

An Error-Correction Model of the Determinants of Private Saving in Nigeria

by

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Abstract

This article examines the determinants of private saving in Nigeria. It compares the estimation results of the Error-Correction Model with those of three conventional models: Partial-Adjustment, Growth Rate and Static Models. The conclusion is that the ECM performs much better than the other models. Its results reveal that the saving rate rises with the level of disposable income but falls with the rate of growth of disposable income. The real interest rate on bank deposits has a significant negative impact while public saving seems not to crowd out private saving. Furthermore, external terms of trade, inflation rate and external debt service ratio have a positive impact on private saving.

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I. INTRODUCTION

Past regression analyses were often run without a thorough examination of the characteristics of time series economic data. It is therefore not surprising that some of them are, in fact “spurious regressions” exhibiting an excellent fit between unrelated variables, especially when levels of the variables themselves are used in the regression. In general, when the regression includes non-stationary variables, the estimation of coefficients and inference from them becomes impossible. Besides, recent empirical studies have shown that major economic variables such as GDP and saving rate may individually be a non-stationary process rather than a trend-stationary process as was generally assumed. This implies that the conventional approach in regression has not always yielded reliable results.

In addition, studies over the years have revealed a major problem in the conventional methodology of empirical analysis. They had typically specified their lag structure as a simple process of partial adjustments. In other words, the dynamic specification assumed *a priori* imposed a very strict restriction on the model’s lag structure prior to estimation. This kind of misspecification has been the principal cause of erroneous forecasts. In specifying a model’s lag structure, it is preferable to derive information on the lag structure from the data itself (data-based dynamic specification) instead of imposing an untested restriction in advance (theory-based dynamic specification). The ECM approach differs from the conventional one by eliminating prior restrictions on the lag structure of the model. It determines them according to direct information from economic data, thus, estimating the models after the variables have been rearranged to reflect current economic theories.

Against this background, this paper brings the perspective of econometrics to a critical review of the traditional empirical studies on the saving function. It also reestimates Nigeria’s saving function with the Error Correction Model (ECM), a new estimation method that has rapidly gained currency in recent years, and examines its stability. Recent studies are

gradually identifying major defects in the conventional approach to regression analysis with time series data. This paper considers these problems at some length and highlights the practical advantages of the Error Correction Model over three traditional models: Partial Adjustment, Growth Rate and Static Models.

Empirical studies have shown that the ECM is best suited for model estimation when economic variables that are individually non-stationary are cointegrated, i.e. when there is a meaningful long-run relationship between them. The error-correction methodology is appealing because of its ability to induce flexibility by combining the short-run dynamic and long-run equilibrium models in a unified system. At the same time, it ensures theoretical rigour and data coherence and consistency. Since the ECM is derived from an over-parameterised ARDL model, its lag structure is quite flexible and is certainly less restrictive than that used in the traditional partial adjustment model which has only one lag. ECM can be conceptualised as an extension and generalisation of the traditional approach to modelling short-run disequilibrium by use of the partial adjustment model. This is because the ECM incorporates the previous period disequilibrium in the final equation. However, the use of the methodology of cointegration and error-correction adds more richness, flexibility and versatility to the econometric modelling of the dynamic systems and the integration of short-run dynamics with long-run equilibrium.

The time series properties of Nigeria's macroeconomic variables seem to justify an ECM-type saving function. The estimation of Nigeria's saving function from 1970 to 2005 showed that over the past 36 years, there have been relatively stable relationships between private saving and seven explanatory variables, with a far closer fit than those using a conventional model for the same period. Recent findings on the determinants of saving in developing countries, including Nigeria, confirm the continued validity of saving oriented policies. They also suggest that ECM can be an effective tool for saving forecasting.

The rest of the paper is laid out as follows: Section II surveys theoretical and empirical issues on the determinants of saving, drawing on the Life-Cycle model of saving and Consumption. Section III discusses the sources of data and estimation procedure of our preferred model, the ECM. Section IV presents our empirical results of the ECM-type saving function in Nigeria, compares its performance with those of three conventional approaches and discusses the implications of these results. Section V concludes this paper with an agenda for policy makers.

II. A REVIEW OF LITERATURE AND THEORY

The life-cycle hypothesis is the principal theoretical underpinning that has guided the study of savings behaviour over the years. Each of the determinants of saving is articulated in the context of the life-cycle hypothesis.

Income

The principal assumption of the life-cycle hypothesis is that an individual seeks to maximise the present value of lifetime utility subject to the budget constraint. The budget constraint is equal to the current net worth plus the present value of expected income from work over the remaining working life of the individual. The theory predicts that consumption in each period depends on expectations about lifetime income. Given that income fluctuates over the course of an agent's life, one's stage in the lifecycle is an important determinant of saving behaviour. Thus, an individual will smooth consumption over his lifetime, being a net saver in his youth and a net borrower in old age (Modigliani, 1986).

Empirical evidence shows that the level of real per capita income has a positive impact on saving rates and that this is usually greater in low-income countries as against richer ones. Loayza et al (2000) found that in developing countries, a doubling of income per capita is estimated to raise long-run private saving by 10 percentage points of disposable income. A direct implication is that development-enhancing policies are an effective means

of raising private saving.¹ Lewis (1954), Kaldor (1957) and Pasinetti (1962) have argued that income inequality is an important determinant of saving. Their models focus on functional distribution of income, that is, the type of distribution where income is the sole criteria. Schmidt-Hebbel and Serven (2000) posit that the links between income inequality and saving cause income concentration to have a positive effect on household saving, but a negative effect on corporate and public saving. Thus, they result in an ambiguous effect on aggregate saving.

Growth

The life-cycle model predicts that an increase in the rate of growth of income per capita will lead to an increase in the aggregate saving rate. This is because it increases the lifetime resources and saving of the younger population relative to that of the older one (see Modigliani, 1970; Madison, 1992; Bosworth, 1993; and Carroll and Weil, 1994). However, controversy is still raging as to its structural interpretation, since some see it as evidence that saving drives growth through the saving-investment link and others as evidence that it is growth that drives saving.²

A panel-instrumental variable method was explored by Loayza, Schmidt-Hebbel and Serven (2000) to estimate the impact of income growth on saving. Their results show that a 10 percentage point rise in growth rate increases the saving rate by a similar amount. Deaton and Paxson (2000), using household data, found that the correlation between saving and growth is largely due to the effect of income growth on saving if individuals determine their consumption plans on the basis of their respective income profiles. Thus, when wealth is introduced into the life-cycle model as an additional explanatory variable, the model yields

¹ For a critical assessment of multi-variate cross-country studies on this, see Collins (1991), Schmidt-Hebbel, Webb, and Corsetti (1992), and Schmidt-Hebbel and Serven (2000).

² For a more detailed analysis, see Levine and Renelt (1992), and Mankiw, Romer and Weil (1992).

ambiguous results about the relationship between saving and growth. Attanasio, Picci, and Scoru (2000), using different samples and econometric methods, found that in each case, growth Granger-causes saving. Besides, they observed that increases in saving rates do not always come before increases in growth. Lastly, they find that when additional controls were put in place, current income growth had a negative impact on lagged saving rates.

Interest Rate

The life-cycle model predicts that a higher interest rate increases the current price of consumption vis-à-vis the future price, thus leading to an increase in saving. This is the substitution effect. If on the other hand, the household is a net lender, an increase in interest rate will increase lifetime income, and so increase consumption and reduce saving. This is the income effect. Thus, saving will have a positive relationship with interest rate only when the substitution effect surpasses the income effect.

Some authors, including McKinnon (1973), Shaw (1973) and Athukorala and Sen (2004) have argued that the relationship between real interest rate and saving is positive for a developing economy. They hinge their argument on the fact that the financial markets of these countries are not well developed. In an environment where self-financing and bank loans make up the bulk of investment funds, accumulation of financial saving is determined more by the desire to invest than the desire to live on interest income. As a result, the greater part of household saving will be in the form of cash and near-money assets. Thus, the substitution effect will usually be much greater than the income effect of an interest rate change.

Inflation and Macroeconomic Uncertainty

The impact of inflation on saving in the life-cycle model is through its role in determining the real interest rate. This is based on the assumption of the absence of real balance effect of inflation and the non-existence of money illusion in people's saving

behaviour. Athukorala and Sen (2004) affirm that inflation may not always be neutral because in the first place, the inflation rate is more difficult to predict in the long run than in the short run. Besides, inflation brings about uncertainty in future income streams, thus resulting in higher savings on precautionary grounds. Lastly, they posit that inflation could influence saving through its impact on real wealth.

Skinner (1988) and Zeldes (1989) observe that an increase in uncertainty should raise saving since risk-averse consumers set resources aside as a precaution against possible adverse changes in income. Carroll (1991) shows that uncertainty helps to explain why consumption is highly correlated with income in the case of young consumers who expect their incomes to increase in the future but do not know by how much. Uncertainty also explains why the older population save a positive amount as they face a lot of uncertainty regarding the length of their life and health costs. Carroll and Samwick (1995a) obtained results which suggest that precautionary saving may account for a large chunk of household wealth. Loayza, Schmidt-Hebbel, and Serven (2000) find a positive and significant relationship between inflation and private saving rate.

Fiscal Policy

The Ricardian Equivalence hypothesis states that it does not matter whether government finances its expenditure through taxes or by borrowing. Therefore, only the time path of government expenditure affects the economy and not the time path of taxes that finance such expenditure. The hypothesis combines the intertemporal budget constraints of both the consumer and government and derives permanent income as net of the discounted value of government spending (Barro, 1974). The implication is that under certain assumptions, a permanent increase in public saving will be completely offset by a corresponding fall in private saving, thus leaving national saving unchanged. The Ricardian Equivalence is predicated on the assumption that saving behaviour does not experience any

uncertainty and that capital markets are perfect. Empirical evidence however rejects full Ricardian Equivalence (See Lopez, Schmidt-Hebbel, and Serven, 2000)³. This means that public and private saving are not perfect substitutes.

External Debt

The relationship between national saving and foreign resource inflow has been examined in several empirical studies, starting with Chenery and Strout (1966). Most attempt to establish whether foreign saving crowds national saving in or out, however, there is no consensus yet. A major problem here is the simultaneity between the two variables, which can only be taken care of if domestic savers face binding borrowing constraints in the world financial market. Loayza, Schmidt-Hebbel, and Serven (2000), in an attempt to address this issue, estimated that an increase of 2 percent of GNDI in the exogenous component of external borrowing reduces private saving by approximately 1 percent of GNDI in the long run. Chete (1999) showed that external debt accumulation has a negative impact on saving. Thus, a high external debt ratio will lead economic agents to anticipate future tax liabilities for its servicing. This will invariably prompt the transfer of capital to foreign countries, thereby reducing domestic saving.

Terms of trade changes (TOT)

The Harberger-Laursen-Metzler hypothesis has served as the launching pad in the study of the relationship between the terms of trade and private saving. It assumes myopic expectations on the part of consumers and postulates that deterioration in the terms of trade reduces real income and thus saving (See Harberger, 1950 and Laursen and Metzler, 1950). Ostry and Reinhart (1992) confirmed this when they found that positive terms of trade will reduce savings by lowering real income. Other researchers have however questioned the

³ For an in-depth analysis of other studies in this area, see Burnside (1998), Corbo and Schmidt-Hebbel (1991), and Edwards (1996).

rationale for the above assertion.⁴ They argue that a change in terms of trade has an ambiguous effect on saving, depending on whether the change in the former is seen to be permanent or temporary. A transitory improvement to the terms of trade, given that it gives rise to only a transitory change in income, leads to higher savings as against higher consumption in line with the direction of the Harberger-Laursen-Metzler hypothesis. A Permanent improvement on the other hand leads to a reduction in saving as consumers increase their consumption. Thus, the effect of terms of trade changes on saving depends on whether or not the change was anticipated.

Financial Development

Until recently, financial development was assumed to enhance the saving rate. It consists of elimination of credit ceilings, interest rate liberalization, easing of entry for foreign financial institutions, enhanced prudential guidelines and supervision, and the development of capital markets. Loayza and Shankar (2000) find that financial development has led the private sector to increase the durable goods component of their assets. The effect of financial development on saving rates can be separated into a direct short-run impact, which is usually negative, and an indirect long-run impact, which is generally positive (See Loayza et al, 2000). However, whether increased financial development itself significantly increases overall propensity to save depends on the extent of substitution between financial saving and other items in the household's asset portfolio. Consequently, the expected signs of this relationship in the private saving function are ambiguous (see Athukorala and Sen, 2004).

⁴ These include Obstfeld (1982), Svensson and Razin (1982), Persson and Svensson (1985), and Frankel and Razin (1992).

III. ECONOMETRIC METHODOLOGY AND DATA

Sources of Data

On the basis of the discussion above, the saving function for the impending empirical analysis is specified as follows:

$$PSR = f [RCY, GRCY, RIR, INF, GSR, EDSR, TOT, DFD] \quad (1) \quad \text{Where:}$$

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PSR = private saving rate.

RCY = real per capita GNDI.

GRCY = growth rate of real per capita GNDI.

RIR = real interest rate.

INF = rate of inflation.

GSR = public saving rate.

EDSR = external debt service ratio.

TOT = terms of trade.

DFD = degree of financial depth.

Equation (1) is estimated using annual data for 1970-2005. The estimation period was determined largely by the availability of adequate data on all variables. Below are the sources of each variable and how it is calculated where applicable:

Private Saving Rate: From Central Bank of Nigeria (CBN) Statistical Bulletin 2005 and International Financial Statistics (IFS) Year book 2003 published by the IMF. Private saving rate is the ratio of private saving to gross national disposable income (GNDI), where private saving is GNDI less private consumption expenditure.

Real per capita GNDI: From Central Bank of Nigeria (CBN) Statistical Bulletin 2005 and International Financial Statistics (IFS) Year book 2003 published by the IMF. Real per capita GNDI is obtained by adding primary income from abroad to GDP in order to give GNI.

When net current transfers from abroad are added to this, we obtain GNDI. Deflating GNDI by CPI gives us real GNDI. Dividing this by the population gives us real per capita GNDI. The natural log of this variable enables us to examine income elasticities as well as the importance of subsistence consumption.

Growth Rate of per capita GNDI: Calculated based on data obtained from Central Bank of Nigeria (CBN) Statistical Bulletin 2005 and International Financial Statistics (IFS) Year book 2003 published by the IMF.

Real Interest Rate: From International Financial Statistics (IFS) Yearbook 2003 and 2005. Real interest rate is obtained by subtracting the inflation rate from the nominal interest rate on bank deposits. This serves as the relative price of current consumption with respect to future consumption.

Inflation Rate: From Central Bank of Nigeria (CBN) Statistical Bulletin 2005.

Public Saving Rate: From Central Bank of Nigeria (CBN) Statistical Bulletin 2005.

Public saving is defined as overall surplus or deficit as a percentage of GDP. This enables us to evaluate the Ricardian equivalence.

External Debt Service Ratio: Calculated based on data obtained from Central Bank of Nigeria (CBN) Statistical Bulletin 2005 and International Financial Statistics (IFS) Year book 2003 published by the IMF. External debt service ratio is defined as the ratio of external debt stocks to exports.

Terms of Trade: Calculated based on data obtained from the International Financial Statistics Yearbook 2005. Terms of trade is defined as the ratio of the price of exports to price of imports (both in domestic currency).

Degree of Financial Depth: Calculated based on data obtained from the International Financial Statistics Yearbook 2005. Degree of financial depth is proxied by the ratio of broad money (M2) to GNDI.

The characteristics of the distribution of the variables are presented in Table 24 in the Appendix. Evidently, the Jarque-Bera statistic rejects the null hypothesis of normal distribution for the following variables: GRCY, GSR, PSR, and RIR. On the contrary, the null hypothesis of normal distribution for the remaining five variables is accepted. The statistic for Kurtosis shows that GRCY, GSR, PSR and RIR are leptokurtic, since their distributions are peaked relative to the normal. On the other hand, DFD, RCY, EDSR, INF and TOT are platykurtic, suggesting that their distributions are flat relative to the normal. Lastly, the statistic for skewness shows that with the exception of INF, RCY and TOT which are positively skewed, the other five variables are negatively skewed.

In Nigeria, as in most developing countries, due to the absence of detailed statistical coverage of sectoral financial activity, most of the data on saving are obtained from the national accounts statistics as the difference between measurable aggregates. This residual or indirect approach to the calculation of saving has some drawbacks. First, the saving of one group of economic units used by another for consumption is not captured. Second, capital gains and losses induced by price changes are not treated adequately. Third, consumer durables and certain elements of government expenditure are also not adequately treated (see Shafer, Elmeskov, and Tease, 1992). For these reasons, the results obtained should be interpreted with caution.

Unit Roots

Table 1 **ADF Unit-Root Test Results**

Variable	ADF test statistic	Critical Value	Order of Integration
LNDFD	-5.3991	-3.6702	I(1)***
LNEDSR	-5.2692	-3.6702	I(1)***
LNGRCY	-5.0106	-3.6702	I(0)***
LNGSR	-4.3788	-3.6617	I(0)***
LNINF	-3.3407	-2.9604	I(0)**

LNRCY	-5.1744	-3.6702	I(1)***
LNPSR	-2.7777	-2.6504	I(2)*
LNRIR	-4.1049	-3.6617	I(0)***
LNTOT	-3.1390	-2.9604	I(0)**

Notes: * Significant at 10 percent

** Significant at 5 percent.

*** Significant at 1 percent; the null hypothesis is that there is a unit root.

Table 2 Phillip-Perron Unit-Root Test Results

Variable	PP test statistic	Critical Value	Order of Integration
LNDFD	-5.6639	-3.6702	I(1)***
LNEDSR	-5.2958	-3.6702	I(1)***
LNGRCY	-5.0119	-3.6702	I(0)***
LNGSR	-4.3788	-3.6617	I(0)***
LNINF	-3.0914	-2.9604	I(0)**
LNRCY	-5.1720	-3.6702	I(1)***
LNPSR	-3.9391	-3.6617	I(0)***
LNRIR	-4.1113	-3.6617	I(0)***
LNTOT	-3.1390	-2.9604	I(0)**

Same as Table 1 above.

Testing for the existence of unit roots is of major interest in the study of time series models and co-integration. The presence of a unit root implies that the time series under investigation is non-stationary; while the absence of a unit root shows that the stochastic process is stationary (see Iyoha and Ekanem, 2002). The time series behaviour of each of the series using both the Augmented Dickey-Fuller and Phillips-Perron tests⁵ are presented in tables 1 and 2, respectively. The results show that DFD, EDSR and RCY are integrated of

⁵ See Dickey and Fuller (1981) and Phillips and Perron (1988).

order one. The other variables are stationary at levels.⁶ The ADF and PP tests give conflicting results for the order of integration of PSR. While the ADF test indicates that it is an I(2) variable, the PP test affirms it to be an I(0) variable. For the purpose of this study however, we treat it as an I(0) variable, in line with the Phillips-Perron test conclusion.

Cointegrated Models

Table 3 **Cointegration Test Results**
Johansen's cointegration test results (Trace test)

Hypothesised No. of Cointegrating Equations	Trace Statistic	5 percent critical value	1 percent critical value	Series
None*	32.5038	29.68	35.65	Indfd, Inrcy and Inedsr
At most 1	4.6420	15.41	20.04	
At most 2	0.1371	3.76	6.65	

Johansen's cointegration test results (Maximum Eigen test)

Hypothesised No. of Cointegrating Equations	Maximum Eigen Statistic	5 percent critical value	1 percent critical value	Series
None**	27.8619	20.97	25.52	Indfd, Inrcy and Inedsr
At most 1	4.5049	14.07	18.63	
At most 2	0.1371	3.76	6.65	

*Notes: * denotes rejection of the null hypothesis at the 5 percent level*

*** denotes rejection of the null hypothesis at the 1 percent level*

In this paper we used the method established by Johansen (See Johansen, 1991) to carry out the cointegration test. The Trace and Maximum-Eigen Cointegration rank tests are reported in table 3 below.

A cursory glance at table 3 reveals that the null hypothesis of no cointegrating equation is rejected by both tests. While the Trace test indicates one cointegrating equation at the 5 percent level, the Maximum-Eigen test indicates one cointegrating equation at both the 5

⁶ This is deduced from the fact that for the levels of the I(1) variables, the absolute values of the ADF and PP test statistics are less than the absolute value of the critical values at the 99 or 95 percent significance level. However, for the first difference of the variables, the test statistic of each is greater than the critical value of the test statistic in absolute values.

percent and 1 percent levels.⁷ The implication is that even though the series: *lndfd*, *lnedsr* and *lnrcy* are not individually stationary, a linear combination of the three series was found to be stationary. The three original non stationary series are therefore said to be cointegrated. In other words, there is a stable long-run relationship between them and so we can avoid both the spurious and inconsistent regression problems which otherwise would occur with regression of non-stationary data series. The existence of cointegrating relationships among the three I(1) variables implies that the determinants of private saving in Nigeria is most efficiently represented by an error correction specification.

IV. EMPIRICAL RESULTS

Dynamic Error-Correction Model

Having identified the cointegrating vector using Johansen, we proceed to investigate the dynamics of the saving process. Table 4 reports the final parsimonious estimated equation. The results show that the coefficient of the error-term for the estimated saving equation is both statistically significant and negative. Thus, it will rightly act to correct any deviations from long-run equilibrium. Specifically, if actual equilibrium value is too high, the error correction term will reduce it while if it is too low, the error correction term will raise it. In addition, it performs well going by the relevant coefficients, all of which fall within the acceptable region. The explanatory variables explain well over 75 percent of the variations in private saving rate. This is adjudged by the value of the coefficient of determination, Adjusted R-squared. There is no serial autocorrelation given that the Durbin Watson Statistic is within the acceptable bound. In addition, the probability of the F-Statistic suggests that the model has a very good fit. The results support the previous one that the variables constitute a cointegrated set.

⁷ This is because the value of the trace test statistic is greater than the critical value at the 5 percent level but less than the critical value at the 1 percent level. In the second case, the value of the Maximum-Eigen statistic is greater than the critical value at both the 5 percent and 1 percent levels.

Table 4 **Estimated Regression Results for the Private Saving Model**

Dependent Variable: D (LNPSR, 1)

Included observations: 26 after adjusting endpoints

Variable	Coefficient	t-statistic	Probability
C	-0.018896	-0.175278	0.8634
D(LNEDSR(-2), 2)	0.614768	2.974251	0.0101
D(LNGRCY, 1)	-1.955227	-3.304195	0.0052
D(LNGRCY(-2), 1)	-1.023784	-2.836653	0.0132
D(LNGSR(-2), 1)	0.982472	4.714457	0.0003
D(LNINF,1)	0.513718	2.011117	0.0640
D(LNRCY, 2)	11.17143	3.659576	0.0026
D(LNRIR(-2), 1)	-0.412065	-3.217039	0.0062
D(LNTOT, 1)	1.133776	2.260461	0.0403
D(ECM(-1))	-1.732365	-1.835018	0.0878
Adjusted R-squared	0.7590	S.D dependent var	1.1095
S.E. of regression	0.5447	F-statistic	8.1575
Durbin-Watson stat	1.6662	Prob (F-statistic)	0.0002

Note that a variable in the original specification, DFD has been dropped from the final estimated equation. This is because it had statistically insignificant coefficients in all experimental runs. The result for the real interest rate variable (RIR) shows that the real rate of return on bank deposits has a statistically significant negative effect on saving behaviour in Nigeria. This suggests that its income effect outweighs the sum of its substitution and human wealth effects. This result should be taken with some measure of caution however, in view of the fact that there exists a negative relation between interest rate and inflation. Our real interest measure may therefore reflect more the impact of nominal interest rate controls than

consumer's intertemporal rate of substitution. The results are consistent with those of Loayza, Schmidt-Hebbel and Serven (2000).

The Keynesian absolute income hypothesis is found to hold for saving behavior in Nigeria. The coefficient for real per capita GNDI (LNRCY) is positive and statistically significant at the 1 percent level. Thus the Nigerian experience provides support for the argument that, for countries in the initial stages of development, the level of income is an important determinant of the capacity to save. In this respect, our results are consistent with the cross-country results of Modigliani (1993), Hussein and Thirlwall (1999), Loayza et al (2000) and the results for India of Athukorala and Sen (2004). This implies that the high unemployment rate which results in low disposable income is a strong impediment in raising the saving rate in Nigeria.

The results for terms of trade changes (TOT) point to a strong positive relationship between TOT and the private saving rate. This suggests that private agents reduce saving when faced with lower future real incomes as a result of terms of trade deterioration. This is in keeping with the Harberger-Laursen-Metzler hypothesis, which states that deterioration in the terms of trade reduces real income and hence saving. The result implies that private agents in Nigeria seem to consider terms of trade deterioration as a temporary (negative) shock. Thus, they increase their expenditure in an attempt to offset the decrease in purchasing power so as to keep real expenditure constant. This results in a decrease in domestic saving.

The inflation rate (INF) has a strong positive effect on the private saving rate. This result is consistent with the precautionary motive, suggesting that increased macroeconomic uncertainty induces people to save a larger proportion of their incomes. This is particularly true for households in developing countries such as Nigeria whose income prospects are more uncertain than their counterparts in developed countries. While one might be tempted to conclude that inflation stabilization could have an adverse effect on saving, it is important to

keep in mind that stabilization also affects saving through other channels that are likely to more than compensate for any negative direct effect of inflation. In this regard, our result shows that lower inflation raises growth which in turn increases private saving.

The result for public saving rate (GSR) points to the fact that the Ricardian Equivalence Principle does not hold in the case of Nigeria. The coefficient for public saving rate is both positive and significant, thus rejecting any substitutability between public and private saving in the Nigerian context. Thus, public and private saving rates are complementary and mutually reinforcing. This result is consistent with Keynesian theory, which affirms the importance of budget deficits as a powerful instrument for bringing about output growth. Our findings are also in line with those obtained by Chete (1999).

We found that contrary to a priori theoretical expectations, external-debt-service-ratio (EDSR) has a significant positive relationship with private saving rate. This result is in sharp contrast to those obtained by Fry (1989), Aghevli, et al (1990) and Chete (1999), thus rejecting the debt-overhang hypothesis. The results here are however consistent with the views of Summers (1996a) and Bruno (1996). They argue that borrowing to finance investment is healthy because it is taken for granted that the economy is generating the capital to repay this obligation. This results in an increase in domestic saving. The problem arises when the borrowed funds are used to finance consumption since this brings about a plummeting of the saving rate. The implication is that policy makers should not hesitate to borrow from external sources provided the borrowed funds will be utilized for investment expenditure and not consumption expenditure

Contrary to the postulation of the Life-Cycle Model, the income growth variable (GRCY) was found to have a significant negative impact on the private saving rate. This result is interesting given that it does not conform to those obtained from earlier studies (see Modigliani, 1970; Madison, 1992; Bosworth, 1993 and Carroll and Weil, 1994). Our

Nigerian experience seems to provide support for the simple permanent income theory which predicts that higher growth (i.e. higher future income) could reduce current saving. In other words, at sufficiently high rates of economic growth, the aggregate saving rate may decrease if the lifetime wealth of the young is high enough relative to that of their elders (see Athukorala and Sen, 2004). There are two plausible explanations for this finding. The first is the penchant of Nigerians to indulge in conspicuous consumption. As a result, growth in per capita income could actually lead to a decrease in saving. The second is that income growth was actually negative in roughly half of the period under observation.

Comparison of the ECM results with those of the Conventional models

For the Error-Correction model, the independent variables explain over 75 percent of variations in saving rate. On the other hand, those of the Static, Partial-Adjustment, and Growth rate models were only able to explain 41.4, 41 and 40 percent respectively. Besides, the relatively high value of the F-statistic (8.16) attests to the overall significance of the ECM regression. This is in sharp contrast to what was obtained from the traditional models where the F-statistics did not exceed 3.65. Furthermore, while seven of the eight original variables were significant in the ECM, each of the three conventional models yielded only one significant variable, TOT.

In order to render the final equation acceptable, we carried out various diagnostic tests. Three of them are residual tests, namely Histogram and Normality Test, Serial Correlation LM Test and ARCH LM Test. Two are stability tests: Chow's breakpoint test and Chow's forecast test. The last is a Predictive and Forecast ability test. The results are presented in the appendix while their implications are outlined below.

The Error-Correction Model was the only one which yielded residuals that are normally distributed. This conclusion is arrived at given that the Jarque-Bera statistic is not significant. On the contrary, the three traditional models give rise to residuals which are not

normally distributed. This is because their Jarque-Bera statistics are all significant. While the ECM performed extremely well in terms of serial correlation, the Growth rate model's performance was particularly poor. Both the Serial Correlation and ARCH LM Tests confirm that there is no serial correlation in the residuals of the ECM regression. This is because the F-statistics of both tests were not significant. This shows that there are no lagged forecast variances in the conditional variance equation. In other words, the errors are conditionally normally distributed, and can be used for inference. With regard to the Growth Rate model however, the Serial Correlation LM Test indicates that there is a high level of serial correlation in the residuals.

The results for Chow Breakpoint and Forecast Tests show that there are no significant differences in the estimated ECM equations, leading us to conclude that there was no structural change in the saving function before and after 1988. In other words, in terms of the Chow test for parameter stability conducted by splitting the total sample period into 1970-1987 and 1988-2005, there is no evidence of parameter instability. Besides, on re-estimating for the sub-period 1970-1988, all equations pass Chow's prediction failure test (Chow test of out-of-sample forecast ability) for the post reform period (1989-2005). On the contrary, both tests suggest that there were structural changes in the saving function for each of the three conventional models.

The three common measures of predictive accuracy namely Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and Theil Inequality Coefficient (U) are employed in evaluating the predictive performance of the ECM model. Given that their values are very small, it is a clear indication that the model is quite accurate in its predictive ability. The implication is that the mean of the forecasts does a good job of tracking the mean of the dependent variable. In addition, given that the value of the bias proportion is zero and that of the variance proportion very close to zero, we conclude that both the mean and variance of

the forecast are very close to those of the actual series. Even though the forecast statistics indicate that the three traditional models also have reasonable predictive abilities, a more critical study of the results will reveal that the forecast ability of the ECM is far superior to those of the other three models. This is because the values of the five forecast statistics mentioned earlier are substantially smaller for the ECM than for the conventional models.

V CONCLUSION

This paper has investigated the determinants of private saving in Nigeria for the period 1970-2005. In the first place, it attempts to shed more light on the problems associated with the conventional models of determinants of saving. Drawing on econometric analysis, it goes on to propose the alternative of an Error-Correction Model of the determinants of saving function. The results of the ECM-type saving function are compared with those of three traditional models namely, the Partial-Adjustment Model, the Growth Rate Model and the Static Model.

A comparison of the performance of the Error-Correction specification of the saving function with that of the traditional models reveal that the ECM regression has a far closer fit than those of the conventional models. Whereas seven variables were significant in the Error-Correction regression, only one was significant in each of the three traditional models. Furthermore, a barrage of diagnostic tests revealed that of the four models, only the ECM produced normally distributed residuals. Besides, we found no structural change in the ECM saving function, in sharp contrast to the conventional models where there was strong evidence of parameter instability. Lastly, the Error-Correction Model was found to have a much higher predictive ability than any of the traditional models.

The estimation results for the error-correction model point to the level of per capita income, terms of trade changes, public saving rate, external debt service ratio, and the inflation rate as having statistically positive influences on domestic saving. The real interest

rate and growth rate of income seem to have a negative impact on the saving rate. Perhaps, our most interesting finding is that, contrary to most previous empirical results, growth was found to have a negative impact on saving in Nigeria. There is thus strong empirical support for the hypothesis that both the change in the rate of income growth and the change in income levels are powerful determinants of changes in the private saving rate (albeit in opposite directions). We also found a clear role for fiscal policy in increasing total saving in the economy, with the private sector considering public saving as a complement for its own saving. The Ricardian Equivalence was thus found not to hold in Nigeria as opposed to what obtains in industrialized and semi-industrialized economies.

Some major recommendations for policy can be drawn from the analysis. First, the focus of development policy in Nigeria should be to increase the productive base of the economy in order to promote real income growth and reduce unemployment. For this to be achieved, a diversification of our resource base is indispensable. This policy thrust should include a return to Agriculture; the adoption of a comprehensive energy policy, with stable electricity as a critical factor; the establishment of a viable iron and steel industry; the promotion of small and medium scale enterprises and a serious effort at improving information technology. Second, contrary to popular belief, income growth has a negative influence on private saving in Nigeria. Policy makers should thus take explicit account of this result in the formulation of economic policy. For instance past experience has shown that rapid increases in wages of urban sector workers did not result in any appreciable increase in private saving. Rather, the extra income was used in the purchase of mainly imported consumer goods, thus increasing our dependence on imports.

Third, public saving has been shown to be a complement rather than a substitute for private saving in Nigeria. Government should therefore no longer embark on spending sprees under the pretext that saving excess revenue would crowd out private saving. A stop must be

put to the sharing of excess oil revenue among the various tiers of government since this usually has an inflationary impact on the economy. Lastly, it is pertinent to note that though this paper has concentrated on Nigeria, we are of the opinion that its results can be applied to other African countries not previously studied. They contain some valuable lessons for informing policy measures in the current thrust towards greater mobilization of private saving in the African continent.

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APPENDIX

Error-Correction Model Results

Figure 1 Histogram and Normality Test

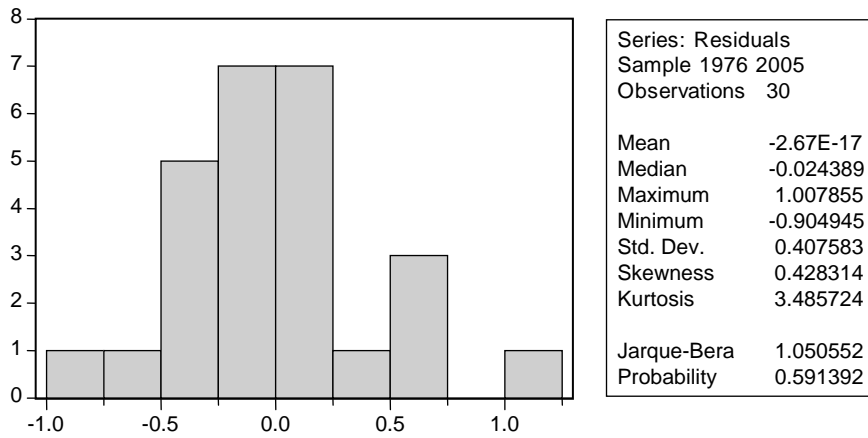


Table 5 Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.278827	Probability	0.761441
Obs*R-squared	1.154596	Probability	0.561413

Table 6 ARCH LM Test

ARCH Test:

F-statistic	1.021921	Probability	0.377117
Obs*R-squared	2.128647	Probability	0.344961

Table 7 Chow Breakpoint Test

Chow Breakpoint Test: 1988

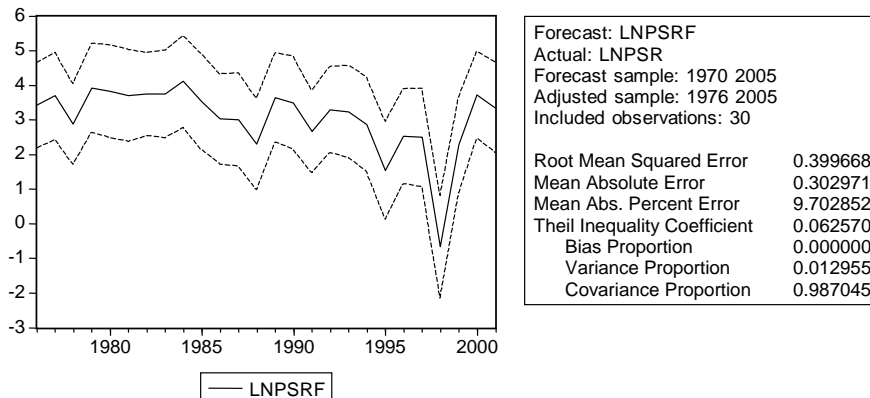
F-statistic	1.078295	Probability	0.577828
Log likelihood ratio	52.28246	Probability	0.000001

Table 8 Chow Forecast Test

Chow Forecast Test: Forecast from 1989 to 2005

F-statistic	18.05988	Probability	0.182367
Log likelihood ratio	142.0352	Probability	0.000000

Figure 2 Predictive and Forecast Test



Partial Adjustment Model Results

Table 9 Estimation Results

Dependent Variable: LNPSR

Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.527706	7.164414	-0.631972	0.5342
LNPSR(-1)	0.157715	0.167735	0.940265	0.3578
LNDFD	0.591237	0.739939	0.799035	0.4332
LNEDSR	-0.269003	0.185383	-1.451063	0.1615
LNGRCY	-0.325111	0.318431	-1.020978	0.3189
LNGSR	-0.127636	0.226365	-0.563850	0.5788
LNINF	-0.096774	0.262221	-0.369055	0.7158
LNRCY	1.009146	0.995132	1.014083	0.3221
LNRIR	0.238069	0.220536	1.079499	0.2926
LNTOT	1.627170	0.451785	3.601648	0.0017
R-squared	0.587605	Mean dependent var		3.139739
Adjusted R-squared	0.410865	S.D. dependent var		0.872820
S.E. of regression	0.669935	Akaike info criterion		2.292423
Sum squared resid	9.425060	Schwarz criterion		2.755000
Log likelihood	-25.53256	F-statistic		3.324676
Durbin-Watson stat	2.142580	Prob(F-statistic)		0.011152

Figure 3 Histogram and Normality Test

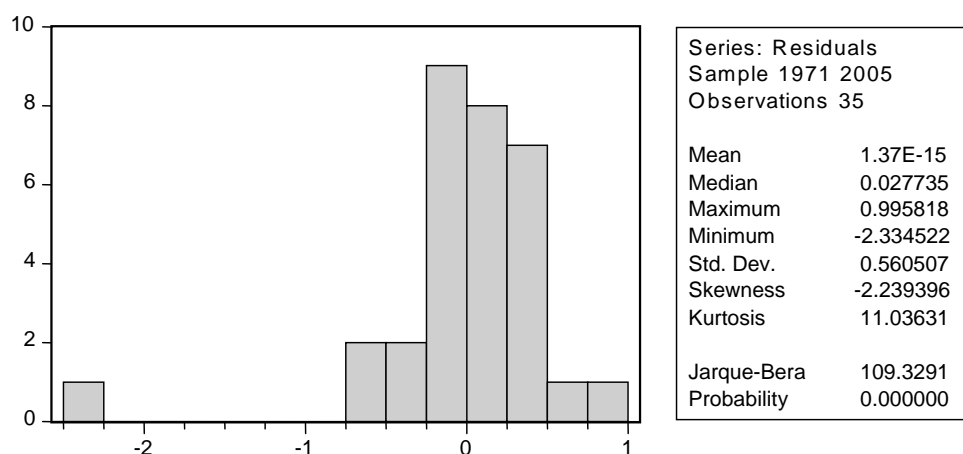


Table 10 Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.860683	Probability	0.364609
Obs*R-squared	1.279017	Probability	0.258082

Table 11 ARCH LM Test

ARCH Test:

F-statistic	0.113880	Probability	0.738286
Obs*R-squared	0.121520	Probability	0.727392

Table 12 Chow Breakpoint Test

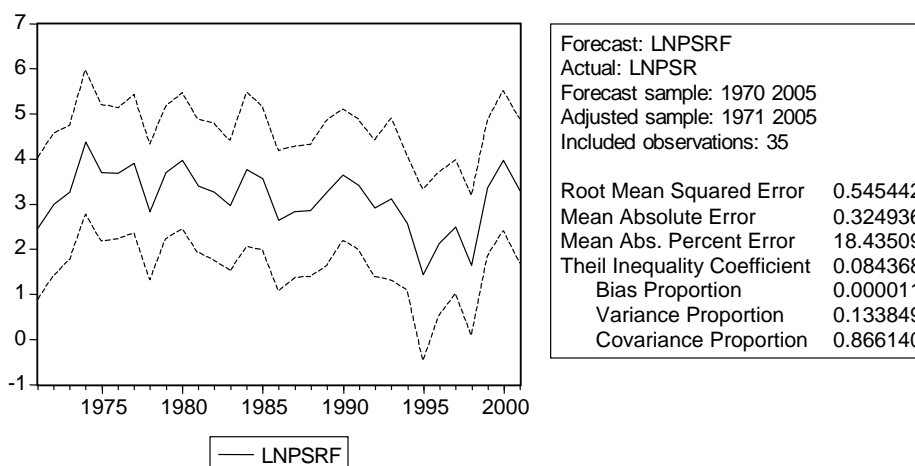
Chow Breakpoint Test: 1988

F-statistic	20.49045	Probability	0.000011
Log likelihood ratio	92.28518	Probability	0.000000

Table 13 **Chow Forecast Test**

Chow Forecast Test: Forecast from 1989 to 2005

F-statistic	114.8098	Probability	0.000000
Log likelihood ratio	162.2580	Probability	0.000000

Figure 4 **Predictive and Forecast Test****Growth Rate Model Results****Table 14** **Estimation of Results**

Dependent variable: D(LNPSR, 1)

Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.113099	0.153030	-0.739061	0.4681
LNDFD1	0.419755	0.964374	0.435261	0.6678
LNEDSR1	0.407652	0.282974	1.440598	0.1644
LNGRCY1	-0.373272	0.296317	-1.259702	0.2216
LNGSR1	-0.026791	0.188373	-0.142222	0.8883
LNINF1	-0.220252	0.250282	-0.880014	0.3888
LNRCY1	2.088010	1.441258	1.448742	0.1622
LNRIR1	0.215871	0.182707	1.181514	0.2506
LNTOT1	1.636744	0.434625	3.765880	0.0011
R-squared	0.564234	Mean dependent var		0.004568
Adjusted R-squared	0.398228	S.D. dependent var		1.032048
S.E. of regression	0.800600	Akaike info criterion		2.636416
Sum squared resid	13.46018	Schwarz criterion		3.056775
Log likelihood	-30.54623	F-statistic		3.398881
Durbin-Watson stat	2.694672	Prob(F-statistic)		0.011627

Figure 5 Histogram and Normality Test

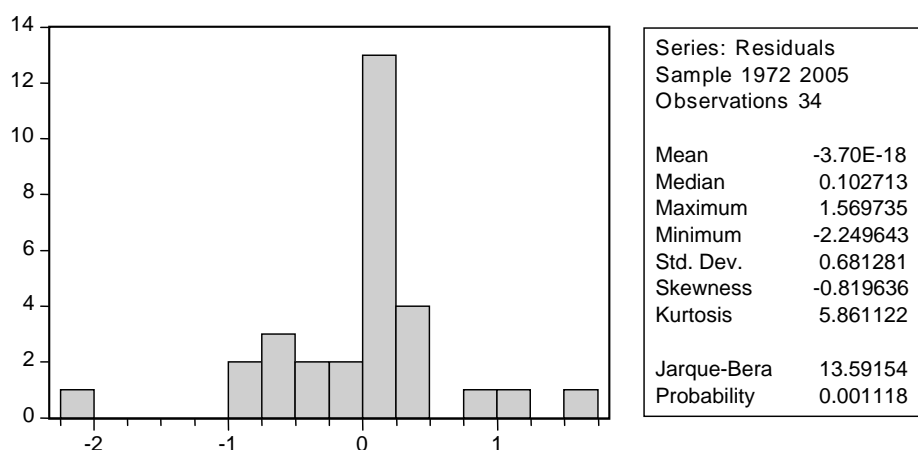


Table 15 Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	4.493368	ability	0.046730
Obs*R-squared	5.503573	Probability	0.018978

Table 16 ARCH LM Test

ARCH Test:

F-statistic	2.226311	Probability	0.147271
Obs*R-squared	2.209072	Probability	0.137201

Table 17 Chow Breakpoint Test

Chow Breakpoint Test: 1988

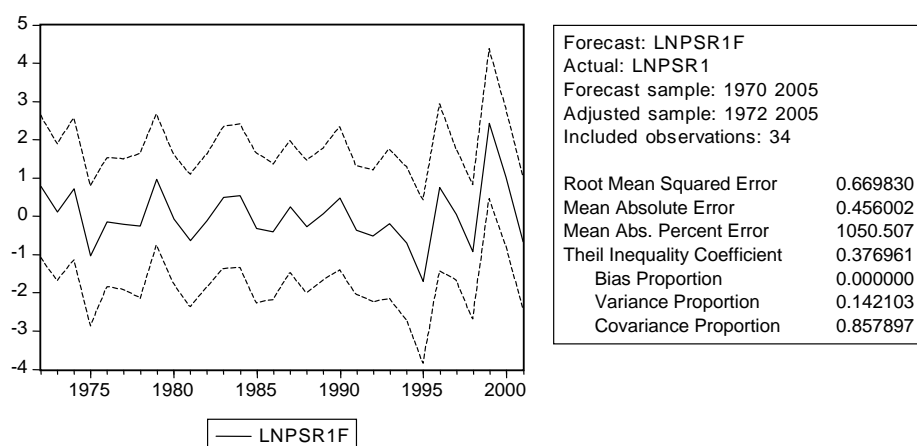
F-statistic	6.622026	Probability	0.001748
Log likelihood ratio	53.58491	Probability	0.000000

Table 18 Chow Forecast Test

Chow Forecast Test: Forecast from 1989 to 2005

F-statistic	77.25448	Probability	0.000001
Log likelihood ratio	145.2164	Probability	0.000000

Figure 6 Predictive and Forecast Test



Static Model Results

Table 19 **Estimation Results**

Dependent Variable: LNPSR

Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.939193	7.132174	-0.692523	0.4959
LNDFD	0.807228	0.701524	1.150679	0.2622
LNEDSR	-0.282467	0.184342	-1.532297	0.1397
LNGRCY	-0.312060	0.317289	-0.983521	0.3360
LNGSR	-0.103050	0.224257	-0.459518	0.6504
LNINF	-0.095998	0.261528	-0.367066	0.7171
LNRCY	1.199868	0.971670	1.234851	0.2299
LNRIR	0.229149	0.219751	1.042767	0.3084
LNTOT	1.613567	0.450362	3.582821	0.0017
R-squared	0.570243	Mean dependent var		3.139739
Adjusted R-squared	0.413968	S.D. dependent var		0.872820
S.E. of regression	0.668168	Akaike info criterion		2.269145
Sum squared resid	9.821854	Schwarz criterion		2.685464
Log likelihood	-26.17175	F-statistic		3.648971
Durbin-Watson stat	1.786929	Prob(F-statistic)		0.007551

Figure 7 **Histogram and Normality Test**

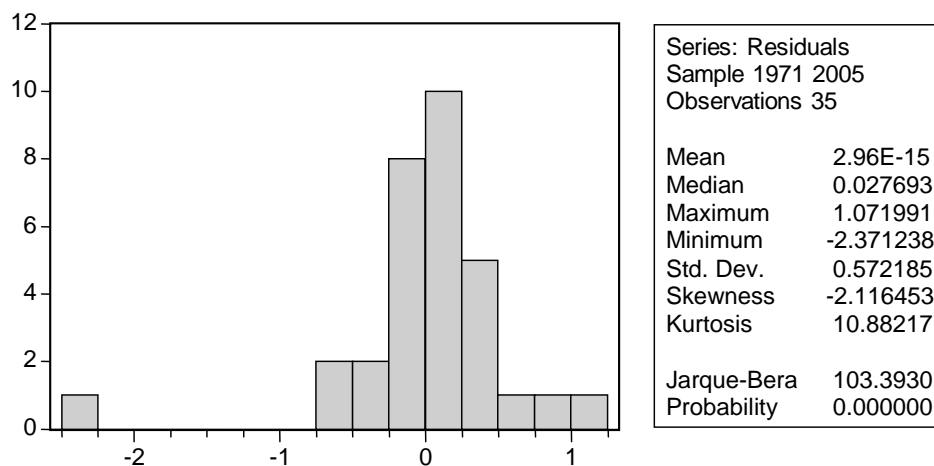


Table 20 **Serial Correlation LM Test**

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.033441	ability	0.856655
Obs*R-squared	0.049287	Probability	0.824309

Table 21 **ARCH LM Test**

ARCH Test:

F-statistic	0.131023	ability	0.720092
Obs*R-squared	0.139728	Probability	0.708552

Table 22 **Chow Breakpoint Test**

Chow Breakpoint Test: 1988

F-statistic	25.64682	ability	0.000001
Log likelihood ratio	90.87609	Probability	0.000000

Table 23 **Chow Forecast Test**

Chow Forecast Test: Forecast from 1989 to 2005

F-statistic	106.0939	Probability	0.000000
Log likelihood ratio	156.1952	Probability	0.000000

Figure 8 **Predictive and Forecast Test**

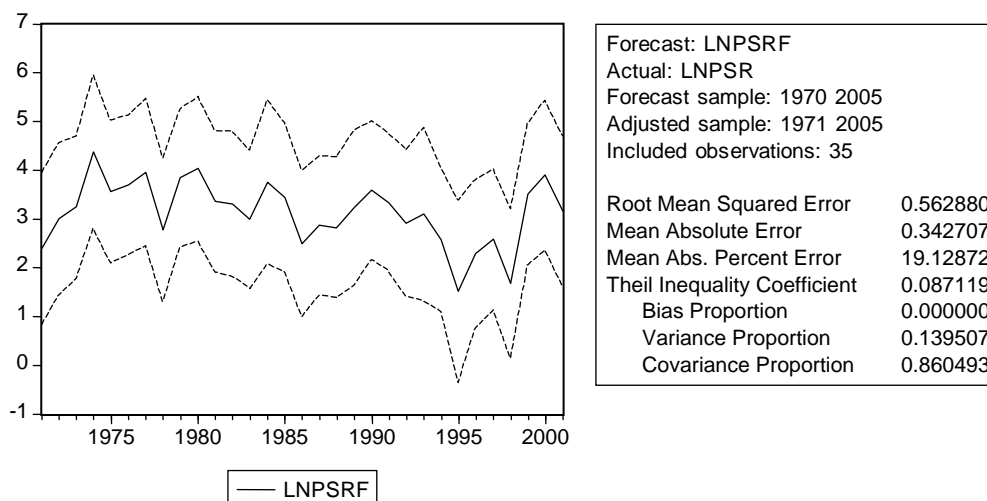


Table 24 **Summary of the Descriptive Statistics of the Variables under consideration**

	LNDFD	LNEDSR	LNGRCY	LNGSR	LNINF	LNPSR	LNRCY	LNRIR	LNTOT
Mean	-1.9557	-0.4184	-1.2614	2.3014	2.7501	3.1361	6.8865	3.7217	0.3187
Median	-1.9379	-0.1803	-1.1394	2.4464	2.6795	3.3339	6.8400	3.8999	0.2622
Maximum	-1.5654	2.0769	-0.3011	3.2503	4.2877	3.8649	7.3733	4.2808	1.1505
Minimum	-2.5510	-3.2188	-3.5065	-0.6931	1.1631	-0.6931	6.5235	-0.3566	-0.3710
Std. Dev.	0.2793	1.5908	0.6581	0.6979	0.8074	0.8588	0.2445	0.8149	0.3684
Skewness	-0.5954	-0.2238	-1.4200	-2.4983	0.1455	-3.1014	0.3450	-4.1109	0.2579
Kurtosis	2.3657	1.6633	5.6212	11.689	2.1236	13.805	2.0000	20.982	2.471
Jarque-Bera	2.4273	2.6493	19.292	133.96	1.1371	206.97	1.9680	521.27	0.7269
Probability	0.2971	0.2658	0.0001	0.0000	0.5663	0.0000	0.3738	0.0000	0.6952
Sum	-62.582	-13.391	-39.105	73.645	88.003	100.35	220.36	119.09	10.200
SumSq.Dev.	2.4191	78.455	12.995	15.100	20.210	22.867	1.8540	20.590	4.2079
Observation	36	36	35	36	36	36	36	36	36