# Structural Change and Real Output Growth in Nigeria: A Cointegration Analysis

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***Abstract***

*The study employed the Johansen (1988) and the Johansen and Juselius (1990) multivariate maximum likelihood method within a Vector Autoregressive framework to explore the impact of structural reforms on the level of real output in Nigeria. We fit the equation separately for two sub-samples, the pre-reform and the market-reform periods, to enable comparisons of the outcomes under alternative policy regimes. We further estimate the model using data that covered the entire sample period to evaluate the total effects and include a dummy variable to capture the impact of the policy shift. The Johansen cointegration test confirms the existence of long-run equilibrium relationships among the variables. Various diagnostic tests conducted confirmed the robustness of the results. The Chow Breakpoint test rejected the null hypothesis, which states that the real output function remained the same before and after structural reforms. The results of our parsimonious models suggest that real exchange rate, real credit to the private sector and the previous level of real output are the most consistent drivers of real income in Nigeria. The long-run Granger causality test supports that the above variables could help predict the future level of real output. Since it is evident that the price system cannot guarantee the desired moderation in interest rates, the monetary authorities need to take extra measures to reduce interest rates in different segments of the market. Government can also play complementary roles by limiting the size of budget deficits to cut down on huge domestic borrowing, which now runs into trillions of naira. This will not only improve investment but will go a long way to free additional credit for onward lending to the private sector. The present stability in the foreign exchange market also needs be sustained to forestall any further depreciation in the exchange rate. Above all, more stable sources of foreign exchange need to be urgently sought if the monetary authorities are to meet the ever increasing demand for foreign exchange to stabilise rates in the market.*

**Keywords:** Structural Reforms, Real Output, Cointegration, Error-Correction Model

**JEL Classification Numbers:** F41, F43, O42, O47

## I. Introduction

For more than two and a half decades after the adoption of structural reforms, the Nigerian economy has shown no appreciable progress. The Structural Adjustment Programme (SAP) adopted in June 1986 marked a major shift in the

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country's economic history. This altered the structure of the economy from a largely regulated or controlled to a mostly liberalised economy, with greater reliance on market forces. The above reforms were further strengthened with the implementation of a home-grown National Economic Empowerment and Development Strategy (NEEDS) in 2003, which imbibed the same *laissez-faire* principles. Despite the removal of complex administrative controls to ease distortions in the system, the nation's development objectives remain unattainable. The economy has also become more dependent on the oil sector with economic growth diverging from set targets. Though modest growths were recorded in the nominal gross domestic product (GDP) from 2003, there are no strong indications of a corresponding growth in real output.

A number of studies have attempted to establish reasons for the low performance of the economy despite the implementation of market reforms, but most of the authors hinged their arguments on theoretical underpinnings with little or no empirical support. Majority of those that volunteered empirical evidence also relied on traditional estimation techniques in drawing inferences about the implications of the deregulation policy in Nigeria. This is in addition to their use of nominal measures that do not reflect the actual achievement in production activities. Others confined their studies to specific sectors on the basis of which they came up with generalisations about the overall performance of the economy. Another major omission in the past studies is the non-recognition of the obvious reality that reforms generally have delayed effects on the level of output, and in some cases the lags can be long.

The aforementioned limitations and failure of the past studies to adequately account for the impact of the structural reforms informed our resolve in this paper to evaluate the impact of the structural change, occasioned by the adoption of the SAP, on the level of real output in Nigeria using system approaches, the Johansen (1988) and the Johansen and Juselius (1990) cointegration and error correction techniques. Our approach, however, marks a significant departure from the past in view of the segregation of the data in line with the major policy episodes; the inclusion of lag regressors in our real output model, and the estimation using modern approaches, system cointegration and error correction modeling.

The study, therefore, examined the performance of the economy in the light of the major structural changes. Have changes in the structural relationships arising from the shift to deregulation policy resulted in any significant change in the real output function? The study would afford us the opportunity to compare Nigeria's

performance under two-alternative policy regimes. It would also enable us to offer informed-policy recommendations regarding the need to either strengthen or reject the ongoing market-oriented strategies. The study was structured into six Sections. Following this introduction was Section II, which discussed the theoretical issues, including the conceptual framework and empirical literature. Section III examined the profile of Nigeria's recent reforms. In Section IV, the methodology, incorporating the estimation technique and model specifications, were provided. The data analysis and discussion of empirical results are contained in Section V. Section VI provides the concluding remarks and policy recommendations.

## II. Conceptual Framework and Empirical Literature

### II.1 Conceptual Framework

The impact of structural reforms in Nigeria could be analysed within the framework of the market mechanism, which dated back to Adam Smith. Smith argued that individuals pursuing their self-interest would be led 'as if by an invisible hand' to do things that are in the interests of society as a whole, adding that the pursuit of self-interest, without any central direction, could produce a coherent society making sensible allocative decisions (Begg, Fisher and Dornbush, 1984). The neo-classical postulations later popularised the classical doctrine of the invisible hand.

The neo-classical theory of markets and the price system dominated economic thoughts over a long period before the Great Depression of the 1930s. However, the inability of the invisible hand to function efficiently during the Great Depression made a case for government intervention in the economy. With the advent of Keynesianism, protectionist views became dominant in the 20th century and for decades majority of developing countries implemented industrialisation policies based on a very limited degree of international openness. A large number of development economists embraced the protectionist view from the 1950s through the 1970s and devoted enormous energy to design planning models that relied on import substitution ideas. Although the protectionist paradigm had gained prominence, the findings of various investigations on the implications of alternative trade regimes later revealed that open and outward-oriented economies had out-performed those pursuing protectionism. The obvious implication was that developing countries should move away from protectionist and restrictive trade practices and open up their foreign trade sector (Edwards, 1993).

The debt crisis of the early 1980s later compounded the problem as economic growth collapsed in many developing countries forcing them to embrace reforms that emphasised the reduction of trade barriers and the opening of international trade to external competition. This philosophy was also supported by the World Bank, the IMF and other multilateral institutions, which required developing countries to embark on trade liberalisation and to open up their external sector as a condition for receiving financial assistance. Michaely, Papageorgiou and Choksi (1989) saw trade liberalisation as "any change that leads a country's trade system towards neutrality in the sense of bringing its economy closer to the situation, which would prevail if there were no governmental interference".

Another essential feature of the structural reforms was the deregulation policy adopted in many developing countries. Deregulation entailed the appropriate realignment of the fiscal, monetary, trade, pricing and exchange policies to enthrone an environment that was conducive for growth. Deregulation was, thus, intended to foster competition, promote efficiency and optimise the allocation of credit and other scarce financial resources to enhance the potentials for growth and development. Deregulation was also imperative in freeing an economy from financial repression, which was a conscious distortion of financial prices by the regulatory authorities. Such interference in the financial market promoted rent-seeking behaviours misallocating financial resources and imposing substantial costs on the society (Ayadi, Adegbite and Ayadi, 2008). It was in line with the above economic thinking that the Federal Government of Nigeria embarked on the Structural Adjustment Programme (SAP) in mid-1986.

## II.2 Empirical Literature

The best strategy for enhancing economic growth remained an unsettled issue in the literature. Evidence abounds on a number of developing countries that liberalised their domestic economies but were unable to achieve sustainable growth. Arestis (2005) in a review of the relationship between financial development and economic growth found no convincing empirical evidence in support of the propositions of the financial liberalisation hypothesis. He, thus, agreed with Stiglitz (1998) that the financial liberalisation thesis was "based on an ideological commitment to an idealised conception of markets that was neither grounded in fact nor in economic theory" but one that falls under the rubric of some "innocent fraud" with a continuing divergence between conventional wisdom and reality.

Paudel and Perera (2009) found significant negative impact of financial liberalisation on economic growth of Sri Lanka in the short-run and a positive but insignificant role in the long-run. Tswamuno, Pardee and Wunnava (2007) also investigated the impact of financial liberalisation on the economic growth of South Africa and concluded that post-liberalisation foreign portfolio investments had no positive effect on economic growth. They, however, found that foreign portfolio investment and increased turnover contributed positively to economic growth in a more controlled pre-1994 South African economy. Trade liberalisation may, therefore, be considered unnecessary for successful outward-oriented strategies (Sachs, 1987). The above findings also appear to be in consonance with Taylor's (1991) declaration that "the trade liberalisation strategy is intellectually moribund", and that there are "no great benefits (plus some losses) in following open trade and capital market strategies".

Furthermore, Shaw (1973) revealed that distortions in financial prices – including interest and foreign exchange rates – reduced the real level of output and retarded the development process. Eichengreen (2001) stressed that financial liberalisation may be catastrophic for financial stability and macroeconomic performance if distortions exist. In another development, Ayadi, Adegbite and Ayadi (2008) established that financial development and economic growth had no consistent relationship in post-SAP Nigeria. This may not be surprising since financial liberalisation was not expected to produce the desired effects where domestic institutional capacities remain fragile (Bakeart, Harvey and Lundblad, 2005).

On the other hand, financial liberalisation has been found to stimulate growth in several countries. Pulling together some existing theory and evidence in the literature to reassess the impact of international financial liberalisation on economic growth, Levine (2001) found that liberalising restrictions on international portfolio flows enhances stock market liquidity, which in turn accelerates economic growth primarily by boosting productivity growth. She also found that foreign bank presence tends to enhance the efficiency of the domestic banking system which, in turn, spurs economic growth mainly by accelerating the level of productivity.

Bekaert, Harvey and Lundblad (2005) in a study of the growth impact of financial liberalisation across countries established that equity market liberalisations, on average, lead to a 1.0 per cent increase in annual real economic growth of the 50 liberalised countries covered in the study. Chaudhry (2008) discovered a significant positive impact of financial liberalisation variables on economic growth and

investment in Pakistan. Using the Johansen Cointegration tests, Banam (2010) investigated the impact of financial liberalisation on economic growth in Iran for the period 1965 to 2005. The results showed that financial intermediation, capital, research and development, and financial liberalisation have positive and statistically significant impact on economic growth. Reserve requirement ratio has a negative but statistically insignificant impact on economic growth while exports have positive but statistically insignificant impact on economic growth. The results also indicate that labour has a negative impact on economic growth, implying that the labour force in Iran was not effective in promoting economic growth, contrary to what existing theories suggest.

Bonfiglioli (2005) equally assessed the effects of international financial liberalisation and banking crises on investments and productivity in a sample of 93 countries from 1975 to 1999 and provided empirical evidence that financial liberalisation spurs the level of productivity and marginally affects capital accumulation. Both levels and growth rates of productivity were found to respond to financial liberalisation and banking crises. The study also provided evidence of conditional convergence in productivity across countries. Stiglitz and Uy (1996) also found that financial market liberalisation contributed to the rapid growth of the Asian tigers and that the respective governments only intervened to correct for market imperfections. Bakare (2011) established a long-run significant relationship between financial sector liberalisation and economic growth. The multiple regression results showed a significant negative relationship between financial sector liberalisation and economic growth in Nigeria. He, thus, advised the authorities to revisit the SAP with a view to enhancing the effectiveness and efficiency of the financial sector.

Iganiga (2010) found that the gradual increase in the capital base of firms in the financial sector rekindled public confidence and increased savings in the Nigerian financial sector, but added that interest rate deregulation resulted in high lending rates that crowded out private investment. This was antithetical to the catalytic role that the liberalisation policy was intended to achieve. Okpara (2010) demonstrated the significant sensitivity of real GDP, national savings and foreign direct investment (FDI) to the financial liberalisation policy in Nigeria. He ascertained the existence of a significant difference between the performance of real GDP, national savings and FDI before and after the introduction of financial liberalisation. The result, however, showed no significant difference between the pre-liberalisation and post-liberalisation rate of inflation and financial deepening in the country. He, thus, concluded that

financial liberalisation has no effect on financial deepening and the rate of inflation but that it positively increases the growth of GDP in Nigeria.

## III. Nigeria's Structural Reforms

Nigeria's structural reforms began with the adoption of the Structural Adjustment Programme (SAP), which was in response to the adverse developments that characterised the structural changes in the nation's economy. The country had evolved from a poor agrarian economy to a rich oil producer in the early 1970s. By 1975, oil had accounted for more than 80 per cent of government revenue and 95 per cent of foreign exchange earnings. Following the collapse of oil prices in the early 1980s, the country's economic fortunes deteriorated, imposing an unhealthy state with chronic symptoms that included balance of payment problems, galloping inflation, rising unemployment, increased poverty, mounting debt burden, and persistent budget and current account deficits.

The Economic Stabilisation Act enacted in 1982 provided stringent demand management measures but failed to address the above negative trends. Among the adopted austerity measures were: the freezing of public sector wages/salaries, the imposition of ceilings on foreign exchange disbursements, import restrictions, the freezing of capital expenditure, and increase in customs tariffs and prices of petroleum products, as well as user charges on public utilities. Restrictions were also placed on bank borrowing by the private sector and foreign borrowing by sub-national governments.

The apparent failure of the austerity measures necessitated the adoption of a broad-based SAP to restore internal and external balance. Trade liberalisation and a market-determined exchange rate system were the key policies for structural adjustment, while monetary and fiscal policies were the primary instruments of financial stabilisation. Administrative controls (including credit allocations, exchange and interest rate ceilings) were all eliminated to remove the distortions in the economy created by the illiberal policies to improve efficiency, promote investment and enhance growth. Regardless of the policy reversals that characterised the post-SAP period, the exchange and interest rate regime was generally flexible. The conduct of monetary policy improved as price developments provided market signals that were essential for monetary adjustments. The central bank influence on interest rates in different segments of the financial market was consequently enhanced. The monetary authorities became equipped to influence the level and direction of

monetary aggregates via adjustments in the central bank policy rate, the Minimum Rediscount Rate (MRR).

The perceived insensitivity of market rates to the nominal anchor rate (MRR) later necessitated a transformation of the monetary policy framework in December 2006 to reduce the volatility in inter-bank rates, facilitate inter-bank trading and enthrone a transaction rate that would better enhance the transmission of monetary policy actions (Okpara, 2010). This was complemented with the discount window operations which provided overnight accommodation for authorised dealers through the standing lending and standing deposit facilities. The applicable rates were periodically determined by the CBN in response to the prevailing monetary conditions.

Additional measures[1] were also put in place to address some of the problems plaguing the financial sector. These include: the upward review of capital adequacy standards, deregulation of the capital market, liquidation of distressed banks, strengthening of prudential regulations, enhancement of disclosure standards to reflect risk exposures in the banking system, enlargement of the powers of the Central Bank of Nigeria (CBN) towards the achievement and maintenance of monetary stability and financial soundness, enforcement of dormant laws (e.g. dud cheques), anti-money laundering and other related offences regulation, establishment of the Nigerian deposit insurance corporation (NDIC) to inspire the confidence of especially small depositors and the consolidation of the banking industry through mergers and acquisitions.

These new reforms embarked upon from 2004 were meant to enthrone a more resilient, efficient and sound financial system. The consolidation of the banking system was partly aimed at increasing the capital base of Nigerian banks to improve their lending capacity to the real sector, curtailing banks' risks to improve their resilience to systemic distress, and enhance competition to facilitate the evolution of Nigerian banks as global players. As a result, the capital base of banks rose from ₦2.0 billion in 2004 to a minimum of ₦25.0 billion at end-December, 2005, while the number of banks fell from 89 to 25 "strong banks". Stock market indices witnessed astronomical growth as public confidence in the banking system improved.

By 2008, the impact of the global financial meltdown and the inadequacies that characterised the banking consolidation exercise triggered changes that resulted in fresh crisis. A holistic investigation into what went wrong leading up to the banking crisis

1 See Iganiga (2010) for comprehensive review of the financial sector reforms in Nigeria.

in 2008 found eight interrelated factors responsible. These were macroeconomic instability caused by large and sudden capital inflows, major failures in corporate governance, lack of investor and consumer sophistication, inadequate disclosure and transparency about the financial position of banks, critical gaps in the regulatory framework and regulations, uneven supervision and enforcement, unstructured governance and management processes at the CBN/and weaknesses in the business environment. The capital flight that greeted the uncertainties surrounding the global financial crisis in conjunction with other factors led to a 70 per cent collapse of the stock market from 2008 to 2009 (Sanusi, 2012). Many banks that were unduly exposed to the capital market incurred huge losses. The central bank had to inject funds to rescue 8 of the banks to restore confidence and sanity in the banking system. This led to the removal of top executives of the affected banks and the subsequent prosecution of those culpable.

The central bank commenced another round of reforms under the "The Project Alpha Initiative" to transform the financial system, in particular the banking sector. The reforms sought to address the underlying problems, integrate the previously fragmented reforms and align them with the ultimate goal of achieving a sustainable inflationary growth. Apart from enhancing banks' capital base, the new initiative aimed at strengthening the regulatory function of the CBN through the adoption of risk-focused and rule-based regulatory framework; a zero tolerance in regulatory framework in data/information rendition/reporting and infractions; a strict enforcement of corporate governance principles in banking; an expeditious process for rendition of returns by banks and other financial institutions through the Electronic Financial Analysis and Surveillance System (e-FASS); a revision and updating of relevant laws for effective corporate governance and ensuring greater transparency and accountability in the implementation of banking laws and regulations; as well as the introduction of a flexible interest rate based framework that treats the monetary policy rate as operating target. The new framework enabled the central bank to be proactive in countering inflationary pressures. The corridor regime also helped the bank to check the existing wide fluctuations in the interbank rates, thereby engendering confidence in the banking system (Sanusi, 2012).

The most recent innovation was the introduction of "Cash less Policy" to minimise the operating costs associated with huge cash transactions, lessen the challenges to efficient currency management and enhance the national payments system. The policy was also expected to fast-track the country's adoption of global best practices

in the settlement of transactions using cheques and electronic payments. Efforts were made to reduce the cheque clearing cycle to T+1. It became possible to make payments up to ₦10 million through the clearing system with a cheque. The new cash withdrawal policy imposes penalties on cash withdrawals beyond ₦500,000 from individual accounts and ₦3,000,000 from corporate accounts. This was intended to reduce the volume of currency outside banks and allow for more effective and efficient monetary policy.

The CBN also took steps to integrate the banking system into global best practice in financial reporting and disclosure through the adoption of the International Financial Reporting Standards (IFRS) in the Nigerian banking sector by end-2010. This helped to enhance market discipline, and reduce uncertainties, thereby limiting the risk of unwarranted contagion.

The central bank also reviewed the Universal Banking Model adopted in 2001 to encourage banks to focus on their core banking business. The new model categorised banks into commercial, merchant (investment) and specialised banks, in addition to development finance institutions. Commercial banks are sub-divided into regional, national and international banks. Specialised banks deal in microfinance, mortgage and non-interest banking. Non-interest banks are further sub-divided into regional and national banks. The introduction of non-interest banking was meant to attract fresh institutional players and new markets to deepen the financial system in addition to enhancing financial inclusion. The only licensed non-interest bank in the country (Jaiz Bank Plc.) opened for business on Friday, January 6, 2012.

The reforms repositioned Nigerian Banks among the major players in the global financial market with many of them ranking among the top 20 banks in Africa and among the top 1000 banks in the world. The spread between the lending and deposit rates moderated to 9.7 per cent as at end-December 2011, from 12.2 per cent in 2010. This has also contributed to the existing macroeconomic stability in the economy with inflation moderating to 10.3 per cent at end-December 2011. The volatility in exchange rate also reduced with the premium remaining within the international standard of 5.0 per cent. The removal of distress banks and adherence to code of corporate governance also enhanced confidence in the banking system. The reform of the payments system further popularised the use of electronic payments in Nigeria. The establishment of the Asset Management Corporation of Nigeria (AMCON) equally helped to resolve the problem of non-performing loans in the Nigerian banking system.

AMCON recently acquired the non-performing risk assets of some banks worth over ₦1.7 trillion, and this was expected to boost banks' liquidity, as well as enhance their safety and soundness. With the intervention of AMCON, the banking industry ratio of non-performing loans to total credit significantly reduced from 34.4 per cent in November 2010 to 4.95 per cent at December 2011 (Sanusi, 2012).

## IV. Methodology

The study employed cointegration and error correction techniques to establish the short- and long-run relationships between real output (RGDP) and the relevant indicators of economic reform for the 1960-2011 time period. The chosen approach provides more powerful tools for testing hypotheses about the relationship between non-stationary time series where data sets are of limited length. The danger in using linear regressions on non-stationary time series is the tendency to produce spurious correlation. The presence of unit roots in our data series and the inadequacies associated with linear regressions necessitated our choice of a superior methodology, the cointegrating vector approach. The approach also provides the best estimation mechanism as the Gauss-Markov theorem indicates that the least squares technique provides the best linear unbiased estimator through which straight line trend equations could be estimated.

### IV.1 The Data

The study used annual time series data for the period 1960-2011. The period was deliberately chosen to include the major episodes under which Nigeria implemented different policy regimes. The time was also considered adequate to capture both the short and long-run dynamics. The data were obtained from various editions of the CBN Statistical Bulletin and CBN Annual Report and Statements of Account. The annual time series data were standardised to capture changes in the general price level to enable us use real as against nominal values. The relevant macroeconomic variables, therefore, include real gross domestic product (RGDP), the degree of openness (DOP), real exchange rate (RER), real interest rate spread (RIRS), real credit to the private sector (RCPS), real gross national savings (RGNS), real foreign direct investment (RFDI) and manufacturing capacity utilisation (CAPUT). DOP captured the overall impact of trade liberalisation, which was occasioned by the changes in the general structure of the economy, while RER and RIRS reflected the price effects, and RCPS, RFDI, RGNS and CAPUT mirror the outcome effects.

## IV.2 Estimation Technique

The model was estimated under three different scenarios. First, the equation was fitted separately for two sub-samples - the pre-reform (1960-1985) and the market-reform (1986-2011) periods - to compare the drivers of real output under the two alternative policy regimes. Second, we estimate the model using data that covered the entire sample period (1960-2011) to evaluate the total effects. This time, we include a dummy variable (DUM) to test for the general impact of the policy changes on the level of real output in Nigeria. The DUM assigns 1 (DUM=1) for periods of deregulation (1986-2011) and 0 (DUM=0) for periods of regulation (1960-1985). Under the market mechanism, deregulation was expected to play a special role in realigning the fiscal, monetary, trade, pricing and exchange policies; and enhance productivity by freeing the economy from the distortions that might have arisen from excessive regulation. The DUM was, therefore, expected to relate positively with real output in line with the aspirations of the reforms.

A further verification of the results was carried out using the Chow Breakpoint test[2] on the data that covered the entire sample period to confirm the existence or otherwise of any significant difference in the estimated equation. The null hypothesis, therefore, is that there is no structural break in the real GDP series. In other words, the Chow Breakpoint test applies on the null hypothesis that the real output function remained the same before and after the implementation of SAP. This specification which includes both the autoregressive and trend components is as given below: H0: $\theta = \gamma = 0$ This third scenario excluded the DUM to prevent any biases that might arise from the influence of the dummy variable on the outcome of the Chow test. We make a final comparison of the three results in our empirical analysis.

The total effects estimated using data that covered the entire sample period would indicate the existence or otherwise of a significant long-run equilibrium relationship among the variables and provide the basis for our decision to either challenge or support the outward-oriented growth hypothesis as against the alternative protectionist paradigm. In other words, the results would offer empirical evidence as to whether trade barriers or controlled regimes had adversely affected the level of real output in Nigeria, and whether or not the ongoing liberalisation policies have the potentials to support the growth of the real sector. The estimations were done using E-views econometric software.

2 The classical test for structural change was developed by Chow (1960). The test-procedure splits the sample into two sub-periods and estimates the parameters for each of the sub-periods before testing for the equality of the two sets of parameters using the F statistic. The underlying assumption of the test is that the break date is known apriori (See Hansen 2001; Neeraj and Ambrish, 2005).

### IV.2.1 Time Series Properties

The time series properties of the data were investigated to avoid the phenomenon of spurious regression when statistical inferences are drawn from non-stationary time-series. A variable was said to be stationary if it had no unit root. This meant that the mean, variance and auto-covariance of the series must be independent of time[3]. Thus, the absolute value of the test statistics must be greater than that of the critical value for the stationarity condition to be met. The level at which a non-stationary series becomes stationary after differencing defines the order of integration of the series[4]. We applied the Phillips-Perron (PP) test (1988) to verify the stationarity of the variables. Under the PP test, the null hypothesis about the existence of unit roots is tested against the alternative hypothesis that the series has no unit roots. Being a non-parametric test, the PP test was more robust and did not require a selected level of serial correlation like the Augmented Dickey Fuller (ADF) test, in addition to its ability to modify the Dickey Fuller (DF) test statistic to correct for any serial correlation and heteroscedasticity in the error term. Unlike the ADF tests, the PP tests were robust to general forms of heteroskedasticity in the error term and did not require a lag length to be specified for the test regression.

### IV.2.2 The Johansen Cointegration Test

After determining the order of integration of the variables, we applied the Johansen (1988) and the Johansen and Juselius (1990) multivariate maximum likelihood method within a Vector Autoregressive (VAR) framework to verify the number of cointegrating equations in the Vector Error Correction Model (VECM)[5]. It is important to note that differencing variables to achieve stationarity leads to loss of long-run properties[6]. Cointegration, therefore, provides a remedy since it confirmed whether or not the deviations from the long-run path of two or more non-stationary variables that have a long-run relationship were stationary. The null hypothesis of the Johansen's method was that there were no more than r cointegrating relations. The test begins at r = 0 and accepts as r^ the first value of r for which the null hypothesis would be rejected (Pham and Nguyen, 2010). Johansen and Juselius (1990) provided two test statistics – the Maximum Eigenvalue Test (λmax) and Trace Test (λtrace) Statistics to determine the number of cointegrated vectors (r).

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3 A stochastic process is considered to be stationary if its mean and variance are constant over time and the value of the covariance between the two time-periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed (See Gujarati, 2004; Tunali, 2010).

4 A non-stationary time series can be made stationary by differencing or logging (Tunali, 2010).

5 The Johansen approach provides an alternative means or, more precisely, a simultaneous or systems approach of testing for the existence of unit roots in each variable when the null hypothesis is that of stationarity, rather than non-stationarity. Unit root test and cointegration techniques are, therefore, designed to deal with the spurious regression problem (See Nachega, 2001).

6 Bakare (2011) demonstrates how the Engel Granger's two-step procedure can be used to establish cointegration among variables.

disequilibrium[7]. We, therefore, allowed for a distinction between the long-and short-run behaviours in the economy by specifying an error-correction mechanism of real output toward its equilibrium level. For stationary time series, no distinction is required between the short and the long-run.

### IV.2.4 Granger Causality Test

Cointegration provided no information about the direction of causality. The Engle-Granger (1987) test which is based on the error correction mechanism was, therefore, used to provide information about the direction of causality[8]. Examination of the short-run Granger causality is usually done by replacing yt and xt by their first differences $\triangle$yt and $\triangle$ xt provided that the (long-run) error correction term (ECT) was included in the equation lagged once. This ECT can be the estimated residual from a level regression of yt on xt lagged once. Another alternative was to use the Johansen's (1988) procedure to estimate the long-run coefficients and generate a long-run ECT.[9]

## IV.3 Model Specification

Following from the theoretical literature, the functional form of the econometric model was specified as follows:

$$RGDPt = f(DOP_t, RER_t, RGNS_t, RCPS_t, RFDI_t, RIRS_t, CAPUT_t) \quad (4.1)$$

Where:
RGDP = Real gross domestic product
DOP = Degree of openness

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7 The deviations from equilibrium in the short-run are adjusted through equilibrium in the long-run. The coefficient of adjustment δ gives the speed of adjustment to the long-run equilibrium level. The estimated value of δ is expected to be negative and statistically significant. A statistically insignificant δ is an indication that disequilibrium will be sustained in the long-run. The Error Correction Mechanism (ECM) was first used by Sargan and later popularised by Engel and Granger. The *Granger representation theorem* states that if two variables Y and X are cointegrated, then the relationship between the two can be expressed as ECM (Gujarati, 2004); See Tunali (2010) for further exposition.

8 $x_t$ is Granger causal of $y_t$ if $x_t$ helps predict $y_t$ at some point in the future. Granger causality is not causality in the deep sense of the word. It just talks about linear prediction and only has "teeth" if one thing happens before another (i.e. in one direction). The definition of Granger causality made no mention of instantaneous correlation between the two variables. If the innovation to $y_t$ and the innovation to $x_t$ are correlated, then there is instantaneous causality. Since causality in the "real" sense can go either way, we usually do not test for instantaneous correlation. However, if we are able to find Granger causality in only one direction, we may feel the case for "real" causality is stronger if there is no instantaneous causality, because then the innovations to each series can be thought of as actually being generated from this particular series rather than part of some vector innovations to the vector system. We usually use the VAR approach to test for Granger causality if we have an econometric hypothesis of interest that states that $x_t$ Granger causes $y_t$ but $y_t$ does not Granger cause $x_t$ (See Sorensen, 2005).

9 In practice, arbitrary long-run coefficients have also been used to produce an estimate of the unknown long-run ECT (Dunne and Vougas, 1999); See Engel and Granger (1987) for theoretical details and Oxley (1993) for empirical exposition.

$$LRGDPt = \alpha + \beta_1 DOP_t + \beta_2 RER_t, + \beta_3 LRGNS_t + \beta_4 LRCPS_t + \beta_5 LRFDI_t + \beta_6 RIRS_t + \beta_7 CAPUT_t + \mu_t \quad (4.3)$$

Where:

$\alpha$ is the intercept term.

$\beta_1$ - $\beta_7$ capture the relative effects of the included regressors.

$\mu_t$ is the stochastic error term

Model (4.3) above was estimated to generate our residual series (ECM) and later used to test for the stationarity of the linear combination of the data series.

## IV.4 Diagnostic Tests

We carried out single equation and system mis-specification tests to evaluate the statistical adequacy of the models under the relevant assumptions[10]. Durbin Watson Statistics was used to test for long-run residual autocorrelation; normality test (for skewness and excess kurtosis) was used to verify the distribution of the error term; the Autoregressive Conditional Heteroskedasticity (ARCH) test and the Ramsey's RESET test (Regression Specification Error Test) were applied to confirm the correctness of the model specification. The White Heteroscedasticity test (with no cross terms) was employed to ensure that the disturbances truly exhibit the equal variance (homoscedasticity) assumption. Weak exogeneity tests on the individual variables were also conducted under the assumption of one cointegrating vector in view of the limited length of our data and the risks associated with the possibility of insufficient degrees of freedom[11]. The Chow Test was further used to test for the structural stability of the model, while the Breusch-Godfrey Lagrange Multiplier (LM) test was employed to check for higher order serial correlation in the disturbances of the estimated short-run dynamic models.

# V. Data Analysis and Discussion of Empirical Results

## V.1 Descriptive Evidence

Table 1 summarises the descriptive statistics of the data employed in the study. The results show that the annual real GDP averaged ₦227.97 billion over the 1960-2011 period. Real interest rate spread averaged 7.6 per cent per annum. The average real private sector credit amounted to ₦20.03 billion compared to the real average gross national savings which stood at ₦12.56 billion. The descriptive evidence indicated that the degree of openness index had the lowest variability while the real GDP had the highest judging from the standard deviations recorded over the period.

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10 The Johansen approach is known to be robust even when the normality assumption is not satisfied. Read Nachega (2001), Gonzalo (1994) and Hubrich (1999) for clarifications.

11 See Nachega (2001) for empirical exposition.

**Table 1: Descriptive Statistics on Selected Macroeconomic Variables (1960 – 2011)**

| Variables | Number of Observations | Mean | Standard Deviation |
|---|---|---|---|
| Real GDP (₦ million) | 52 | 227,966.6 | 232,915.5 |
| Real Exchange Rate (₦/US$1.00) | 52 | 3.825343 | 3.193981 |
| Real Interest Rate Spread (%) | 52 | 7.589514 | 4.017179 |
| Real Credit to the Private Sector (₦ | 52 | 20,025.08 | 25,029.79 |
| Real Foreign Direct Investment (₦ | 52 | 2,959.803 | 3,124.994 |
| Real Gross National Savings (₦ | 52 | 12,563.03 | 12,393.95 |
| Manufacturing Capacity Utilisation | 52 | 57.65242 | 17.20627 |
| Degree of Openness (index) | 52 | 0.473367 | 0.153894 |

**Source**: Author's Computation using E-views econometric software

Table 2 below presents the correlation matrix which provides evidence on the magnitude and direction of the relationship between each pair of variables. The correlation matrix was symmetric about the diagonal with values of 1.000000 indicating the perfect correlation of each variable with itself. The result indicated that all the variables expected to boost the level of real output in Nigeria possess the expected positive sign with the exception of manufacturing capacity utilization, which showed a negative relationship with the dependent variable. This may not be surprising given the huge energy constraints facing manufacturing enterprises in Nigeria and the resultant inability to enhance productivity by fully utilising their installed capacities. On the other hand, the real interest rate spread, which was expected to have negative relationship surprisingly shows positive correlation with the dependent variable. The strong positive correlations between the dependent variable and real credit to the private sector, real foreign direct investment and real gross national savings were understandable in view of their potentials to increase output levels in developing countries. The negative correlation with the real exchange rate was in line with *apriori* expectations and was also understandable given the over-reliance of the economy on imported inputs.

12 See Sodipe and Ogunrinola (2011).

**Table 2: Pair-wise Correlation Matrix**

| | RGDP | RER | RIRS | RCPS | RFDI | RGNS | CAPUT | DOP |
|---|---|---|---|---|---|---|---|---|
| **RGDP** | 1.000000 | -0.595449 | 0.710561 | 0.849780 | 0.880911 | 0.834818 | -0.529186 | 0.667314 |
| **RER** | -0.595449 | 1.000000 | -0.362142 | -0.453957 | -0.358537 | -0.521319 | 0.617777 | -0.548848 |
| **RIRS** | 0.710561 | -0.362142 | 1.000000 | 0.529511 | 0.676476 | 0.473418 | -0.429941 | 0.677984 |
| **RCPS** | 0.849780 | -0.453957 | 0.529511 | 1.000000 | 0.821718 | 0.966450 | -0.188257 | 0.426328 |
| **RFDI** | 0.880911 | -0.358537 | 0.676476 | 0.821718 | 1.000000 | 0.793024 | -0.295940 | 0.589807 |
| **RGNS** | 0.834818 | -0.521319 | 0.473418 | 0.966450 | 0.793024 | 1.000000 | -0.222673 | 0.393881 |
| **CAPUT** | -0.529186 | 0.617777 | -0.429941 | -0.188257 | -0.295940 | -0.222673 | 1.000000 | -0.563861 |
| **DOP** | 0.667314 | -0.548848 | 0.677984 | 0.426328 | 0.589807 | 0.393881 | -0.563861 | 1.000000 |

**Source**: Author's Computation using E-views econometric software

## V.2 Results of Unit Root Tests

The results of the Phillips-Perron (PP) test did not reject the null hypothesis about the existence of unit roots at the level form of the data, thus, necessitating the differencing of the series. The results of the first differenced form of each of the series as reported in table 3 below, however, rejected the null hypothesis; implying that the series became stationary after their first difference. Therefore, each of the variables can be said to have a unit root, and all are integrated of the same order {I(1)}, thus meeting the precondition for the application of the Johansen (1988) and the Johansen and Juselius (1990) multivariate cointegration technique to determine the number of cointegrating vectors.

**Table 3: Stationarity Test Analysis**

| Phillips-Perron (PP) TEST | | | |
|---|---|---|---|
| **Variable** | **Test Statistic** | **Critical Values** | **Order of Integration** |
| **RGDP** | -5.470943* | -3.568308 | I (1) |
| **DOP** | -21.78126* | -3.568308 | I (1) |
| **RER** | -5.791018* | -3.568308 | I (1) |
| **RGNS** | -2.829142*** | -2.598551 | I (1) |
| **RCPS** | -4.406950* | -3.568308 | I (1) |
| **RFDI** | -12.21839* | -3.568308 | I (1) |
| **CAPUT** | -4.205148* | -3.568308 | I (1) |
| **RIRS** | -13.14309* | -3.568308 | I (1) |

Note: *, **, *** indicate significance at 1%, 5% and 10% respectively. The lag lengths were automatically selected by E-views and all the test equations included intercept.

## V.3 VAR Lag Order Selection

Considering the limited length of the data series, a maximum lag of 4 was permitted in the selection of the optimum lag length to be used in the estimation of the VAR model (Table 4). The Akaike Information Criterion (AIC), Hannan-Quinn information criterion (HQ) and the Schwartz Information Criterion (SC) were employed for the VAR lag order selection. The optimum lag order of one suggested by the SC criterion was selected because the estimation result, using lag 4 which most of the selection criteria seemed to suggest, could not satisfy the stability condition.

**Table 4: VAR Lag Order Selection Criteria**

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -417.1367 | NA | 0.053442 | 19.77380 | 20.10146 | 19.89463 |
| 1 | -124.8714 | 462.1869 | 1.38e-06 | 9.156809 | 12.10580* | 10.24430 |
| 2 | -51.26593 | 89.01126 | 1.21e-06 | 8.710043 | 14.28035 | 10.76420 |
| 3 | 49.14397 | 84.06411* | 5.83e-07 | 7.016559 | 15.20819 | 10.03738 |
| 4 | 223.1295 | 80.92350 | 4.78e-08* | 1.900954* | 12.71390 | 5.888436* |

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

## V.4 Stability Test

The Autoregressive (AR) root stability test was used to verify the consistency or otherwise of the coefficients of the normalised cointegrating model as well as the short-run vector error correction model. The test result reported in table 5 below confirmed that the VAR system satisfied the stability condition since all the roots had modulus below one, implying that none of the roots fell outside the unit circle.

**Table 5: Autoregressive (AR) Root Stability Test**

| Root | Modulus |
|---|---|
| 0.989633 | 0.989633 |
| 0.930738 - 0.063762i | 0.932919 |
| 0.930738 + 0.063762i | 0.932919 |
| 0.737528 - 0.175810i | 0.758193 |
| 0.737528 + 0.175810i | 0.758193 |
| 0.695272 | 0.695272 |
| 0.266879 | 0.266879 |
| -0.000267 | 0.000267 |

No root lies outside the unit circle.
VAR satisfies the stability condition.

## V.5 Results of the Johansen's Test for Cointegration Vectors

From the results of the Johansen's cointegration test presented in Appendix I, both the standard trace and maximum eigenvalue test statistics indicated the existence of 1 cointegrating vector among DDOP, DRER, DLRGNS, DLRCPS, DLRFDI, DCAPUT, DRIRS and DLRGDP. These results asserted that the above variables were cointegrated with the logarithm of real output (DLRGDP). It was, thus, statistically proven that a long-run equilibrium relationship existed among the variables. The Johansen cointegration test used maximum lag order 1 along with constant trend specification. The Augmented Engle-Granger (AEG)'s two-step procedure was also used to verify the above result by applying the PP-test on the residuals generated from the long-run equations of the non-stationary variables to confirm the stationarity of the linear combination of the data series. The PP-test statistics confirm the stationarity of the residuals under the three different scenarios. Our parsimonious models were then estimated and the results presented in table 6 below.

## V.6 Long-run Granger Causality Test

The long-run Granger-Causality test applied to the non-stationary level variables thereby ignoring the possibility of cointegration among the level variables. Dunne and Vougas (1999) emphasised the misspecification that might arise from the non-inclusion of the error correction term and the loss of long-run information that led to wrong inferences. Barring the above weaknesses, the result of the long-run Granger causality test showed that the real exchange rate, credit to the private sector and gross national savings are Granger causal of the level of real output in Nigeria while openness index, interest rate spread, foreign direct investment and manufacturing capacity utilisation were not (Appendix 3). The result showed strong evidence that the real exchange rate, credit to the private sector and gross national savings could help predict future levels of output.

## V.7 Results of Diagnostic Tests for VAR Residuals[15]

The Breusch Godfrey Lagrange Multiplier (LM) test for both the pre- and post-reform time series did not reject the null hypothesis of no serial correlation, implying that the error terms are not serially correlated (see Appendixes V and VI). The Jarque-Bera tests rightly yielded insignificant probabilities with the skewness not significantly different from zero and kurtosis that nearly approximate the normal value of 3 (Appendix IV). With the skewness being of the highest importance for the Jarque-Bera normality test and validity of statistical inference, the residuals could, thus, be confirmed to be normally distributed as expected from the observed features of the estimated parameters.[16] The white heteroscedasticity tests (with no cross terms) confirmed that

13 Hendry and Juselius (2001) emphasised the critical importance of the properties of the VAR error term for the Johansen test for cointegration.

14 See Kitov, Kitov and Dolinskaya (2007) for further exposition.

the disturbances actually exhibited the equal variance (homoscedasticity) assumption as the tests did not reject the null hypothesis of homoscedasticity, implying that the error terms had constant variance (Appendices VII and VIII).

The Ramsey RESET test which followed the F-distribution, did not reject the null hypothesis that the models were well specified, implying that the estimated parsimonious real output models were free of specification errors (Appendices XI and XII). Even though the result of the pair-wise correlation matrix for the non-stationary level series reported in table 2 seemed to suggest the presence of multicollinearity between RCPS and RFDI; and RCPS and RGNS in view of their correlation coefficients that are in excess of 0.8, it could be confirmed that the relationship between them, under the Johansen's framework was non-linear, implying that multicollinearity could not be established among the regressors. Thus, the VAR model accurately describes the data and satisfies the principal statistical requirements that apply to the residuals. The VAR model stability was also guaranteed. The results of Wald Tests on the individual regressors all rejected the null hypothesis that the variables were weakly exogenous. This implied that the estimated coefficients were not nuisance parameters but were error-correcting (Appendix XIII).

## V.8 Chow Test

Using the Chow Breakpoint test to verify whether there was any significant difference in the estimated equation, the empirical results obtained as seen from the F-statistic of the Chow Breakpoint test on the data covering the entire sample period rejected the null hypothesis that the real output function remained the same before and after structural reforms (Appendix II). This implies that the market-based incentives implemented during the SAP have had vital effects on the real output level in Nigeria.

## V.9 Empirical Analysis

The long-run structure of the model was summarised in table 6 hereunder. The results of the OLS estimates of equation 4.3 at levels under the three different scenarios gave spurious regressions as earlier articulated in the methodological concepts, since all the variables were not time invariant at level (table 3). Though spurious, the long-run static models showed that credit to the private sector and capacity utilisation were consistent determinants of real productivity growth in both the pre-reform and market reform periods.

**Table 6: The Long-Run Static Relationships**

| Variables, Constants | (A) Pre-Reform Results (1960-1985) | (B) Post-Reform Results (1987-2011) | (C) Pooled Regression Results (1960-2011) |
|---|---|---|---|
| C | 6.659299 (1.375798) | 9.414517* (18.20420) | 4.394379* (3.452008) |
| DOP | 3.725751 (0.945569) | 0.410864 (1.598410) | 0.560551 (0.729582) |
| RER | -0.127116 (-0.904488) | -0.098860** (-2.757192) | -0.144232* (-2.658013) |
| RIRS | -0.129055 (-1.471989) | 0.012758*** (1.798287) | -0.001541 (-0.060703) |
| LRCPS | 1.066248***(1.817126) | 0.341243*** (1.956098) | 1.271949* (4.737145) |
| LRFDI | -0.130246 (-0.458367) | 0.038841 (0.594261) | 0.071796 (0.527834) |
| LRGNS | -0.257247 (-0.513536) | -0.139623 (-0.798601) | -0.315893 (-1.094088) |
| CAPUT | -0.047875***(-1.911701) | 0.019321* (4.380774) | -0.044359* (-8.579152) |
| R-squared | 0.962543 | 0.955348 | 0.963136 |
| Adjusted R-squared | 0.947120 | 0.936962 | 0.957134 |
| D-W Statistics | 0.945776 | 1.202629 | 0.551306 |
| F-Statistic | 62.40773* | 51.96061* | 160.4911* |

*T statistic values are in parenthesis*
**Significant at 1% level of Confidence*
***Significant at 5% level of Confidence*
****Significant at 10% level of Confidence*

The long-run regression results estimated using data covering the entire sample period suggested that the total effects of the variables on real output were significant but spurious with the Durbin-Watson (D.W.) statistics put at 0.551306. While the overall significance of the models were confirmed by the F-statistics, the long-run static models all showed negative first order serial correlation as evidenced by the D.W. statistics.

The estimation of the de-trended series using the general-to-specific methodology and subsequent elimination of the insignificant lags yielded the parsimonious models as reported in table 7. The empirical models for the short-run dynamics perform well both on statistical grounds and in terms of economic theory. Panel "D" of table 7 presented the results of the pre-reform period, during which the Nigerian economy was largely regulated. The results showed that changes in real output were positively related to the variations in real private sector credit and one period lag values of the dependent variable at the 1.0 per cent level of significance. The interest rate variable also conformed to *apriori* expectations as the result revealed a negative but significant relationship at the 1.0 per cent level, suggesting that the arbitrary fixing of interest rates by the monetary authorities during the pre-reform era actually discouraged investment and diminished real output in Nigeria. Ceteris paribus, if real interest rate spread widened by 1.0 per cent, real output would diminish by 0.3 per cent in the pre-SAP Nigeria. A 1.0 per cent increase in the previous level of output

would improve real income by 1.6 per cent in the regulation era, all things being equal. If real credit to the private sector increases by 1.0 per cent real national income would increase by 4.5 per cent.

The openness index, exchange rate variable and gross national savings were statistically insignificant and, thus, eliminated from the parsimonious model. The openness index was not expected to be significant during this period when domestic markets were widely regulated. The result further suggested that pegging exchange rates, as practiced during the period, was not an essential factor in the determination of real output. Foreign direct investment and manufacturing capacity utilisation were both significant but wrongly signed. This was not surprising as foreign direct investment hardly resulted in substantial diffusion of international technology to local industries. Even if the managerial and technological skills were readily absorbed, domestic industries would not deliver output when energy remained a major nightmare. The regulation era was equally marked by credit rationing and financial repression, thereby creating distortions that worsened the investment climate with adverse implications for capacity utilisation and output levels.

**Table 7: The Short-Run Dynamic Relationships**

| Variables, Constants | (D) Pre-Reform Results (1962-1985) | (E) Post-Reform Results (1987-2011) | (F) Pooled Regression Results (1963-2011) |
|---|---|---|---|
| C | 7.939716* (30.69406) | 0.035150* (3.771259) | -0.011053 (-0.327545) |
| DLRGDP(-1) | 1.609595* (2.841466) | 0.367670** (2.488338) | 0.388693* (2.777570) |
| DRIRS | -0.346339* (-2829974) | RVP | RVP |
| DRIRS(-1) | RVP | -0.004649** (-2.218281) | RVP |
| DRER | RVP | -0.042065* (-3771385) | -0.132081* (-3.007568) |
| DLRCPS | 4.467433* (2.839113) | 0.054352 (1.449083) | RVP |
| DLRCPS(-1) | RVP | RVP | -0.574938* (-3.462720) |
| DLRFDI | -1.189568** (-2.401335) | RVP | 0.004597 (0.089339) |
| DLRFDI(-2) | RVP | -0.034790* (-3.050211) | 0.055978 (1.161916) |
| DCAPUT | -0.227359* (-3.364832) | 0.008233* (4.368278) | RVP |
| DCAPUT(-1) | -0.272384* (-4.363016) | RVP | 0.012280 (1.611004) |
| DDOP(-1) | RVP | -0.116016** (-2.218035) | 0.251206 (1.030466) |
| DLRGNS | RVP | RVP | 0.573360* (3.827031) |
| ECM1(-1) | -0.298385*** (-0.845396) | na | na |
| DUM | na | na | 0.322357***(1.786992) |
| ECM2(-1) | na | -0.277544** (-2.634846) | na |
| ECM(-1) | na | na | -0.210250* (-2.790876) |
| R-squared | 0.885068 | 0.731846 | 0.553939 |
| Adjusted R-squared | 0.827602 | 0.597768 | 0.360645 |
| D-W Statistics | 1.612643 | 2.179037 | 1.945037 |
| F-Statistic | 15.40161* | 5.458389* | 2.865793* |

*T statistic values are in parenthesis* RVP = *Redundant Variable eliminated from Parsimonious Model* *Significant *at 1% level of Confidence* *na = Not applicable in the model*
***Significant at 5% level of Confidence*
****Significant at 10% level of Confidence*

***Source:*** *Author's Computation*

At 0.83, the value of the adjusted R-squared for the estimated equation was high showing that 83.0 per cent of the systematic variations in real output over the observed period was explained by the included explanatory variables while the balance of 17.0 per cent was explained by other determinants outside the model. The estimated coefficient of the lag error correction term ECM1(-1) was found to be statistically significant and correctly signed, implying that long-run equilibrium was attainable as the shocks generated by the exogenous factors can be corrected to restore equilibrium.

Panel "E" of table 7 presented the results of the post-SAP era during which Nigeria dismantled existing regulatory structures to allow for the free interplay of market forces. The results showed that all the variables except credit to the private sector and gross national savings exert significant influence on real output level. This implied that the post-SAP performance of financial intermediaries in terms of savings mobilisation and funding of the private sector did not meaningfully support the real sector. This finding was in conformity with the conclusion by Ayadi, Adegbite and Ayadi (2008) that the performance of financial intermediaries in the SAP period in terms of credit to the private sector did not surpass the pre-SAP level".

It was also evident that the interest rate sensitivity of output has drastically weakened in the post-SAP period given the drop in short-run interest elasticity of income from 0.35 to a lag response of 0.005, implying that if the difference between the lags of real maximum lending and real consolidated deposit rates widens by 1.0 per cent, real output would decrease by 0.005 per cent. It was also interesting to note that the exchange rate variable, which was insignificant in the pre-SAP era emerged a significant output determinant under the deregulation regime as the result showed that 1.0 per cent depreciation in the national currency (in real terms) reduces real output by 0.04 per cent. This finding was consistent with Bakare's (2011) statement that "the exchange rate policy of Nigeria's Structural Adjustment Programme may have contributed negatively to the level of real output in Nigeria".

It was equally instructive to note that the one period lag of the openness index this time was significant but wrongly signed implying that trade openness had adverse effects on the real sector of the Nigerian economy. This finding was somewhat similar to the conclusions by Iganiga (2010) and Bakare (2011) to the extent that the coefficients of the key indicators of economic reforms both turned out to be negative, suggesting that the structural change was unable to deliver the desired levels of output. Unlike in the pre-SAP era, manufacturing capacity Utilisation in the deregulation period made a positive impact on the real sector, but albeit a very weak contribution of 0.008 per cent owing to the same reasons earlier articulated. The coefficient of foreign direct

investment though consistent in its relationship with real output also suggests a waning magnitude from the contemporaneous 1.19 per cent impact in the pre-SAP period to a 0.03 per cent lag effect in the post-SAP period. The value of the adjusted R-squared though still high actually declined from 82 to 60 per cent, implying that the explanatory power of the included regressors faded by 22 per cent after the introduction of market reforms. The estimated coefficient of the lag error correction term (ECM) was also found to be statistically significant and correctly signed, implying that long-run equilibrium is attainable as the shocks generated by the exogenous factors can be corrected.

Panel "F" of table 7 showed the regression results obtained when we utilised data that covered the entire sample period. The result showed that the policy changes that attended the implementation of the SAP had some weakly significant positive effects on the level of real output in Nigeria as the deregulation dummy (DUM) passed the test of statistical significance at the 10 per cent level. The result indicated that real gross national savings has positive overall influence on the level of real output despite its redundant effects in the sub-samples. This finding was, again, not surprising in view of the usual accumulation of savings in the informal sector, which the mainstream financial system hardly accounts for, but might exert some significant influence on the level of real output. Perhaps, the accumulated savings in the shadow economy were not sufficient for their impacts to be felt over a short period, making them to be redundant in the sub-samples. The one period lagged dependent variable, however, emerged stronger in affecting real output and it was correctly signed. The real exchange rate variable was found to be consistent in sign and exhibited a stronger impact on the level of real output. The result also indicated that credit to the private sector has significant but negative lag effects on real output. However, manufacturing capacity utilisation, degree of openness and foreign direct investment were found to be insignificant in influencing the overall level of real output, partly due to the reasons earlier explained.

## VI. Conclusion and Policy Recommendations

The paper explored the impact of structural reforms on real productivity growth in Nigeria using system cointegration analysis and error correction modeling. It highlighted the relationships between real output growth and some important indicator variables thought to capture the average behaviours during the period. Results of the parsimonious output models provide useful insights into the real income determination process in Nigeria. The Chow Breakpoint test on the data covering the entire sample period rejected the null hypothesis that the real output function remained the same before and after structural reforms, implying that the market-

based incentives implemented during the SAP had vital effects on the real output level in Nigeria. While the deregulation dummy (DUM) indicated that structural changes had positive effects on the level of real output, sub-sample evidence suggested that the overall impact was mixed. In particular, manufacturing capacity utilisation was discovered to play an essential role in enhancing productivity in Nigeria. This implied that addressing critical infrastructural problems like epileptic power supply and poor transport/communication networks with the goal of promoting manufacturing capacity utilisation is a sure way to enhancing productivity in the economy. The result also indicated that real gross national savings has positive overall influence on the level of real output despite its redundant effects in the sub-samples. This implied that savings mobilisation would actually play a major role in growing the Nigerian economy. The monetary authorities should, therefore, endeavour to integrate the large underground economy into the mainstream financial sector to improve financial intermediation and mobilise more savings.

The paper also suggested that credit market liberalisation in Nigeria did not achieve the purpose of improving allocation efficiency, as real private sector credit was found to impact negatively on the level of productivity in the post-SAP period. This was not surprising given the incompatibility of banks' lending behaviour with the long-term investment drive of private businesses. It was a known fact that most banks preferred to lend short-term in order to satisfy urgent liquidity needs in addition to ensuring the security of capital. Banks also preferred to trade in the foreign exchange market for better and quicker returns than lend to the private sector. Their lending behaviour was, thus, at variance with the country's growth and development goals. It was, therefore, advisable that government design suitable mechanisms to channel investment credit to the private sector if the nation's dream of emerging among the 20 largest economies by the year 2020 is to be achieved.

Furthermore, administered interest rates and exchange rate pegs were found to be counter-productive. This suggested that financial liberalisation might be a better alternative for hoisting productivity in Nigeria. But, flexible exchange rates and interest rates liberalisation were also found to have dampened the level of output in the post-SAP period. This again was not surprising given the upward pressures on interest and exchange rates in the aftermath of SAP and the attendant effects on macroeconomic stability. Since it was evident that the price system cannot guarantee the desired moderation in interest rates, the monetary authorities need to take extra measures to reduce interest rates in different segments of the market. Government can also play complementary roles by limiting the size of budget deficits to cut down on huge domestic borrowing, which is now in trillions of naira. This would

not only improve investment but also go a long way to free additional credit for focused lending to the private sector towards enhancing the level of output. The present stability in the foreign exchange market also needed to be sustained to forestall any further depreciation in the naira exchange rate. Above all, more stable sources of foreign exchange needed to be urgently sought if the monetary authorities are to meet the ever increasing demand for foreign exchange to stabilise rates in the market.

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## Appendix I: the Johansen's Test for Cointegration Vectors

Exogenous series: DDOP DRER DLRGNS DLRCPS DLRFDI DCAPUT DRIRS
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

| Hypothesised No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.595858 | 42.58152 | 3.841466 | 0.0000 |

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

| Hypothesised No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.595858 | 42.58152 | 3.841466 | 0.0000 |

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalised by b'*S11*b=I):

| DLRGDP |
|---|
| 4.996171 |

Unrestricted Adjustment Coefficients (alpha):

| | |
|---|---|
| D(DLRGDP) | -0.186878 |

## Appendix II: Chow Breakpoint Test

| Chow Breakpoint Test: 1986 | | | |
|---|---|---|---|
| F-statistic | 9.727149 | Prob. F(13,18) | 0.000012 |
| Log likelihood ratio | 91.63361 | Prob. Chi-Square(13) | 0.000000 |

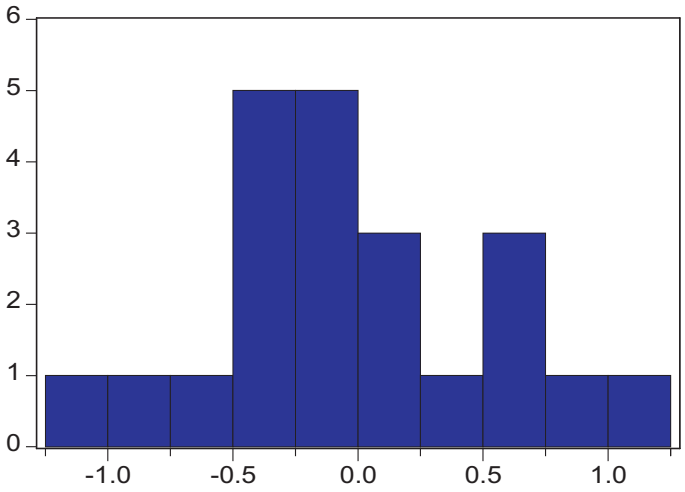
## Appendix III: Long-run Granger Causality Tests

Pairwise Granger Causality Tests
Date: 06/27/12 Time: 09:50
Sample: 1960 2011
Lags: 1

| Null Hypothesis: | Obs | F-Statistic | Probability | Decision Rule |
|---|---|---|---|---|
| DOP does not Granger Cause LRGDP | 51 | 0.36307 | 0.54964 | Do Not Reject $H_0$ |
| LRGDP does not Granger Cause DOP | | 6.56141 | 0.01362 | Reject $H_0$ |
| RER does not Granger Cause LRGDP | 51 | 7.55309 | 0.00842 | Reject $H_0$ |
| LRGDP does not Granger Cause RER | | 0.44778 | 0.50660 | Do Not Reject $H_0$ |
| RIRS does not Granger Cause LRGDP | 51 | 0.02658 | 0.87117 | Do Not Reject $H_0$ |
| LRGDP does not Granger Cause RIRS | | 5.08468 | 0.02874 | Reject $H_0$ |
| LRCPS does not Granger Cause LRGDP | 51 | 4.20943 | 0.04568 | Reject $H_0$ |
| LRGDP does not Granger Cause LRCPS | | 0.63911 | 0.42797 | Do Not Reject $H_0$ |
| LRFDI does not Granger Cause LRGDP | 49 | 1.23971 | 0.27131 | Do Not Reject $H_0$ |
| LRGDP does not Granger Cause LRFDI | | 1.95001 | 0.16929 | Do Not Reject $H_0$ |
| LRGNS does not Granger Cause LRGDP | 51 | 5.72560 | 0.02068 | Reject $H_0$ |
| LRGDP does not Granger Cause LRGNS | | 0.02532 | 0.87424 | Do Not Reject $H_0$ |
| CAPUT does not Granger Cause LRGDP | 51 | 0.86747 | 0.35632 | Do Not Reject $H_0$ |
| LRGDP does not Granger Cause CAPUT | | 3.09062 | 0.08512 | Reject $H_0$ |

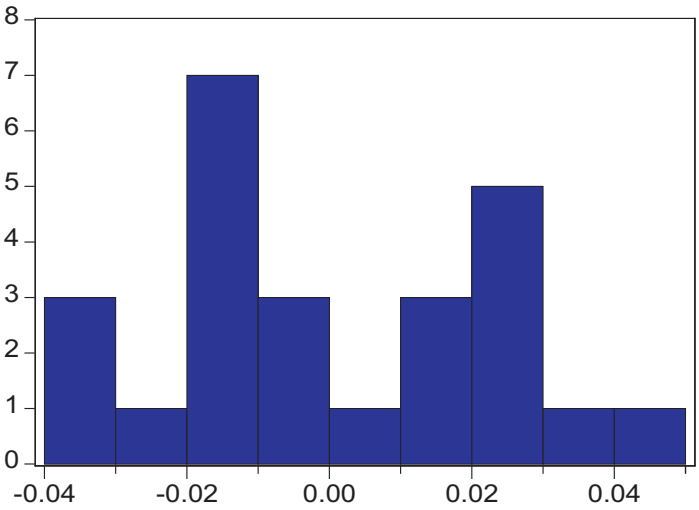
## Appendix IV: Test of Normality

### (Pre-SAP)




| | |
|---|---|
| Series: Residuals | |
| Sample 1962 1985 | |
| Observations 22 | |
| Mean | 6.01e-16 |
| Median | -0.062924 |
| Maximum | 1.042557 |
| Minimum | -1.223174 |
| Std. Dev. | 0.548340 |
| Skewness | 0.027347 |
| Kurtosis | 2.841164 |
| Jarque-Bera | 0.025869 |
| Probability | 0.987149 |

### (Post-SAP)




| | |
|---|---|
| Series: Residuals | |
| Sample 1987 2011 | |
| Observations 25 | |
| Mean | 5.00e-18 |
| Median | -0.006248 |
| Maximum | 0.046472 |
| Minimum | -0.034568 |
| Std. Dev. | 0.023272 |
| Skewness | 0.264395 |
| Kurtosis | 1.831588 |
| Jarque-Bera | 1.713339 |
| Probability | 0.424574 |

## Appendix V: Serial Correlation LM Test (Pre-SAP)

| Breusch-Godfrey Serial Correlation LM Test: | | | |
|---|---|---|---|
| F-statistic | 0.040773 | Prob. F(2,12) | 0.960180 |
| Obs*R-squared | 0.148491 | Prob. Chi-Square(2) | 0.928444 |

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 06/27/12 Time: 15:56
Sample: 1962 1985
Included observations: 22
Presample and interior missing value lagged residuals set to zero.

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.041868 | 0.336920 | 0.124267 | 0.9032 |
| DLRGDP(-1) | 0.012981 | 0.622871 | 0.020840 | 0.9837 |
| DRIRS | 0.022740 | 0.154387 | 0.147295 | 0.8853 |
| DLRCPS | -0.284280 | 2.030957 | -0.139973 | 0.8910 |
| DLRFDI | 0.087723 | 0.683384 | 0.128366 | 0.9000 |
| DCAPUT | 0.008214 | 0.078412 | 0.104751 | 0.9183 |
| DCAPUT(-1) | 0.000613 | 0.070191 | 0.008729 | 0.9932 |
| ECM1(-1) | 0.083914 | 0.889765 | 0.094310 | 0.9264 |
| RESID(-1) | 0.112946 | 0.395527 | 0.285559 | 0.7801 |
| RESID(-2) | 0.018455 | 0.424191 | 0.043507 | 0.9660 |

| | | | |
|---|---|---|---|
| R-squared | 0.006750 | Mean dependent var | 6.01E-16 |
| Adjusted R-squared | -0.738188 | S.D. dependent var | 0.548340 |
| S.E. of regression | 0.722933 | Akaike info criterion | 2.491956 |
| Sum squared resid | 6.271593 | Schwarz criterion | 2.987884 |
| Log likelihood | -17.41152 | F-statistic | 0.009061 |
| Durbin-Watson stat | 1.718329 | Prob(F-statistic) | 1.000000 |

## Appendix VI: Serial Correlation LM Test (Post-SAP)

Breusch-Godfrey Serial Correlation LM Test:

| | | | |
|---|---|---|---|
| F-statistic | 0.313525 | Prob. F(2,14) | 0.735867 |
| Obs*R-squared | 1.071730 | Prob. Chi-Square(2) | 0.585163 |

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 06/27/12 Time: 16:01
Sample: 1987 2011
Included observations: 25
Presample missing value lagged residuals set to zero.

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.003019 | 0.012357 | -0.244285 | 0.8106 |
| DLRGDP(-1) | 0.048402 | 0.188030 | 0.257416 | 0.8006 |
| DRIRS(-1) | 0.001029 | 0.002569 | 0.400421 | 0.6949 |
| DRER | 0.002282 | 0.012037 | 0.189610 | 0.8523 |
| DLRFDI(-2) | 0.000416 | 0.012139 | 0.034255 | 0.9732 |
| DCAPUT | -8.65E-05 | 0.002089 | -0.041432 | 0.9675 |
| DDOP(-1) | 0.009485 | 0.062978 | 0.150613 | 0.8824 |
| ECM2(-1) | 0.040348 | 0.121408 | 0.332333 | 0.7446 |
| DLRCPS | -0.004047 | 0.041023 | -0.098642 | 0.9228 |
| RESID(-1) | -0.198075 | 0.381919 | -0.518632 | 0.6121 |
| RESID(-2) | 0.154598 | 0.369926 | 0.417916 | 0.6823 |

| | | | |
|---|---|---|---|
| R-squared | 0.042869 | Mean dependent var | 5.00E-18 |
| Adjusted R-squared | -0.640796 | S.D. dependent var | 0.023272 |
| S.E. of regression | 0.029810 | Akaike info criterion | -3.887797 |
| Sum squared resid | 0.012441 | Schwarz criterion | -3.351491 |
| Log likelihood | 59.59746 | F-statistic | 0.062705 |
| Durbin-Watson stat | 1.834976 | Prob(F-statistic) | 0.999946 |

## Appendix VII: White Heteroskedasticity Test (Pre-SAP)

| White Heteroskedasticity Test: | | | |
|---|---|---|---|
| F-statistic | 1.721791 | Prob. F(14,7) | 0.239287 |
| Obs*R-squared | 17.04904 | Prob. Chi-Square(14) | 0.253574 |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 06/27/12 Time: 16:05
Sample: 1962 1985
Included observations: 22

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.127379 | 0.160962 | 0.791362 | 0.4547 |
| DLRGDP(-1) | -2.045578 | 0.909753 | -2.248499 | 0.0593 |
| DLRGDP(-1)^2 | 0.735750 | 0.631413 | 1.165244 | 0.2821 |
| DRIRS | -0.090971 | 0.095205 | -0.955529 | 0.3711 |
| DRIRS^2 | -0.005938 | 0.026962 | -0.220250 | 0.8320 |
| DLRCPS | 0.578891 | 1.460050 | 0.396487 | 0.7036 |
| DLRCPS^2 | 13.69877 | 7.276858 | 1.882512 | 0.1018 |
| DLRFDI | -0.917748 | 0.326194 | -2.813507 | 0.0260 |
| DLRFDI^2 | -0.546753 | 0.527972 | -1.035571 | 0.3348 |
| DCAPUT | -0.192662 | 0.141899 | -1.357742 | 0.2167 |
| DCAPUT^2 | -0.020246 | 0.011545 | -1.753642 | 0.1229 |
| DCAPUT(-1) | 0.011564 | 0.096990 | 0.119231 | 0.9084 |
| DCAPUT(-1)^2 | -0.003790 | 0.006695 | -0.566130 | 0.5890 |
| ECM1(-1) | 0.880059 | 0.536368 | 1.640776 | 0.1448 |
| ECM1(-1)^2 | 0.546413 | 1.320308 | 0.413852 | 0.6914 |

| | | | |
|---|---|---|---|
| R-squared | 0.774956 | Mean dependent var | 0.287010 |
| Adjusted R-squared | 0.324869 | S.D. dependent var | 0.398607 |
| S.E. of regression | 0.327521 | Akaike info criterion | 0.823972 |
| Sum squared resid | 0.750888 | Schwarz criterion | 1.567864 |
| Log likelihood | 5.936309 | F-statistic | 1.721791 |
| Durbin-Watson stat | 2.266457 | Prob(F-statistic) | 0.239287 |

## Appendix VIII: White Heteroskedasticity Test (Post-SAP)

White Heteroskedasticity Test:

| | | | |
|---|---|---|---|
| F-statistic | 1.075214 | Prob. F(16,8) | 0.481438 |
| Obs*R-squared | 17.06457 | Prob. Chi-Square(16) | 0.381431 |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 06/27/12 Time: 16:04
Sample: 1987 2011
Included observations: 25

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.000324 | 0.000377 | -0.858936 | 0.4154 |
| DLRGDP(-1) | 0.018319 | 0.007939 | 2.307637 | 0.0499 |
| DLRGDP(-1)^2 | -0.080142 | 0.046403 | -1.727098 | 0.1224 |
| DRIRS(-1) | 1.91E-05 | 4.94E-05 | 0.386213 | 0.7094 |
| DRIRS(-1)^2 | -3.29E-07 | 7.89E-06 | -0.041725 | 0.9677 |
| DRER | -0.000292 | 0.000479 | -0.608360 | 0.5598 |
| DRER^2 | 5.83E-05 | 0.000188 | 0.310146 | 0.7644 |
| DLRFDI(-2) | -0.000624 | 0.000343 | -1.819298 | 0.1064 |
| DLRFDI(-2)^2 | 0.000359 | 0.000307 | 1.170198 | 0.2756 |
| DCAPUT | 3.02E-05 | 7.05E-05 | 0.427936 | 0.6800 |
| DCAPUT^2 | 1.47E-06 | 6.59E-06 | 0.223331 | 0.8289 |
| DDOP(-1) | -0.001805 | 0.001469 | -1.228736 | 0.2541 |
| DDOP(-1)^2 | 0.002374 | 0.003138 | 0.756610 | 0.4710 |
| ECM2(-1) | -0.002356 | 0.001968 | -1.196686 | 0.2657 |
| ECM2(-1)^2 | 0.012501 | 0.010647 | 1.174192 | 0.2741 |
| DLRCPS | 0.000340 | 0.000985 | 0.345182 | 0.7389 |
| DLRCPS^2 | -0.000610 | 0.002274 | -0.268212 | 0.7953 |

| | | | |
|---|---|---|---|
| R-squared | 0.682583 | Mean dependent var | 0.000520 |
| Adjusted R-squared | 0.047748 | S.D. dependent var | 0.000484 |
| S.E. of regression | 0.000472 | Akaike info criterion | -12.25780 |
| Sum squared resid | 1.78E-06 | Schwarz criterion | -11.42896 |
| Log likelihood | 170.2224 | F-statistic | 1.075214 |
| Durbin-Watson stat | 1.977818 | Prob(F-statistic) | 0.481438 |

## Appendix IX: Autoregressive Conditional Heteroskedasticity (ARCH) Test (Pre-SAP)

| ARCH LM Test: | | | |
|---|---|---|---|
| F-statistic | 0.165177 | Prob. F(1,18) | 0.689225 |
| Obs*R-squared | 0.181862 | Prob. Chi-Square(1) | 0.669778 |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Sample (adjusted): 1963 1985
Included observations: 20 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.220670 | 0.084905 | 2.599015 | 0.0181 |
| RESID^2(-1) | 0.070052 | 0.172364 | 0.406420 | 0.6892 |

| | | | |
|---|---|---|---|
| R-squared | 0.009093 | Mean dependent var | 0.240507 |
| Adjusted R-squared | -0.045957 | S.D. dependent var | 0.303788 |
| S.E. of regression | 0.310690 | Akaike info criterion | 0.594597 |
| Sum squared resid | 1.737508 | Schwarz criterion | 0.694170 |
| Log likelihood | -3.945968 | F-statistic | 0.165177 |
| Durbin-Watson stat | 1.702348 | Prob(F-statistic) | 0.689225 |

## Appendix (X): Autoregressive Conditional Heteroskedasticity (ARCH) Test (Post-SAP)

ARCH LM Test:

| | | | |
|---|---|---|---|
| F-statistic | 0.269200 | Prob. F(1,22) | 0.609049 |
| Obs*R-squared | 0.290122 | Prob. Chi-Square(1) | 0.590142 |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Sample (adjusted): 1988 2011
Included observations: 24 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.000477 | 0.000148 | 3.220970 | 0.0039 |
| RESID^2(-1) | 0.109453 | 0.210955 | 0.518844 | 0.6090 |

| | | | |
|---|---|---|---|
| R-squared | 0.012088 | Mean dependent var | 0.000533 |
| Adjusted R-squared | -0.032817 | S.D. dependent var | 0.000490 |
| S.E. of regression | 0.000498 | Akaike info criterion | -12.29309 |
| Sum squared resid | 5.45E-06 | Schwarz criterion | -12.19492 |
| Log likelihood | 149.5171 | F-statistic | 0.269200 |
| Durbin-Watson stat | 1.935802 | Prob(F-statistic) | 0.609049 |

## Appendix (XI): Ramsey RESET Test (Pre-SAP)

| Ramsey RESET Test: | | | |
|---|---|---|---|
| F-statistic | 0.864459 | Prob. F(1,13) | 0.369438 |
| Log likelihood ratio | 1.416344 | Prob. Chi-Square(1) | 0.234006 |

Test Equation:
Dependent Variable: LRGDP
Method: Least Squares
Sample: 1962 1985
Included observations: 22

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -5.121000 | 14.04977 | -0.364490 | 0.7214 |
| DLRGDP(-1) | -4.904866 | 7.029670 | -0.697738 | 0.4976 |
| DRIRS | 0.985870 | 1.438117 | 0.685529 | 0.5051 |
| DLRCPS | -10.36174 | 16.02761 | -0.646493 | 0.5292 |
| DLRFDI | 2.780054 | 4.298422 | 0.646762 | 0.5290 |
| DCAPUT | 0.728273 | 1.030063 | 0.707017 | 0.4920 |
| DCAPUT(-1) | 0.777825 | 1.131286 | 0.687558 | 0.5038 |
| ECM1(-1) | 3.409062 | 5.112189 | 0.666850 | 0.5165 |
| FITTED^2 | 0.206101 | 0.221671 | 0.929763 | 0.3694 |

| | | | |
|---|---|---|---|
| R-squared | 0.892234 | Mean dependent var | 9.422163 |
| Adjusted R-squared | 0.825917 | S.D. dependent var | 1.617446 |
| S.E. of regression | 0.674851 | Akaike info criterion | 2.343440 |
| Sum squared resid | 5.920516 | Schwarz criterion | 2.789776 |
| Log likelihood | -16.77784 | F-statistic | 13.45400 |
| Durbin-Watson stat | 1.413842 | Prob(F-statistic) | 0.000039 |

## Appendix (XII): Ramsey RESET Test (Post-SAP)

Ramsey RESET Test:

| | | | |
|---|---|---|---|
| F-statistic | 0.019265 | Prob. F(1,15) | 0.891457 |
| Log likelihood ratio | 0.032087 | Prob. Chi-Square(1) | 0.857836 |

Test Equation:
Dependent Variable: DLRGDP
Method: Least Squares
Sample: 1987 2011
Included observations: 25

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.036021 | 0.011486 | 3.136139 | 0.0068 |
| DLRGDP(-1) | 0.400020 | 0.278535 | 1.436158 | 0.1715 |
| DRIRS(-1) | -0.005018 | 0.003433 | -1.462034 | 0.1644 |
| DRER | -0.045116 | 0.024812 | -1.818329 | 0.0890 |
| DLRFDI(-2) | -0.037781 | 0.024559 | -1.538366 | 0.1448 |
| DCAPUT | 0.009043 | 0.006156 | 1.469046 | 0.1625 |
| DDOP(-1) | -0.126804 | 0.094632 | -1.339966 | 0.2002 |
| ECM2(-1) | -0.295454 | 0.168736 | -1.750981 | 0.1004 |
| DLRCPS | 0.056606 | 0.041982 | 1.348354 | 0.1976 |
| FITTED^2 | -0.571966 | 4.120868 | -0.138797 | 0.8915 |

| | | | |
|---|---|---|---|
| R-squared | 0.732190 | Mean dependent var | 0.055913 |
| Adjusted R-squared | 0.571503 | S.D. dependent var | 0.044940 |
| S.E. of regression | 0.029418 | Akaike info criterion | -3.925265 |
| Sum squared resid | 0.012981 | Schwarz criterion | -3.437715 |
| Log likelihood | 59.06581 | F-statistic | 4.556640 |
| Durbin-Watson stat | 2.220153 | Prob(F-statistic) | 0.004896 |

## Appendix XIII: Weak Exogeneity Test[15]

Weak Exogeneity Test Statistics

| Variable | Exogeneity test | Chi-Square (1) |
|---|---|---|
| | ***Pre-Reform*** | |
| dlrgdp (-1) | a dlrgdp (-1) = 0 | 8.1* |
| drirs | a drirs = 0 | 8.0* |
| dlrcps | a dlrcps = 0 | 8.1* |
| dlrfdi | a dlrfdi = 0 | 5.8** |
| dcaput | a dcaput | 11.3* |
| dcaput (-1) | a dcaput (-1) = 0 | 19.0* |
| | **Post - Reform** | |
| dlrgdp (-1) | ßdlrgdp(-1) = 0 | 6.2* |
| drirs (-1) | ßdrirs ( -1) = 0 | 4.9** |
| drer | ßdrer = 0 | 14.2* |
| dlrfdi (-2) | ßdlrfdi (-2) = 0 | 9.3* |
| dcaput | ßdcaput = 0 | 19.1* |
| ddop (-1) | ßddop (-1) = 0 | 4.9** |
| | **Pool Regression** | |
| dlrgdp (-1) | δ dlrgdp (-1) = 0 | 7.7* |
| drer | δ drer = 0 | 9.0* |
| dlrgns | δ dlrgns = 0 | 14.6* |
| dlrcps (-1) | δ dlrcps (-1) = 0 | 12.0* |
| dum | δ ddum = 0 | 3.2** |

** and ** denote rejection at 1 and 5 per cent critical values, respectively.*

15 Conducted under the assumption of one cointegrating vector