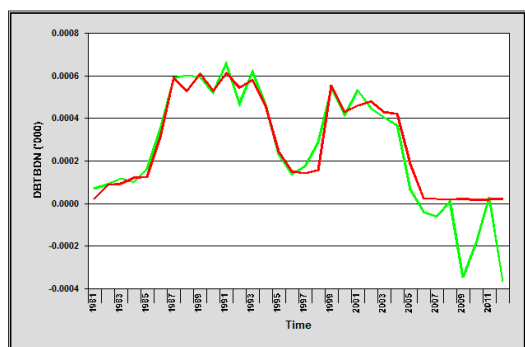
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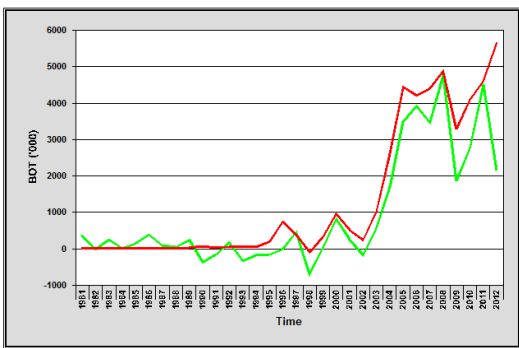
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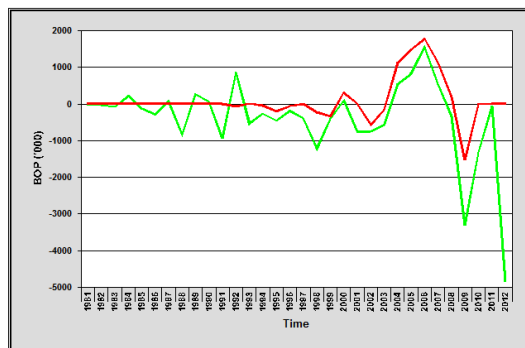
**DBTBDN CHART**



**BOT CHART**



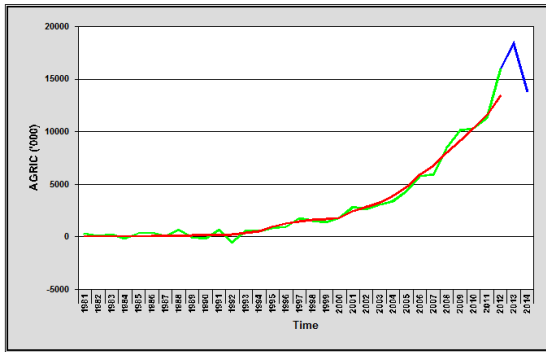
**BOP CHART**



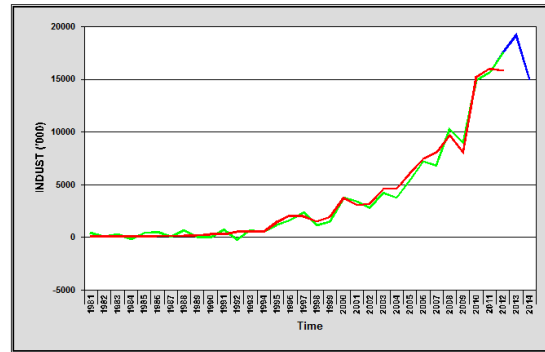
APPENDIX III:

EXPOST FORECAST OF THE NIGERIAN ECONOMY

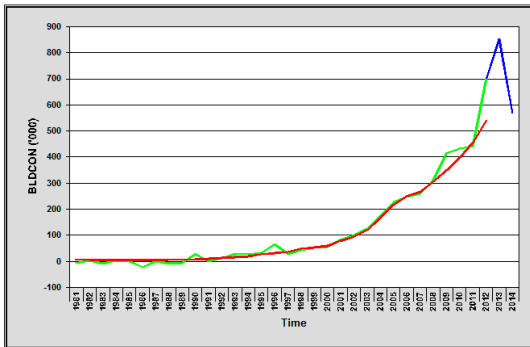
AGRIC CHART



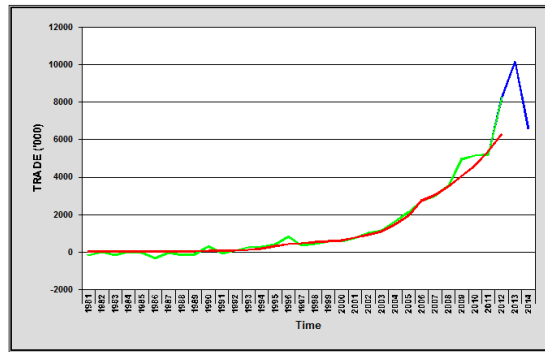
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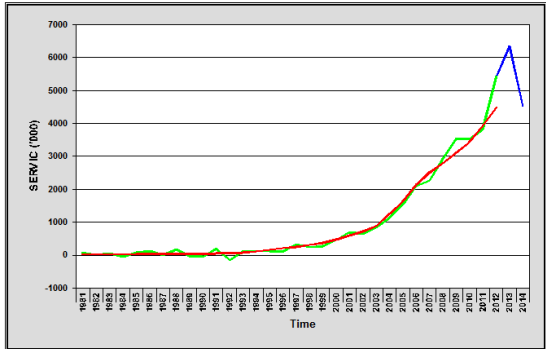
BLDCON CHART



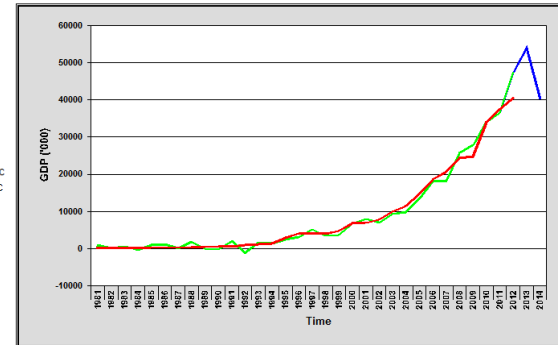
TRADE CHART



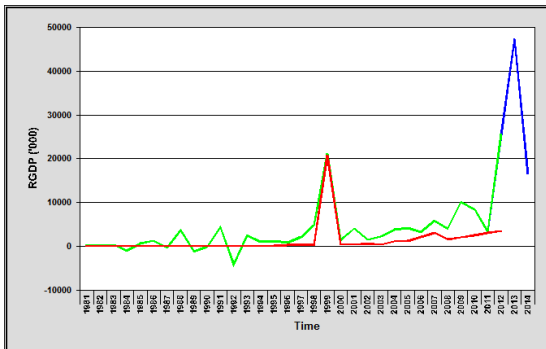
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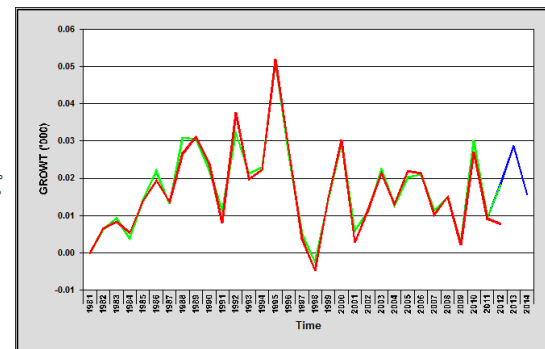
GDP CHART



RGDP CHART

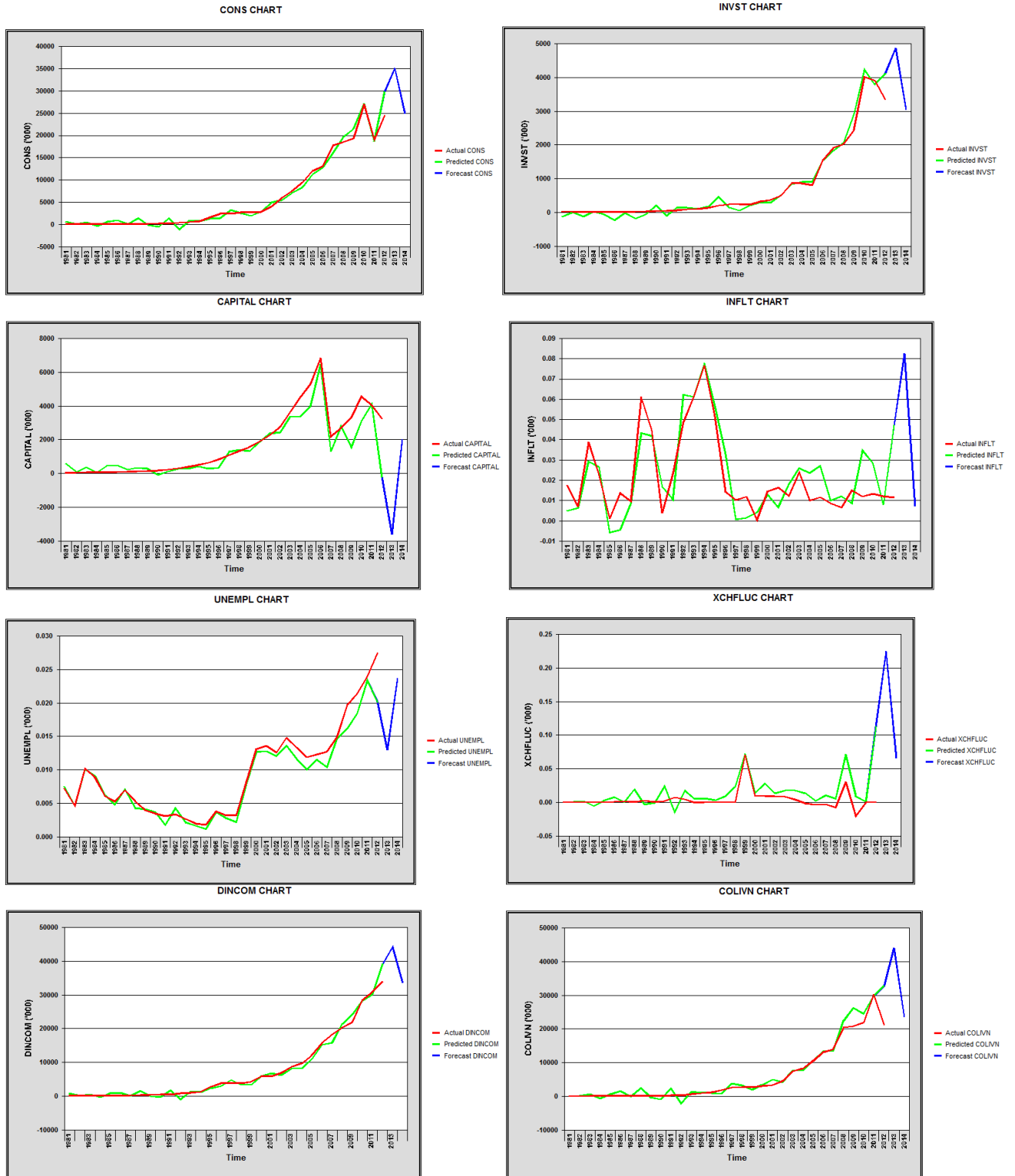


GROWT CHART

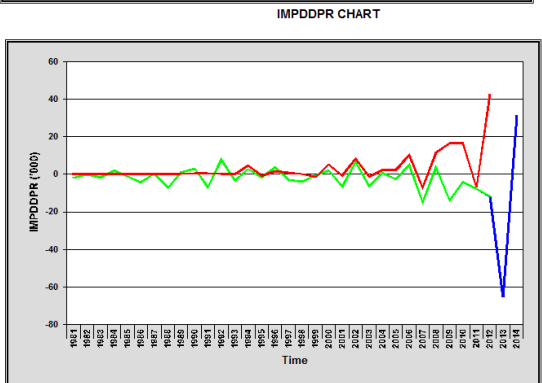
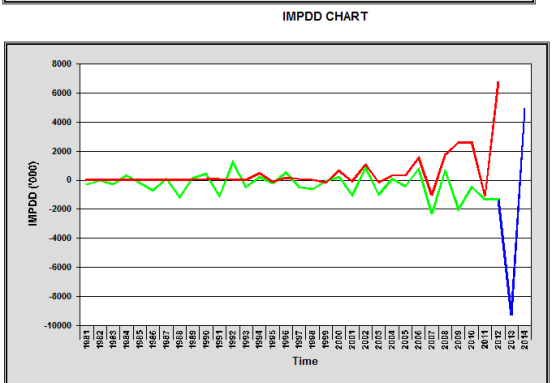
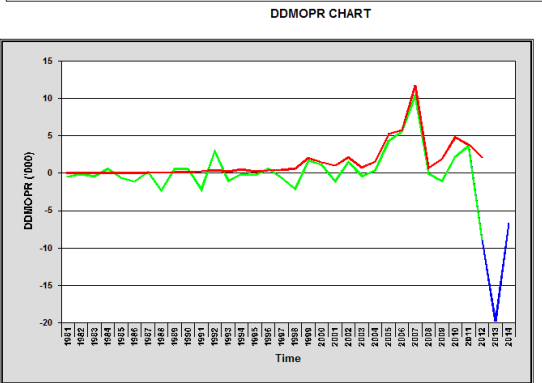
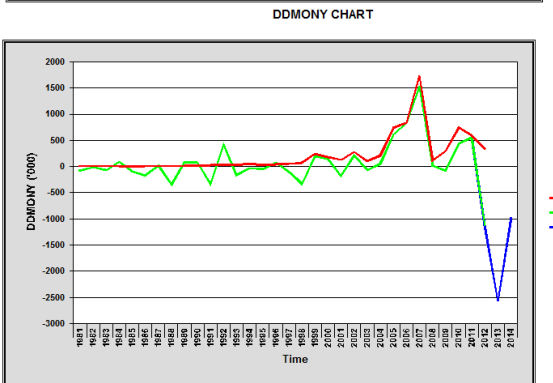
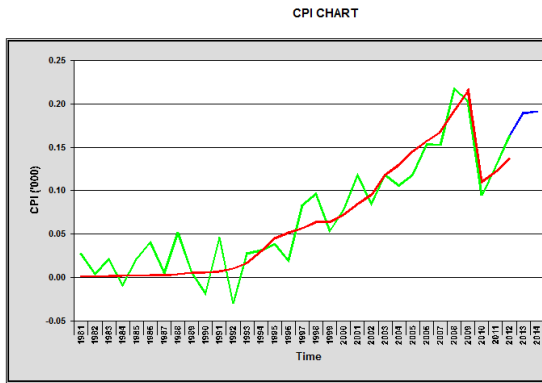
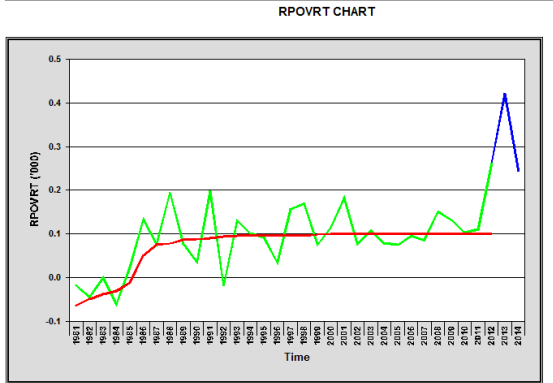
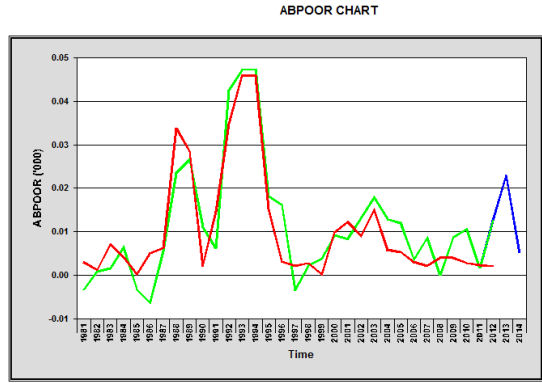
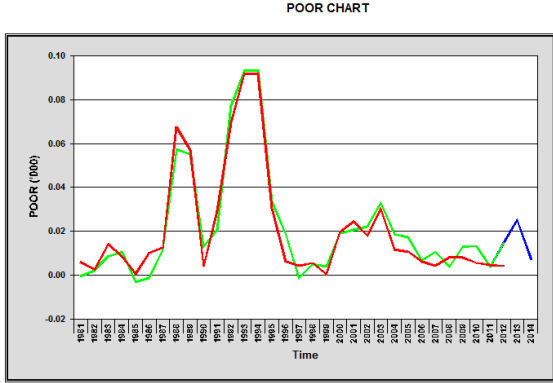




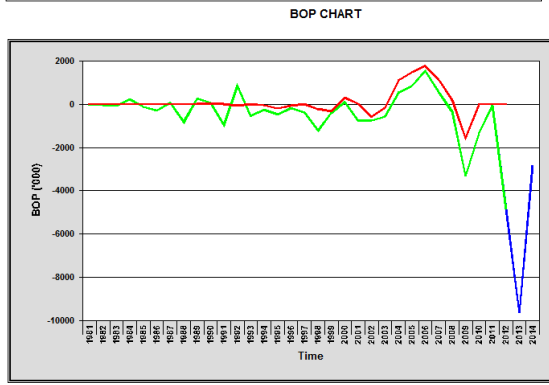
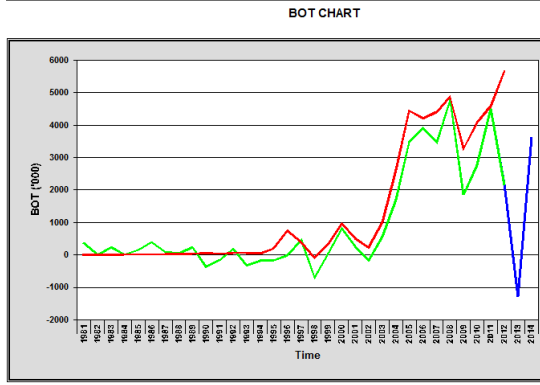
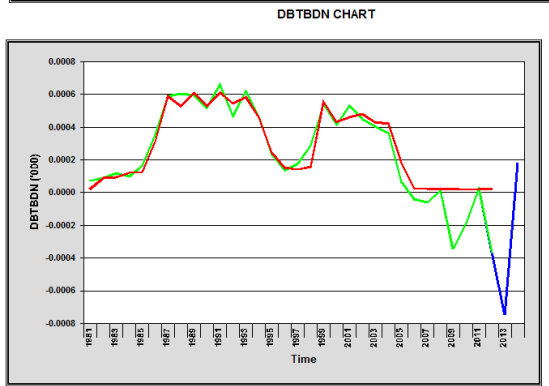
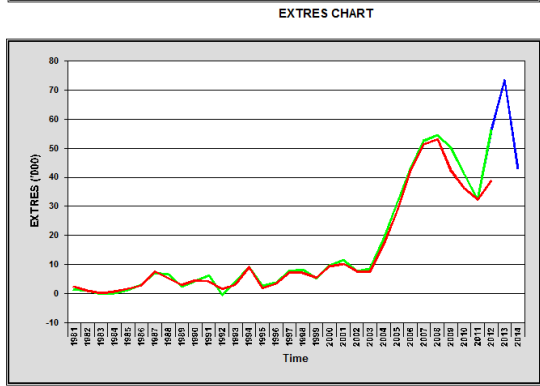
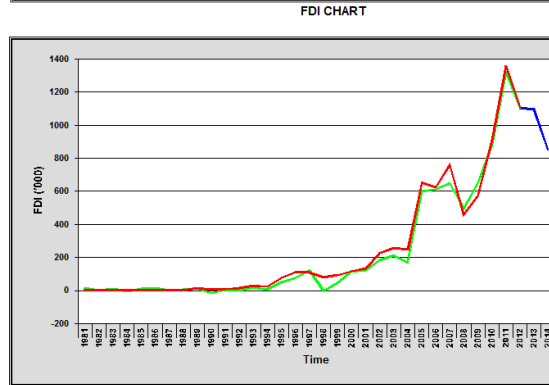
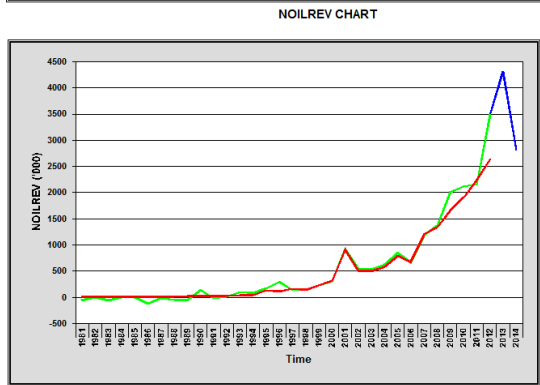
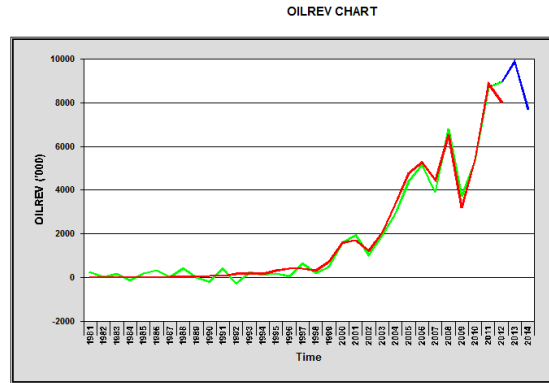
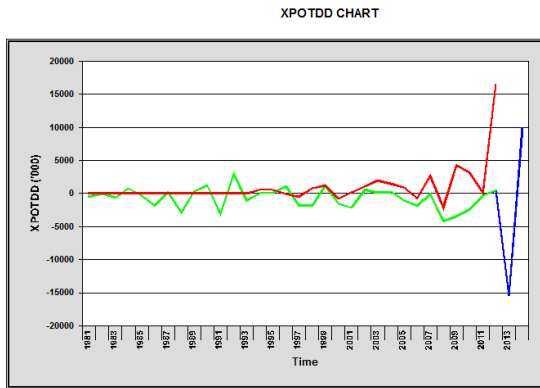
# APPENDIX III CONTD: EXPOST FORECAST OF THE NIGERIAN ECONOMY



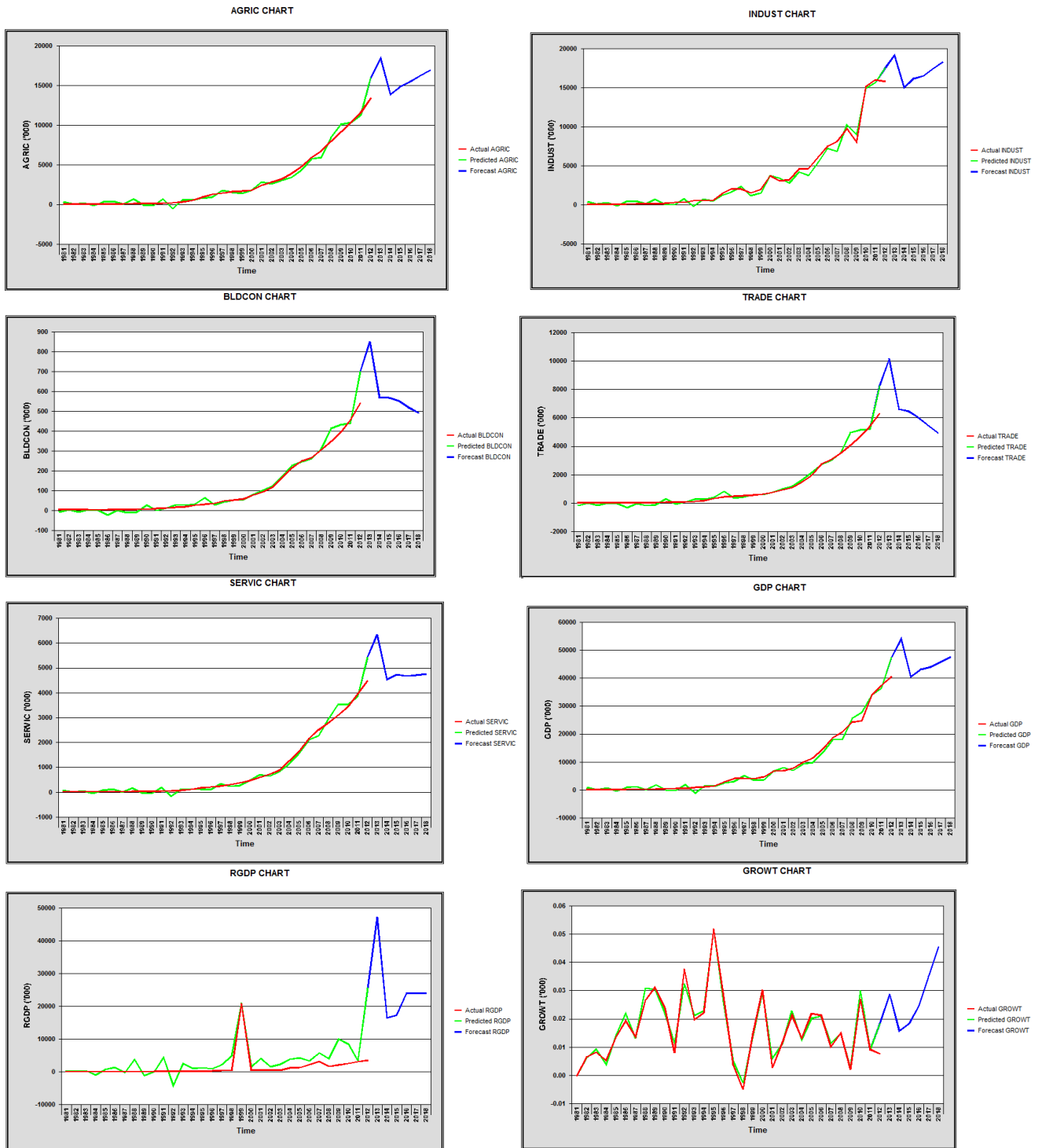
# APPENDIX III CONTD: EXPOST FORECAST OF THE NIGERIAN ECONOMY



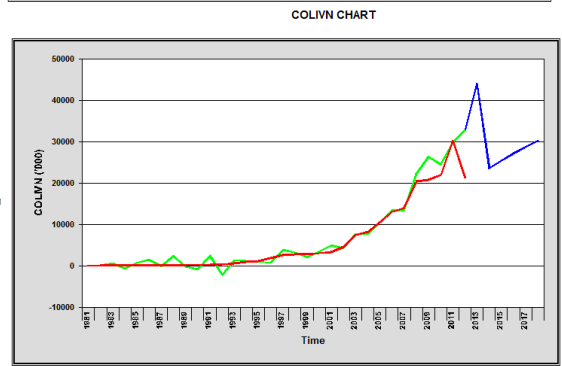
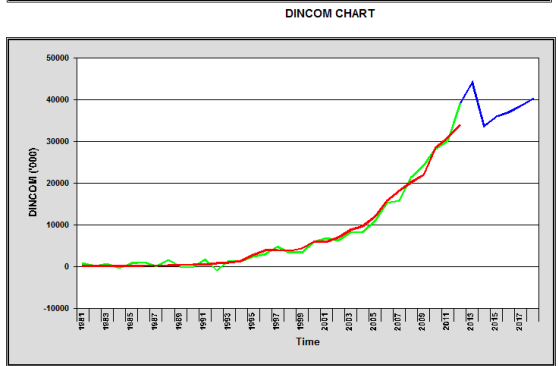
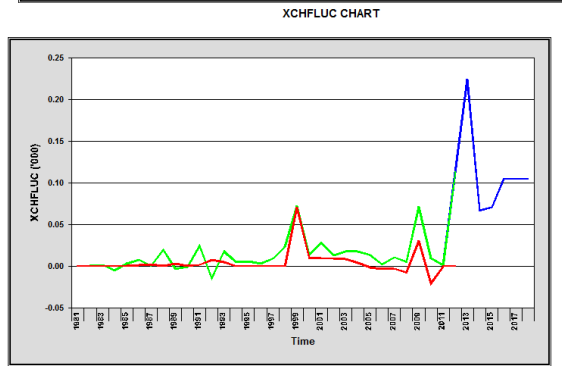
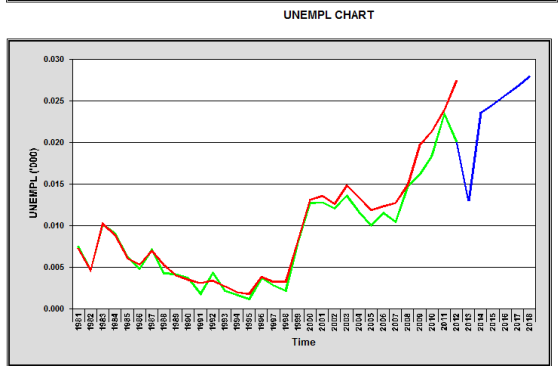
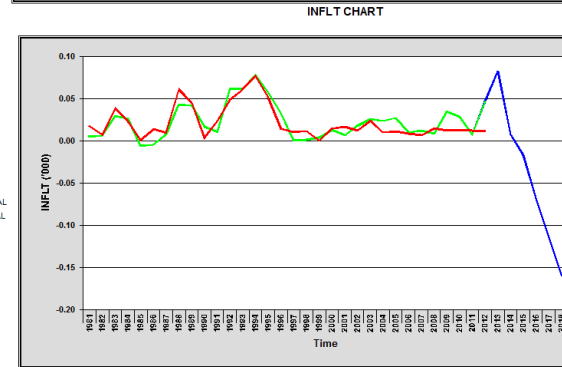
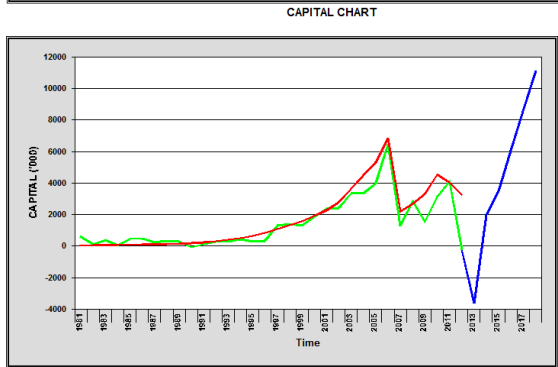
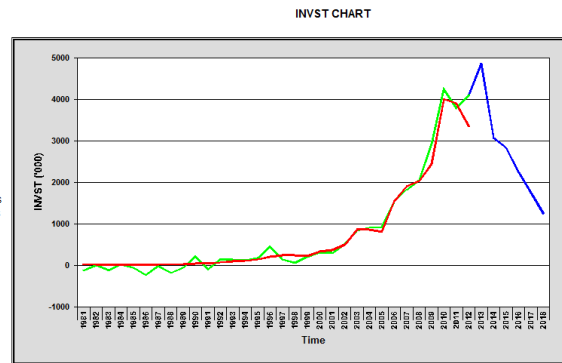
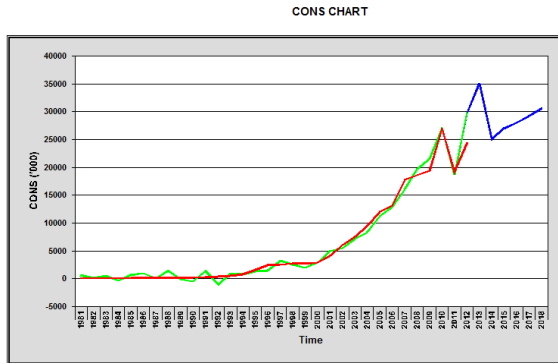
# APPENDIX III CONTD: EXPOST FORECAST OF THE NIGERIAN ECONOMY



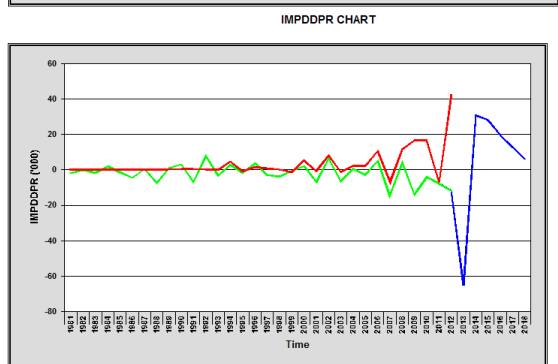
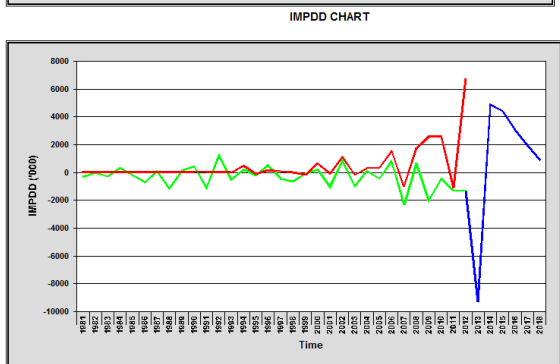
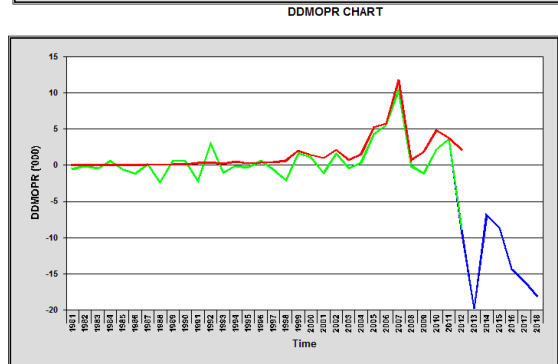
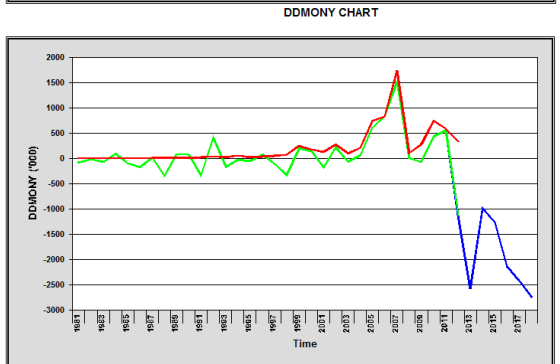
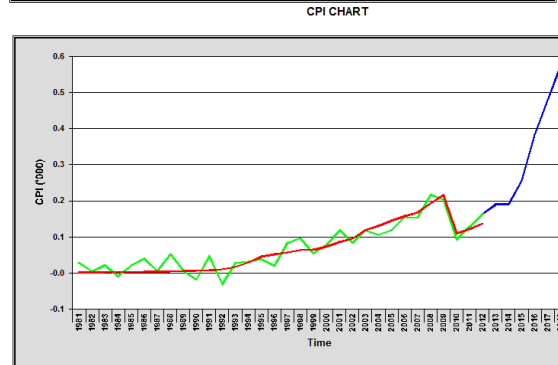
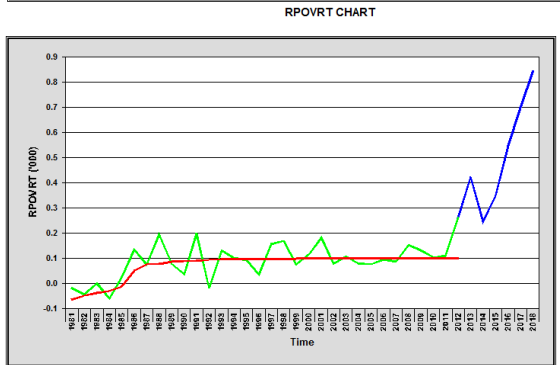
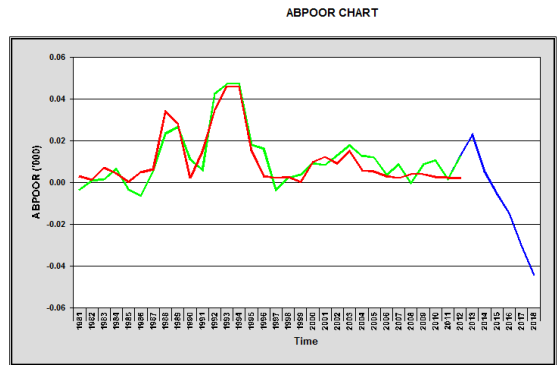
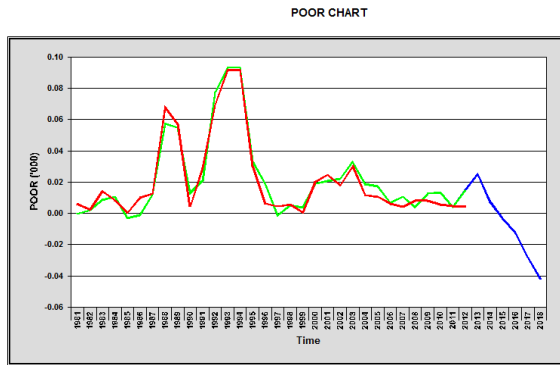
# APPENDIX IV: EXANTE FORECAST/CONTROL OF THE NIGERIAN ECONOMY



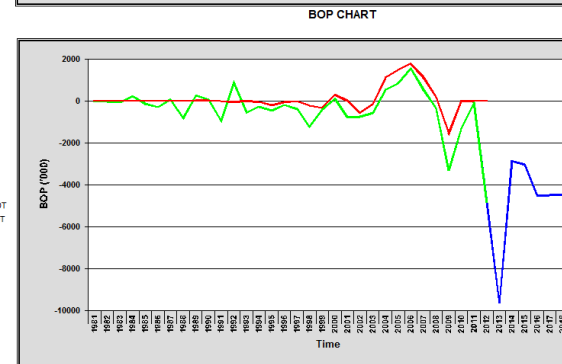
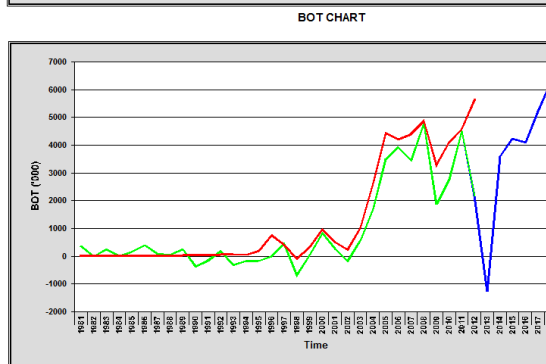
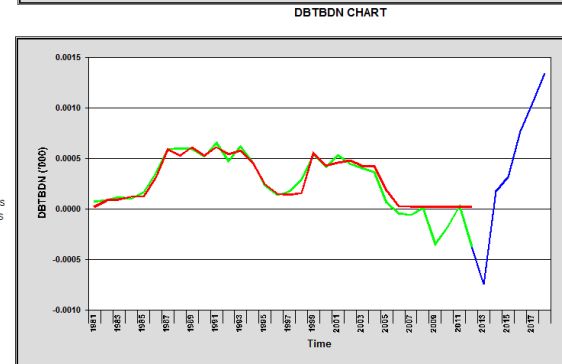
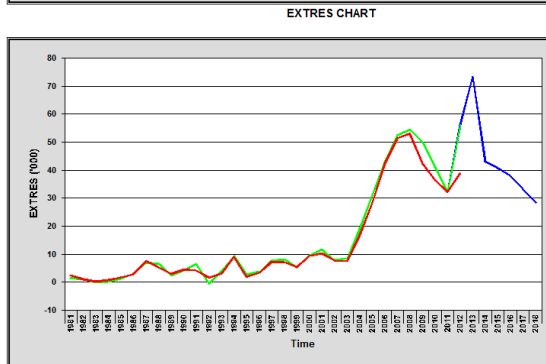
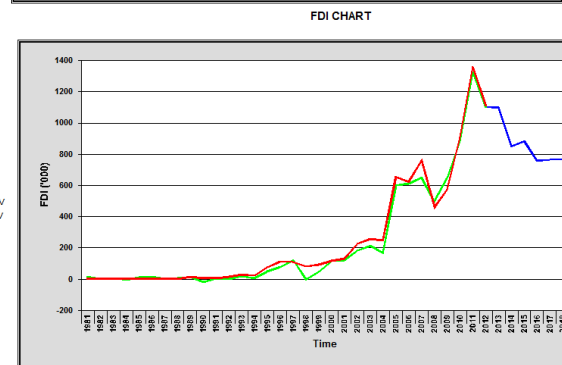
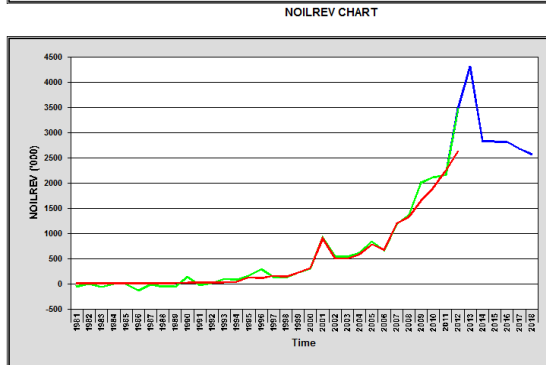
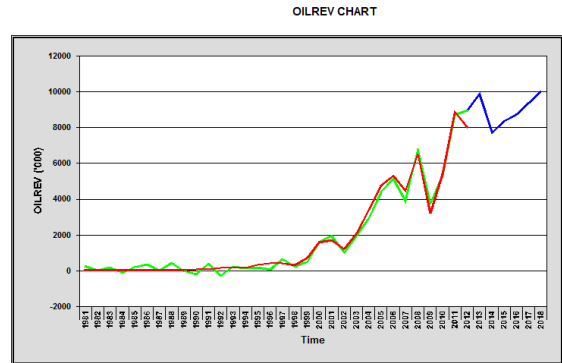
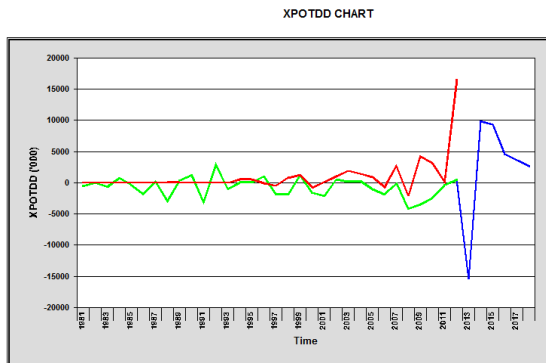
# APPENDIX IV CONTD: EXANTE FORECAST/CONTROL OF THE NIGERIAN ECONOMY



# APPENDIX IV CONTD: EXANTE FORECAST/CONTROL OF THE NIGERIAN ECONOMY



# APPENDIX IV CONTD: EXANTE FORECAST/CONTROL OF THE NIGERIAN ECONOMY



# APPENDIX V: TYPICAL LINEAR PROGRAMMING PROBLEM FOR 2018

	GEXPODI	TAX(t)	PRIMEL	INTSAV	M1(t)	M2(t)	EXTDB	EXCHR	XPORT	XPOTDI	XPTNOI	IMPOR	POP(t)	OILPRC	USGDP	AGRIC	INDUST	BLDCOI	TRADE	SERVIC	GD
AGRIC	-0.1787	-0.0415	63570	-9811.9	-0.0439	-0.0483	10.254	-1408.7	0.1345	-0.0988	0.012	0.1037	-854.03	-1593	-10.327	-1	0	0	0	0	0
INDUST	-0.2514	-0.0464	61132	3138.2	-0.0773	-0.0648	16.417	-3301.3	0.1111	-0.1676	0.0171	0.0802	-3206	-13378	-28.492	0	-1	0	0	0	0
BLDCOI	-0.0027	-0.0013	-357.41	-4565.3	-0.0015	-0.0017	-0.4844	-68.599	0.0076	-0.0032	0.0064	0.0064	-215.9	-200.14	-15.349	0	0	-1	0	0	0
TRADE	-0.0343	-0.0106	-6142.3	-53912	-0.0112	-0.0164	-8.8462	-1323.3	0.0946	-0.0427	0.0884	0.0829	-2941.4	-2083.8	-20.357	0	0	0	-1	0	0
SERVIC	-0.0625	-0.0107	17293	-441.26	-0.0108	-0.0125	0.474	-1073.4	0.0497	-0.041	0.0232	0.0414	-1356.6	-3256.1	-9.5234	0	0	0	0	0	-1
GDP	-0.5866	-0.1086	169908	-12149	-0.1451	-0.1438	27.784	-7321.7	0.3788	-0.366	0.1005	0.2978	-7116.5	-33359	-60.518	0	0	0	0	0	0
RGDP	0.2539	0.5115	394573	-348614	0.4807	0.0151	-64.611	27802	0.8903	-0.1373	0.7034	0.8142	63876	-15601	425.32	0	0	0	0	0	0
GROWT	1E-06	-4E-07	0.439	-0.1846	-4E-07	-2E-07	0.0001	-0.0011	5E-07	4E-07	3E-07	3E-07	-0.0317	0.0466	-0.0002	0	0	0	0	0	0
CONS	-0.334	-0.0896	131136	14982	-0.0721	-0.0875	17.826	-3754.3	0.2892	-0.2488	0.0807	0.2201	-2817.8	-24336	-26.899	0	0	0	0	0	0
INVST	-0.0308	-0.0086	-1192	-28119	-0.0087	-0.0077	-6.901	-1568.6	0.041	-0.0465	0.0537	0.0384	-28515	-887.62	-20.066	0	0	0	0	0	0
CAPITA	-0.0066	-0.1108	9702.2	52166	-0.1193	-0.0484	47.175	3399.2	-0.1393	0.0312	-0.142	-0.1722	-1845	-4120.7	-21.984	0	0	0	0	0	0
INFLT	-7E-08	1E-07	-1.3743	-1.4076	1E-07	-1E-07	-0.0007	-0.1031	2E-06	-1E-06	2E-06	2E-06	-0.0554	0.0173	-0.0004	0	0	0	0	0	0
UNEMP	-6E-07	-3E-07	-0.0908	0.0487	-3E-07	-7E-09	5E-05	0.0012	-3E-07	-8E-09	-7E-07	-2E-07	-0.0304	-0.0036	-0.0002	0	0	0	0	0	0
XCHFLU	1E-06	3E-06	2.0217	-1.7862	2E-06	8E-08	-0.0003	0.1424	5E-06	-7E-07	4E-06	0.3273	0.0799	0.0022	0	0	0	0	0	0	0
DINCOM	-0.4837	-0.1123	144673	-6164.9	-0.1293	-0.1248	26.398	-5599.3	0.2969	-0.3014	0.0273	0.2261	-4646	-28797	-43.586	0	0	0	0	0	0
COLIVN	-0.245	-0.1178	227314	-23024	0.1336	-0.035	7.2247	-2318.8	0.5178	-0.3762	0.6941	0.4754	7245.9	-21345	35.516	0	0	0	0	0	0
POOR	1E-06	4E-08	-0.7722	-1.1991	9E-09	2E-09	-0.0002	0.0033	4E-07	3E-07	1E-06	4E-07	-0.0327	0.0639	-0.0002	0	0	0	0	0	0
ABPOD	1E-06	-4E-08	-0.7722	-1.1991	9E-09	2E-09	-0.0002	0.0033	4E-07	3E-07	1E-06	4E-07	-0.0327	0.0639	-0.0002	0	0	0	0	0	0
RPOVR	6E-06	4E-06	10.836	0.1539	4E-06	-4E-06	0.0013	0.4148	7E-06	6E-07	3E-06	4E-06	1.0527	-0.6851	0.0063	0	0	0	0	0	0
CPI	1E-06	-8E-07	4.1001	1.1732	4E-07	-1E-06	0.0012	0.2718	1E-06	3E-07	-2E-06	-6E-07	0.4289	-0.2923	0.0025	0	0	0	0	0	0
DDMDM	-0.0155	-0.0291	-34882	20424	-0.0256	0.0044	0.0773	-2544.5	-0.0586	-0.0346	-0.0397	-0.0398	-4909	1833.2	-31.889	0	0	0	0	0	0
DDMDF	-0.0001	-0.0002	-238.34	141.75	-0.0002	2E-05	0.0039	-16.789	-0.0004	-0.0002	-0.0003	-0.0004	-32.99	12.152	-0.2147	0	0	0	0	0	0
IMDD	-0.1446	-0.2485	-112603	30416	-0.2452	-0.0718	-1.8246	-181.16	-0.3138	0.2193	-0.8207	-0.3365	-11357	306.93	-74.83	0	0	0	0	0	0
IMDDF	-0.0009	-0.0016	-715.29	196.86	-0.0016	-0.0005	-0.0082	-0.1918	-0.002	0.0014	-0.0053	-0.0026	-70.968	1.4545	-0.4688	0	0	0	0	0	0
XPOTDI	-0.3396	-0.4541	-274726	34357	-0.4799	-0.1204	26.196	-14396	-0.6167	0.2047	-15134	-0.5731	-27757	3277.5	-176.95	0	0	0	0	0	0
OILREV	-0.1145	-0.0133	38833	12860	-0.0364	-0.0353	10.773	-1284.4	0.0597	-0.0802	0.0327	0.0343	-1355.5	-5392.1	-10.799	0	0	0	0	0	0
NOILRE	-0.0123	-0.0034	-422.3	-25020	-0.0044	-0.0073	-2.109	-169.11	0.0399	-0.0166	0.0341	0.036	-806.36	-1073.2	-6.0278	0	0	0	0	0	0
FDI	-0.0208	-0.0043	649.63	3516.8	-0.0072	-0.0036	0.7827	-682.09	0.003	-0.0211	0.0071	0.0036	-873.22	-631.74	-6.0669	0	0	0	0	0	0
EXTRES	0.0003	2E-05	166.47	-157.17	0.0003	-5E-05	-0.1146	0.0859	0.0008	-0.0005	0.0012	0.0005	3.3846	-6.4473	0.0147	0	0	0	0	0	0
DBTBD	2E-08	-2E-08	0.0074	-0.0056	-2E-08	-1E-08	4E-06	0.0014	-2E-08	3E-08	-6E-08	-2E-08	0.0003	8E-05	6E-07	0	0	0	0	0	0
BOT	-0.1187	-0.1043	-10127	100904	-0.1051	-0.0243	26.581	-3771.9	-0.1292	-0.0097	-0.166	-0.1393	-10330	-1746.8	-68.354	0	0	0	0	0	0
BOP	-0.0574	-0.113	-87167	77014	-0.1062	-0.0033	14.273	-6141.8	-0.1967	0.0303	-0.1554	-0.1799	-14111	3446.5	-93.96	0	0	0	0	0	0
AGRICE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
INDUST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
BLDCOI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
TRADE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
SERVIC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
DINCOM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
XPOTDI	0	0	0	0	0	0	0	0	1	-1	-1	0	0	0	0	0	0	0	0	0	0
OILPC	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
POPC	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
USYC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
GDPC1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1
GDPC2	-1	0	0	0	0	0	0	0	-1	0	0	1	0	0	0	0	0	0	0	0	0
INTC	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
INTC	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DINCOM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.2539	0.5115	394573	-348614	0.4807	0.0151	-64.611	27802	0.8903	-0.1373	0.7034	0.8142	63876	-15601	425.32	0	0	0	0	0	0



# **CURRICULUM VITAE**

**Full Name:** Prof. Rex Oforitse K. ARUOFOR

**Date and Place of Birth:** 28 April, 1945, Sapele.

**State of Origin:** Delta State.

**Nationality:** Nigerian

**Marital Status:** Married

**Number and Ages of Children:** Two, 39 years and 36 years

**Permanent Address:** No. 9 Evbuomwan Road,  
Off Etete Road by NDPC,  
GRA, Benin City,  
Edo State,  
Nigeria.

**Current Postal Address:** Department of Economics, Banking & Finance,  
Benson Idahosa University,  
P. M. B. 1100,  
Benin City, NIGERIA.

Tel: 0802-3219938

0806-0047296 ;

E-mail: [aruoforr@yahoo.com](mailto:aruoforr@yahoo.com)

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## **Educational Institutions Attended with Dates:**

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**University of California, Davis, (Hubert H. Humphrey North-South Fellowship Programme- Post Graduate Studies in Resource Economics) 1990-1991.**

**University of Ibadan, Nigeria, 1986-1990**

**University of Ibadan, Nigeria 1985-1986**

**University of Edinburgh, (Post Graduate Studies in Resource Economics) Scotland, U.K. 1976-1979**

**University of Ibadan, Nigeria, 1970-1974**

**Federal College of Forestry, Ibadan, Nigeria 1968-1969**

**Academy Grammar School Sapele, Nigeria 1961-1965**

**Council School Sapele, Nigeria 1952-1958**

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## **Academic/Professional Qualifications with dates:**

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**Certificates of Merit. (Resource Economics) University of California, Davis 1991**

**Ph.D. Resource Economics, University of Ibadan, Nigeria, 1990**

**M.Sc. Forest Economics, University of Ibadan, Nigeria 1986**

**B.Sc. Forestry, University of Ibadan, Nigeria, 1974**

**(Second Class Upper Division plus Oxford Book Prize)**

**Diploma in Forestry, College of Forestry, Ibadan, Nigeria 1969**

**(First Class Certificate plus Book Prize in Forest Management).**

**G.C.E, Supplementary Papers, 1966**

**W.A.S.C, (Grade III) Academy Grammar School Sapele, Nigeria 1965**

**First School Leaving Certificate, Council School Sapele, Nigeria 1958**

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## **Current Employment**

**2<sup>nd</sup> May, 2003 to date**

- 
- 1. Professor, Department of Economics, Banking and Finance Faculty of Social and Management Sciences, Benson Idahosa University Benin City, from 1<sup>st</sup> October, 2012**
  - 2. Associate Professor, Department of Economics, Banking and Finance Faculty of Social and Management Sciences, Benson Idahosa University Benin City, from September 26th 2008 to 1<sup>st</sup> October, 2012.**
  - 3. Head of Department of Economics, Banking & Finance, 9<sup>th</sup> September, 2013 to 29<sup>th</sup> February, 2016.**
  - 4. Specialty: Resource Economics, Development Planning, Quantitative Methods, Econometrics, Operations Research and Statistics.**
  - 5. Lecturer in:**
    - i. Econometrics**
    - ii. Applied Econometrics**
    - iii. Project Evaluation (Undergraduate & Post Graduate)**
    - iv. Research Method (Undergraduate & Post Graduate)**
    - v. Statistics**
    - vi. Quantitative Techniques (Post Graduate).**
    - vii. Mathematics for Economics (Post Graduate)**
  - 6. Senior Lecturer, Department of Economics, Banking & Finance 02/05/2003 to**

2008.

7. Ag Head of Department of Economics, Banking & Finance 2003 to 2008
  8. Member of BIU Senate, 2003 to 2008
  9. Member of BIU Senate, 2013 to date.
  10. Ag. Dean of Students, from 7<sup>th</sup> July, 2004 to October, 2005.
  11. Member of BIU Management Committee, 2003/2004, 2004/2005 Sessions.
  12. Coordinator: Oral Robert University, M. Sc. Degree Programme in Christian Education. 2003 to 2005
  - 7 Chairman: BIU Consultancy Management Committee. 2003 to 2004
  - 8 Chairman: Library and Routine Publications Committee 2003 to 2004
  - 9 Chairman: Academic and Ceremonial Gowns Sub- Committee. 2004
  - 10 Member: BIU Tenders Board 2004 to 2010
  - 11 Member, Inter Faculty and Inter Departmental Transfer Committee, BIU. 2007 to 2013.
  - 12 Facilitator: Strategic Planning Committee 2003 to 2010
  - 13 V.C's representative, Appointments and Promotions Sub-Committee, Faculty of Basic & Applied Sciences, BIU. 2006 to 2012
  - 14 Board Member: School of Basic Studies, BIU. 2010 to 2011.
  - 15 Member of BIU Postgraduate Board of Studies, 2011 to 2012.
  - 16 Postgraduate Coordinator, Faculty of Social and Management Sciences, BIU. 2010 to 2012.
  - 17 Chairman: BIU Car Loans Committee, 2009 to 2014.
  - 18 Chairman: BIU Ceremonials Committee, 2013 to 2015.
  - 19 Researcher in,
    - a. Development Planning
    - b. Quantitative Techniques
    - c. Poverty, Equity and Debt
    - d. Deforestation
- 

## **Previous Employment and Career Progression 1967 - 2002**

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- 20 Assistant Director of Forestry (Head Forest Sector Planning Unit) Federal Department of Forestry, Headquarters, Abuja, Nigeria, 2001-2002
- 21 Nigeria's Focal Point for Forestry Outlook Study for Africa, 2000-2001
- 22 Member, National Forest Policy Review Committee, 2001
- 23 Chief Forest Officer, (Projects and Budgets) 1993-2001
- 24 Statistical Correspondent and Liaison Officer to ATO and FAO, 1991-2002
- 25 Monitoring and Evaluation Specialist (World Bank Forestry Project), 1987-1990
- 26 Assistant Chief Forest Officer 1985-1993
- 27 Principal Forest Officer, 1983-1985
- 28 Forestry Sector Planning Officer, World Bank Afforestation Project, 1977-1986
- 29 Senior Forest Officer, 1980-1983
- 30 Forest Officer Grade I, 1978-1980
- 31 Assistant Conservator of Forests, 1975

## **Computer Literacy**

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Literate in the use of Computer and Application packages e.g. Microsoft Word and Excel, Corel Word Perfect, Lotus 123 Smart Suit, GAMS, DBASE IV, SPSS, E-Views, Micro fit, ESM-lab 4.0, among others. Good understanding of Disk and Windows Operating Systems and familiar with both micro and mainframe computers

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## **Overseas Training Fellowship**

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- 1982 Ivory Coast: Study tour of internationally assisted forest projects. IBRD sponsored. (31st Jan. - 5th Feb.) 1982.**
- 1982 Washington D.C.: Course in Agricultural Projects Planning and Analysis. USDA Workshop (7th Sept. - 12th Nov.) 1982.**
- 1989 Malawi: International Seminar on Forestry Statistics in Africa. FAO sponsored (12th - 25th Nov.) Blantyre 1989.**
- 1991 Washington D.C.: International Finance IMF/IBRD Workshop (23rd - 28th March) 1991. IIE Sponsored.**
- 1991 California: Integrated Technology and Public Policy. Workshop by Toxic Substances Research and Teaching Programme. UCD (31st May - 2nd June) 1991.**
- 1991 Minnesota: Global Challenges/Local Solutions: Poverty, Equity and Debt.**

**Summer Workshop, Hubert H. Humphrey Institute of Public Affairs, University Minnesota (24th - 30th June) Minneapolis 1991. IIE Sponsored.**

**1992 Bangui: Statistical Correspondence Workshop. International Workshop by ATO in Central African Republic (10th - 18th March) 1992.**

**1995 Oxford: Making Forest Policy Work. International Seminar and Course work at Oxford Forestry Institute, U.K. British Council sponsored (3rd - 28th July) 1995.**

**1998 Libreville: Workshop on Principles, Criteria and Indicators for sustainable management of natural forests in Gabon (ATO) on Green Label Issue and Timber Certification (26th - 30th April) 1998.**

**1999 Cote d'Ivoire Workshop on Data Collection and Analysis for Sustainable Forest Management in ACP countries (13th - 17th December) 1999. FAO Sponsored.**

**2001 Thies/Dakar, Senegal: Focal Points meeting – Forestry Outlook Study for Africa Senegal November 7 – 10, 2001. FAO Sponsored.**

**2001 Addis-Ababa: Final Technical Review Meeting – Forestry Outlook Study for Africa Ethiopia 17th – 19th September 2001. FAO Sponsored.**

**2002 Ghana: Study Tour to Ghana on the Review of National Forest Policy for Nigeria. 8<sup>th</sup> – 16<sup>th</sup> July, 2002. FGN Sponsored.**

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## **Membership of Societies and Professional Associations**

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**1. Member: Forestry Association of Nigeria 1975**

- 2. Member: Society of American Foresters 1982**
- 3. Hubert H. Humphrey Fellow 1991**
- 4. Member: Economic Society of Nigeria 2012**

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Extra Curricular Activities: Football, Squash Racket, Lawn Tennis, Table  
Tennis, Music and Reading.

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## **Referees:**

---

**Prof. J. O. Oyedeji,**

**Ex-Interim Vice Chancellor**

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**Professor Eghosa Osagie**

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**Professor Andrew Oronsaye**

**Ex-Dean Faculty of Social and Management Sciences**

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**GSM: 0802-3397401**

I certify that these statements are true and complete to the best of my knowledge.

**Signed: Rex Oforitse Aruofor.....**



## **PUBLISHED WORKS (IN PRINT)**

1. **Aruofor, R. O. (1997): A linear Programming Model of the Forest Sector of the Nigerian Economy. Discovery and Innovation Vol 9(3) pp 227-234, African Academy of Sciences, Kenya, 1997.**
  
2. **Aruofor, R. O. (2003): A Presentation of Two Simulated Approaches to Markov Chains Transition Matrix Estimation from Aggregate Data. The Nigerian Economic and Financial Review, Vol. 8 No. 2 pp 51-76,: Department of Economics and Statistics, University of Benin, December, 2003.**
  
3. **Aruofor, R. O. (2004): Planning and Management of the Nigerian Economy through Ecosatometric Analysis: A**

**Retrospect. BIU Journal of Social and Management Sciences, Vol 2, No. 1 pp1-28,: Benson Idahosa University, Benin City, June 2004.**

- 4. Aruofor, R. O. (2005): Poverty Alleviation and Education: A need to Combact the Human factor. Journal of Management and Enterprise Development, Vol 2, No. 1 pp 47-54, : International Research and Development Institute, Nigeria.**
  
- 5. Aruofor, R. O. (2006): Demand and Supply Theory, Statistical Estimation and the Identification Problem Revisited. Journal of Management and Enterprise Development. Vol 3, No. 2 pp 54-63,: International Research and Development Institute, Nigeria.**

6. **Aruofor, R. O. and Isimekhai, O. Z (2006): Global Integration and its Impact on the growth of Nigeria's Non-Oil Exports. The Nigerian Journal of Politics and Public Policy (NJPPP), Vol 4 No. 1, 2, 3, 4, 5, & 6 pp 34-49. Department of Political Science and Public Administration, University of Benin, Benin City, Nigeria.**
  
7. **Aruofor, R. O. and Erhi, M (2007): A Sensitivity Analysis of Poverty Minimization in Relation to Trade, Growth and Environmental Pressure: The Nigerian Case-Study. International Journal of Communication, No. 6, pp 58-74 May 2007. University of Nigeria, Nsukka).**
  
8. **Aruofor, R. O. (2007a): Poverty Reduction Strategy, of the National Economic Empowerment and Development Strategy (Needs): Requirements and Impact Assessment. Journal of Management and Enterprise Development. Vol 4, No. 4 pp10-**

18,; International Research and Development Institute, Nigeria.

9. Aruofor, R. O. (2007b): An Appraisal of the Existing Measurements of Poverty and the Evolution of a Formula for Measuring Real Poverty. The Indian Journal of Economics No. 347 Part 4 Vol. LXXXVII, pp 523-536 April 2007.
10. Aruofor, R. O. (2007c): Empirical Evaluation of Governance in Nigeria in Relation to Poverty, Growth and Development. Nigerian Journal of Economic and Social Studies, Volume 49 No.3, pp 381-400. University of Ibadan.
11. Aruofor, R. O. (2009): An Analysis of the Impact and Sensitivity of Minimizing Deforestation Pressure: a Case Study of the Nigerian Economy. International

**Journal of Social Science, Vol. 1 No. 1, pp 116-127. Pan-African Journal Series, Ghana.**

12. **Aruofor, R. O. (2009): Analysis of Health Care Effectiveness using Markov Chains; An Outlook to Year 2020: The Nigerian Case. Nigerian Journal of Economic and Social Studies, Volume 51 No.2, pp 141-159 University of Ibadan.**
  
- 13 **Aruofor, R. O. (2014): Construction of Input-Output Table from Aggregate National Accounts Data: The Input-Output Analysis Revisited. West African Social and Management Sciences Review (WASMSR) Vol 5 No. 1, pp 1-14.**
  
14. **Aruofor, R. O. (1990): Forestry Sector Statistics in Africa: Federal Republic of Nigeria. Report on Seminar on Forestry Statistics in African, Blantyre Malawi, November, 1989. Food and Agriculture**

**Organisation of the United Nations, Rome, 1990. pp133-139.**

- 15. Aruofor, R. , Bertin, E., Mustafa, E., Miguel, F., Harun, K., Mahendra, L., Ahmed, M. Domitien, N., Sakis, P., Robert, S., Alvaro, S., and Sekou, S (1991): Education and Rural Poverty. Summer Workshop, Hubert H. Humphrey Institute of Public Affairs, University of Minnesota. Funded by United States Information Agency and Administered by the Institute for International Education, USA, 1991. pp 99-108.**
  
- 16. Aruofor R. O. (2000a): Review and Improvement of Data Related to Wood Products in Nigeria. EC-FAO Partnership Programme (1998-2001) Tropical Forestry Budget Line B7-6201/97-15/VIII/FOR. FAO Rome August 2000.**

**17. Aruofor R. O. (2000b): Forestry Outlook Study for Africa (FOSA):The Nigerian Country Outlook Paper.**

**[www.fao.org/DOCREP/004/AB592E/Ab592E02.htm](http://www.fao.org/DOCREP/004/AB592E/Ab592E02.htm)**

**FAO Corporate Document Repository. FDF Abuja/FAO Rome August, 2000.**

**18. Aruofor, R. O. (1984a): An Appraisal of the Pulpwood Plantation Programmes in Nigeria and the Determination of Tariff and Profitability for Gmelina arborea Pulpwood and Sawlog. Published by Forestry Projects Monitoring and Evaluation Unit (FORMECU), World Bank Forestry II Project, Ibadan, Nigeria, 1984.**

**19. Khalique-Ur-Rehman and Aruofor, R. O. (1982): Nigerian Forestry Statistics FOR/EU/STAT/PUB. No. 1 Forestry Projects Monitoring and Evaluation Unit (FORMEU), World Bank Forestry I Project, Ibadan, Nigeria August, 1982.**

## **UNPUBLISHED WORKS**

### **RESEARCH COMPLETED BUT NOT YET PUBLISHED.**

20. **Aruofor, R. O. (2011): Deficit Financing, Savings, Debt and Foreign Direct Investment: An Evaluation of the Impact on Capital Formation, Employment and Development: The Nigerian Case. Submitted to Ahmadu Bello University.**
  
21. **Aruofor, R. O. (2011): The Theory of Demand and Supply Revisited: The Total Differential Approach. Submitted to The Indian Journal of Economics**
  
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