DETERMINANTS OF AGGREGATE AGRICULTURAL SUPPLY RESPONSE IN NIGERIA (1960-2010).

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Abstract

The study investigated the determinants of aggregate agricultural supply response in Nigeria for the period spanning 1960-2010. The data were sourced from Central Bank of Nigeria Statistical Bulletin. The objective of the study was to determine the macroeconomic policy mix contributing to the aggregate supply response or aggregate agricultural output of Nigeria. The objective was achieved using regression analysis. The variables were tested for unit root and co-integration tests to determine the stationarity and long run equilibrium relationship between variables respectively. The results found out that 98 percent of the variations in aggregate agricultural output were explained by explanatory variables [inflation (infl), Exchange rate (Exc), foreign direct investment (fdi), interest rate (int), agricultural guarantee credit scheme fund (agcsf), recurrent expenditure (rec) and capital expenditure (cap)]. The results also revealed that exchange rate, foreign direct investment, agricultural guarantee credit scheme fund, Recurrent and capital expenditures were positively related to aggregate agricultural supply response while inflation and interest showed inverse relationship to aggregate agricultural output. The results concluded that FDI, INTR, AGCSF and REC were macroeconomic policy variables that contributed significantly to the aggregate agricultural output at between 5 and 1 percent probability levels respectively. Also, the results of causality test revealed a bi-directional relationship between GDP and AGR. The study therefore, recommended that for Nigerian government to achieve the desired transformation agenda on agricultural output, the significant macroeconomic policy variables are germane to sustainable economic growth and development and hence should be properly addressed

Keywords: Agricultural supply response, Unit root and Co-integration test, Nigeria**.**

Background

A "policy" is a statement of intent to achieve certain goal(s) by a local, regional or national governments of a country. A policy could be documented in legislation or other official documents. An agricultural policy framework sets out the objectives or goals desired by people in the improvement of their situation as well as the means or strategies for attaining them (Ijere, 1993). Agriculture is the cultivation of land, raising and rearing of animals for the purpose of production of food for man, animals and industries. It involves and comprises of crop production, livestock and forestry, fishery, processing and marketing of those agricultural production (Mabuza *et al*., 2008). Agriculture remains the mainstay of

the Nigerian economy despite its decline in the 1970s. Greater proportions of the population depend on the agricultural sector for their livelihood and the rural economy is still basically agricultural. The role of the agricultural sector in the overall response of the Nigerian economy to reform policies is important because, given its relatively large size; a large positive response to adjustment policies was expected as a means of improving the overall performance of the economy (Kwanashie *et al*., 1998).

One of the most important issues in agricultural development economics is supply response since the responsiveness of farmers to economic incentives largely determines agriculture's contribution to the economy. The response elasticities are also important for policy decision regarding agricultural growth. Thus, agricultural supply response represents change in agricultural output due to a change in agricultural output price. The concept of supply response is dynamic and different from supply function which is the static concept. The supply function describes a price quantity relationship, where all factors are held constant. The response relation is a more general concept; it shows the change in quantity with changes in prices as well as supply shifters (price of substitute, climatic conditions, technological progress, changes in the institutional and policy variables etc.), and therefore approximates to the long run, dynamic concept of supply theory (Amarnath, 2008). Nigeria has adopted a series of policies aimed, first, at preventing the collapse of the economy and subsequently targeted at short- to medium-term adjustment to ensure sustainable growth of the economy. For instance, Structural Adjustment Programme (SAP) was supposedly designed to induce structural and institutional changes necessary to reorganize the productive structure of the economy so that self-sustaining growth could be attained. The performance of the economy prior to SAP suggests that the responses of various sectors of the economy undershoot the targets.

The agricultural sector has the potential to be the industrial and economic springboard from which a country's development can take off. Indeed, more often than not, agricultural activities are usually concentrated in the less-developed rural areas where there is a critical need for rural transformation, redistribution, poverty alleviation and socio-economic development (Stewart, 2000). Nigeria's growth experience shows a gradual and steady performance in the immediate post-independence period, with a healthy balance of payments position through exports of cash crops. Marketing boards were used to extract surpluses from the agricultural sector, which were used to provide basic infrastructure. The development of the economy since 1960 has witnessed a declining share of agriculture in the gross domestic product (GDP). Agricultural export was the engine of growth prior to 1973, providing much of the revenue that the government used in developing a basic infrastructural system. Agricultural export also financed the import substitution industrialization programme. Increases in imports due to increasing income and the import requirements of the emerging industrial sector induced balance of payments problems in the late 1960s.

However, the agricultural sector suffered neglect during the hey-days of the oil boom in the 1970s. Ever since then Nigeria has been witnessing extreme poverty and the insufficiency of basic food items. Historically, the root of the crisis in the Nigerian

economy lies in the neglect of agriculture and the increased dependence on a mono-cultural economy based on oil. The agricultural sector now accounts for less than 5% of Nigeria's GDP (Olagbaju and Falola, 1996). It has been observed that the increased awareness of the importance of national policy coordination and planning have been matched neither by the quality of their planning nor by its results. The limited success Nigerian government has achieved in their quest for development effort since 1960 can be scarcely attributed directly to lack of suitable economic and political will in the national planning. It is therefore pertinent to monitor the response of agriculture to various policy measures.

In the light of the above, the study therefore seeks to determine the macroeconomic policy variables contributing to the aggregate agricultural supply response or aggregate agricultural output in Nigeria as well as determining the causal relationship between GDP proxy by economic growth and agricultural output. Lastly, offer suggestions on the macroeconomic policy mix that contribute significantly to agricultural output in Nigeria.

Statement of the Problem

The response of agricultural output in Nigeria has been slow in spite of the various agricultural and macro-economic policies. In fact, the government recognized the unhealthy condition of Nigerian agricultural sector since 1970, and has formulated and introduced a number of programmes and strategies aimed at remedying this situation. These measures included the setting up of large-scale mechanized farms by state and federal government, introduction of schemes such as the River Basin Development Authority. Other measures include, National Accelerated Food Production Programme (NAFP), Operation Feed the Nation (OFN), etc. (Enoma and Uniamikogbo , 2001). In addition to these measures, are the monetary and credit policy measures (such as the establishment of agricultural credit scheme, consolidation of banking industry), fiscal (incentives to boost investment and restrained external borrowing), external sector policy measures (exchange rate policy, tariff, import prohibition, export policy), were introduced by successive governments.

In spite of these measures, the development of the agricultural sector has been slow and the impact of this sector (Agriculture) on economic growth and development has been minimal (Child, 2008). This slow growth of agricultural production has generated some issues, among them are, the role of agriculture in providing food for the population; its role in supplying adequate raw materials to a growing industrial sector, its roles as a major source of foreign exchange earner etc.

1.2 Gross Domestic Product of Agricultural Sector at Current Basic Prices (N' Million)

Figure 1 shows the gross domestic products of various sub-sectors of agriculture since 1960. A cursory look at the comparison of the subsectors shows that crop production had been showing better performance, followed by livestock, forestry and fishing respectively.

However, despite the numerous policies and programmes, the growth rate of agricultural production has remained below expectation in terms of aggregate output response in relation to Nigerian population explosion which is on the astronomical level compared to other sub-Saran African countries.

Justification

The role of agriculture remains significant in the Nigerian economy despite the strategic importance of the oil sector. The need to restructure the agricultural sector in an effort to enhance its role in the transformation of the Nigerian economy had long been recognized in Nigeria. Therefore, there is a strong need to fill a gap in the literature by showing how agricultural productivity has evolved over the years as a result of various policy measures. Thus, a strong and efficient agricultural sector would enable a country to feed its growing population, generate employment, earn foreign exchange and provide raw materials for industries. Also, the agricultural sector has a multiplier effect on any nation's socio-economic and industrial fabric because of the multi-functional nature of agriculture.

Theoretical and Empirical Review

Current State of Nigerian Agriculture:

The neglect of the agricultural sector and the dependence of Nigeria on a mono-cultural, crude oil-based economy have not augured well for the well-being of the Nigerian economy. In a bid to address this drift, the Nigerian government as from 1975 became directly involved in the commercial production of food crops. Several large scale agricultural projects specializing in the production of grains, livestock, dairies and animal feeds, to mention but a few were established (Fasipe, 1990). Sugar factories were also established at Numan, Lafiagi and Sunti (Lawal, 1997). The Nigerian Agricultural and Co-operative Bank (NACB) was established in 1973 as part of government's effort to inject oil wealth into the agricultural sector through the provision of credit facilities to support agriculture and agro-allied businesses (Olagunju, 2000). In spite of these efforts, it is heartrending to note that as from the mid-70s, Nigeria became a net importer of various agricultural products. In 1982 alone, Nigeria imported 153,000mt tons of palm oil at the cost of 92 million USD and 55,000mt tons of cotton valued at 92 million USD (Alkali, 1997). Between 1973 and 1980, a total of 7.07 million tonnes of wheat, 1.62 million tons of rice and 431,000 tons of maize were imported. Thus, from N47.8 million in the 60s, the cost of food imports in Nigeria rose to N88.2 million in 1970 and N1, 027.0 million in 1988 (Alkali, 1997). Since the 1990s and until the recent ban on rice importation, Nigeria has been spending an average of 60 million USD on the importation of rice annually. Indeed, in 1994, the agricultural sector performed below the projected 7.2 per cent of budgetary output (Lawal, 1997). Between 1995 and 1998 the government further embarked on the reformation of the lending policies of the Agricultural Credit Guarantee Scheme (ACGS) for easier

access to agricultural credit schemes. It also established the Calabar Export Processing Zone (EPZ) and initiated the Enugu, Kaduna, Jos, and Lagos EPZs with each specializing in specific food and export crops. In fact, the National Rolling Plan for 1996-1998 assumed that by year 2000, Nigeria would have been able to feed its population, develop the capacity to process agricultural raw materials both for local industries and for export and significantly increase the contributions of the agricultural sector to the GDP (Lawal, 1997). These lofty objectives have turned out to be a mirage mainly because of official corruption and lack of commitment on the part of those saddled with the responsibility of implementing the government's agricultural policies. In order to get out of this doldrums, Nigerian policy makers need to be wary of development economists who assign a relatively minor role to agriculture in economic development and fervently believe that industrialization is synonymous with economic development (Ogen, 2002 and Ogundipe, 1998).

Mbanasor and Nwosu (1997) examined agricultural policies and sustainable agricultural investment in Nigeria. The paper identified inconsistencies, lack of effective monitoring and evaluation of policies, and poor implementation as critical to the non-achievement of sustainable agricultural development in Nigeria. In the theories of economic development propounded by Lewis (1954), he saw agriculture as the basis for industrial growth and development. He saw agriculture as freeing disguised labour for industrial production and hence the engine of growth and development of any society. In this sense, with heavy modernization and mechanization of agriculture, labour is free for industrialization.

Enoma (2010) investigated agricultural credit and economic growth in Nigeria. The study adopted regression and correlation analysis for his empirical findings. He found out that agricultural variables have impact on economic growth and their contribution to export growth was encouraging. As agriculture develops, it releases resources to other sector of the economy. This has been the base of successful industrialization in now developed economies such as United States, Japan or countries in European Union. Thus, agricultural development becomes an important pre-condition of structural transformation towards industrial development, as it precedes and promotes industrialization (Ludena, 2010). Lawal (1997) posited that agricultural sector contributes over 60 percent of the gross domestic product in the 1960s and despite the reliance of Nigerian peasant farmers on traditional tools and indigenous farming methods. These farmers produced 70 percent of Nigerian's export and 95 percent of its food need.

The role of government in economic management is performed through the formulation and implementation of economic policies. Scholars have shown that growth depends on the recipient actualization of economic policies and the general domestic environment and its potentials. Thus, indication of specific economic, social and political variables that determine foreign direct investment flows as well as the agricultural output growth of the economy (Van de Walle, 1996 and Galal, 2003). Udoh (2011) examined the relationship between public expenditure and private investment policies on agricultural output using Autoregressive Distributed Lag (ARDL) modeling otherwise known as bounds test approach to analyze both the short and long-run impact on agricultural output in Nigeria. The results however found

that increase in public expenditure has a positive influence on the growth of the agricultural output. Aliyu (2008) quantitatively assesses the impact of exchange rate volatility on non oil export flows in Nigeria through the use of Unit root tests and the Johansen cointegration tests. The empirical results show evidence of stationarity at levels for some variables while for some at first difference. Evidence of cointegration among variables were established using Johansen procedure. This implies that a stable long run equilibrium condition exists among the variables. Also, error correction models estimated showed a reasonable speed of adjustment towards the long run equilibrium path. Mishra (1998) attempted to assess the impact of economic reforms initiated in 1991 along with price and non-price factors on aggregate supply in the post-green revolution period. His results assured that the aggregate supply measured either through aggregate output or marketable surplus does respond significantly and positively to terms of trade.

Conclusively, previous studies on agricultural supply response used time series and panel data. Most of the studies applied Nerlovian Framework (1958). However, most economic time series data are trended overtime and regression between trended series may produce significant results with high R^2s; but may be spurious (Granger and New Bold, 1974). So, cointegration analysis and error correction model (ECM) was adopted to overcome the problem of spurious regression. Thus, the ECM takes into account the partial adjustment in production and the mechanism used by farmers in forming expectation.

Methodology

Data Sources: The data used for this study were based on time series data available from 1960-2010 (51 years). The period was purposely chosen so as to elucidate the most recent information on macro-economic policy variables in Nigeria. The data sources for this study includes publication from Central Bank of Nigeria (CBN) various issues, of annual report and statements of account and statistical bulletin; and internet publication of policy issues on agriculture in Nigeria. The data from this period present a considerable degree of freedom that is necessary to capture the net effect of explanatory variables on the dependent variables. The data were analyzed using descriptive statistics and inferential statistics.

Analytical Techniques: The analysis involves several steps. The first one is the testing for the stationarity properties of the data using the Augmented Dickey Fuller. Testing for stationarity is done by determining the order of integration of the series which may be 0,1,2,3, etc. designated I(0), I(1), I(2), I(3), etc. A data series is said to be integrated of order 'd', I(d), if it will be differenced 'd' times to produce a stationary series, so data series with order I(2) will have to be differenced twice to ensure stationarity. Thus, series must be differenced enough to achieve stationarity.

Cointegration test: After determining the order of integration of the variables, it is necessary to look for co-integrating vectors if all the variables are of the same order of integration. According to Sorensen (2005), the best way of testing for co-integration is by using the system of Maximum Likelihood (ML) estimator of Johansen (1991) which is a test for co-

integration with restriction using VAR representation. By definition two series y_t and x_t are set to be co-integrated if there exists a parameter α such that the residual $u_t = y_t - \alpha x_t$ is a stationary process. A co-integration test is used to check if long run relationship exists between variables.

Causality analysis: This is used to test the causality between variables of interest. The causality is either unidirectional or bi-directional. That is whether a variable is being influenced by the other variable or not. For instance, if $A = f(Y_t, X_t)$ and Y_t and X_t are pair of linear stationary time series. Thus, the Granger causality between Y_t and X_t in a linearised form can be stated as:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 X_{t-1} + U_{t1} \quad \text{.....1}$$

$$X_t = \beta_0 + \beta_1 X_{t-1} + \beta_2 Y_{t-1} - U_{t2} \quad \text{.....2}$$

Decision rule

(i) Xt causes Yt, if Ho:Bj =0, j = 1,2,3, …n is rejected
(ii) Yt causes Xt, if Ho: Xj=0, j=1,2,3, …n, is rejected
(iii) Xt and Yt causes each other if (i) and (ii) holds;
(iv) Xt and Yt are independent if both (i) and (ii) are not rejected.

Note that the decision rule for i-iv above is test of the null hypotheses that the estimated coefficients are equal to zero at an appropriate level of significance.

Model Specification: Modeling the interaction between agricultural output and macro-economic policy variables has generated the following models. That is, the determinants of the agricultural output for this study include the major distortions, constraints, exogenous shocks and changes in macro-economic policy is as defined below:

$$(Agr) = f(\text{infl, exr, fdi, int, agcsf, rec, cap, u}) \quad \text{.....3}$$

$$Agr = \Omega 0 + \Omega_1 infl + \Omega_2 exr + \Omega 3 fdi + \Omega_4 int + \Omega_5 agcsf + \Omega_6 rec + \Omega_7 cap + u_t \quad \text{... 4}$$

Equation (3) is a theoretical equation, which states that agricultural output growth (Agr) is a function of inflation in percentage (infl), Average exchange rate to dollar equivalent of various years (Exc), foreign direct investment in naira value (fdi), interest rate in percentage (int), agricultural guarantee credit scheme fund in naira value (agcsf), recurrent expenditure in naira (rec) and capital expenditure in naira (cap). The theoretical specification is evidence in the works of Enoma (2001) and Isedu (2008).

The behaviourial assumptions, the apriori, or the presumptive signs are as stated below:

$\Omega 1, < 0, \Omega 2 >< 0, \Omega 3 > 0, \Omega 4 >< 0, \Omega 5, \Omega 6, \Omega 7 > 0$ .Specifically, inflation and interest are expected to negatively related to aggregate agricultural output while exchange rate , foreign

direct investment, agricultural guarantee credit scheme fund, recurrent and capital expenditure are positively related to aggregate agricultural supply response.

Results and Discussion

The results of the regression analysis (table 3) from E-View software version 5.0 shows that about 98 percent of the total variation in aggregate agricultural output is being explained by the explanatory variables (inflation, exchange rates, foreign direct investment, interest rates, agricultural guarantee credit scheme fund, recurrent and capital expenditure). The results of the coefficients also show that inflation and interest rate show negative relationship with aggregate supply response. This implies that a unit increase in inflation and interest rates would bring about -1069.7 and -17196.99 increases in Agricultural output respectively. This result is however in line with our *a priori* expectation that a high rate of inflation and interest rate would have adverse effect on agricultural productivity as it would discourage savings and investments in the sector. Conversely, exchange rate, foreign direct investment, agricultural guarantee credit scheme, recurrent and capital expenditures all have positive relationship with aggregate agricultural output. This implies that a unit increase in all these macroeconomic variables would bring an increase in aggregate agricultural output or supply response. For instance, an increase in exchange rate policy compared to other country currency would make Naira more attractive for investors with a view to enhance investment in agricultural sector. Similarly, foreign direct investment being positive is an indication of the inflow of both tangible and intangible assets into the country. Agricultural guarantee credit scheme fund is a policy which gives credit with a view to impacting positively to the agricultural sector and thereby increases economic growth and sustainability. Thus, the positive coefficient of agcsf is an indication of contribution to the agricultural output response of Nigerian economy. The same applies to the recurrent and capital expenditure as it shows the expenses on the productivity of labour and infrastructure in agricultural sector. The positive coefficient is an indication of improved aggregate agricultural output response in the country.

Durbin Watson statistics value (1.5) shows that there is absence of autocorrelation. The F-statistics is also significant at 1 percent probability level showing fitness of the model.

Unit root test: The results of the augmented Dickey Fuller test (table 1) shows that about 3 variables (AGR, EXR, and REC) are stationary at first difference, INFL is stationary at level, FDI and CAP are stationary at second difference and AGCSF is stationary at 3rd difference and are also significant at either 1, 5 and 10 percent level. It should be noted that if ADF value is greater than Mackinnon critical values, the Null hypothesis of series having unit root is rejected, hence, the series is assumed to be stationary. However, this is necessary to avoid any spurious regression associated with time series data.

Co-integration test: The result of table 2 indicates 7 co-integrating equations at the $p<0.05$ level. However, the asterisk sign (*) denotes rejection of the hypothesis at the $p<0.05$ level.

This implies that the null hypothesis that no co-integration is rejected. Thus, the results revealed that the series are co-integrated.

Causality test: The result of causality test (table 4) shows that bi-directional relationship exists between GDP and AGR. The Null hypothesis that GDP does not Granger Cause AGR is rejected. Similarly, the AGR does not Granger Cause GDP is also rejected. This means that the assumption or hypothesis that AGR does not directly influence GDP was rejected. This is the F-statistics values are both significant at 1 percent probability levels. This implies that GDP influences AGR and AGR also influences GDP. Thus, economic policy aimed at improving agricultural sector would lead to economic growth (i.e GDP as proxy) and economic development of Nigeria.

Conclusion and Recommendation

This study investigated the effect of macro-economic variables on aggregate agricultural output with a view to determine the policy mix that will further enhance the national transformation agenda of the President Goodluck Jonathan led government in Nigeria. The results concluded that Foreign Direct Investment, Interest rate, Agriculture Guarantee Credit Scheme and Recurrent expenditure are macroeconomic policy variables that contributed significantly to the aggregate agricultural output at both 5 and 1 percent probability levels respectively. Also, the results of causality test revealed a bi-directional relationship between GDP and AGR. It is therefore recommended that for Nigerian government to achieve the desired transformation agenda on agricultural output, the impact of significant macroeconomic policy variables is a sin qua none for sustainable economic growth and development. Hence, measures towards their increased performance, effectiveness and efficiency should be prioritized and actualized. Furthermore, greater monitoring and evaluation of these variables should be the goal of succeeding governments and their policies. Thus, a country's agricultural sector is expected to play a particular role in her development performance as it determines the overall well-being of the population, particularly, for agrarian economies such as Nigeria and other developing countries with similar socio-economic characteristics.

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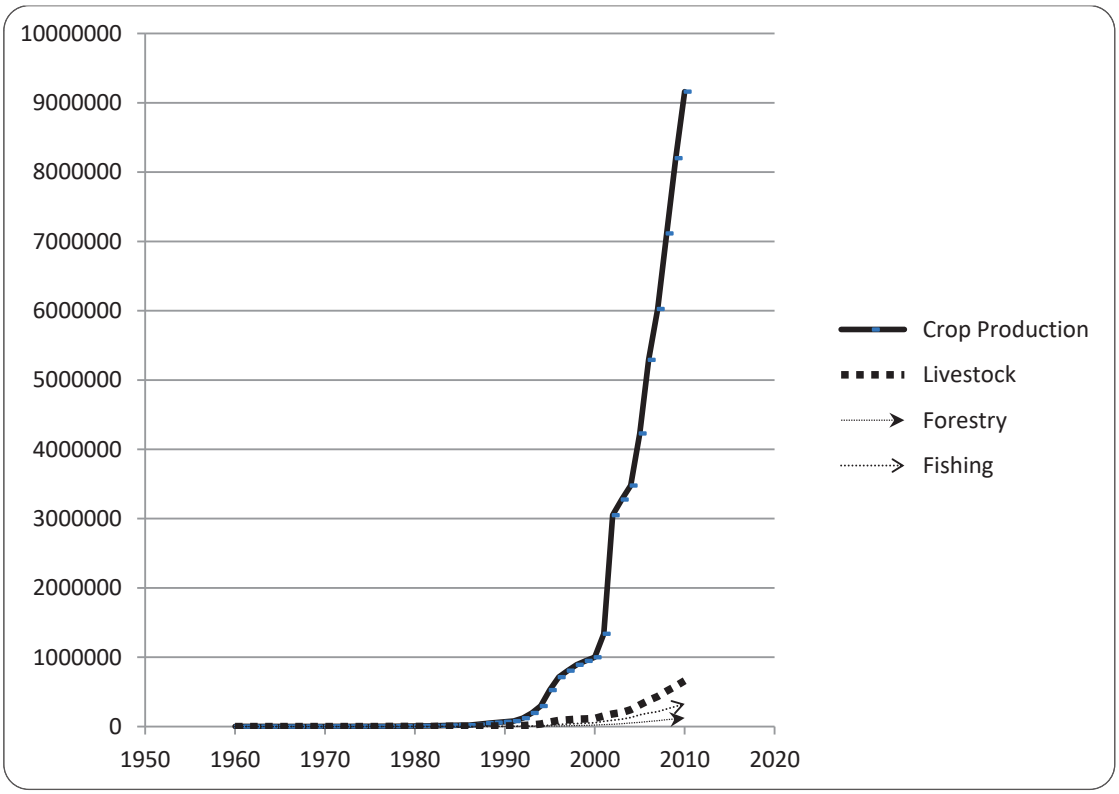

Figure 1: Domestic production of crop, livestock, forestry and fishing sub-sectors of agriculture (₦' million)

Table 1: Unit root test of variables

Variables	ADF value	Mackinnon critical values 1%	5%	10%	Decision
AGR	6.992	-3.6009	-2.935	-2.605	I(1)
INFL	-3.679	-3.568	-2.921	-2.598	I(0)
EXR	-6.401	-3.571	-2.922	-2.599	I(1)
FDI	-5.203	-3.605	-2.937	-2.607	I(2)
INTR	-9.352	-3.571	-2.922	-2.599	I(1)
AGCSF	-3.056	-3.581	-2.926	-2.601	I(3)
REC	8.352	-3.610	-2.939	-2.608	I(1)
CAP	-8.305	-3.605	-2.936	-2.607	I(2)

Source: Data analysis (2012)

Table 2: Co-integration test
Series: AGCSF AGR CAP EXR FDI INFL INTR REC
Lags interval (in first differences); 1 to 1
Unrestricted cointegration test of variables

Hypothesized No. of CE (s)	Eigen value	Trace statistic	0.05 critical value	Prob **
None *	0.996196	712.9357	159.5297	0.0000
At most 1*	0.988272	439.9199	125.6154	0.0001
At most 2*	0.847724	222.0789	95.75366	0.0000
At most 3*	0.690864	129.8579	69.81889	0.0000
At most 4*	0.522121	72.33326	47.85613	0.0001
At most 5*	0.324312	36.15180	29.79707	0.0081
At most 6*	0.263209	16.94262	15.49471	0.0301
At most 7*	0.039515	1.975552	3.841466	0.1599

Trace test indicates 7 co-integrating equation(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level*

Table 3: Regression analysis
Dependent variable: AGR Method: Least Squares Sample: 1960-2010
Included observations: 51

Variable	**Coefficient**	**Standard Error**	**T- Statistic**	**Probability**
INFL	-1069.780	3049.654	-0.350787	0.7275
EXR	1010.261	2434.540	0.414970	0.6802
FDI	5.954982	2.300646	2.588396	0.0131
INTR	-17196.99	8002.142	-2.149049	0.0373
AGCSF	0.118114	0.044298	2.666379	0.0108
REC	2.101485	0.245855	8.547651	0.0000
CAP	0.184355	0.658451	0.279982	0.7808
C	173490.6	105363.7	1.646587	0.1069
R-squared	0.987125	Mean dependent var		1264050
Adjusted R-squared	0.985030	S.D. dependent var		2546056
S.E. of regression	311519.3	Akaike info criterion		28.27941
Sum squared resid	4.17E+12	Schwarz criterion		2858244
Log likehood	-713.1250	F-statistic		470.9885
Durbin-Watson stat	1.537372	Prob (F -statistic)		0.000000

Source: Data analysis (2012)

Table 4: Pairwise Granger Causality Tests

Sample: 19602010 Lags:2

Null Hypothesis	Observation	F-statistics	Probability
GDP does not Granger Cause AGR	48	14.0272	2.0E-05
AGR does not Granger Cause GDP		5.71231	0.00631

Source: Data analysis (2012)