AGRICULTURAL SUPPLY RESPONSE TO TRADE AND EXCHANGE RATE REFORMS IN NIGERIA

Agricultural sector is next to oil sector in terms of revenue generation in Nigeria. With the increasing realisation to diversify the economic base of the country, policies and programmes aimed at bringing back the lost glory of agricultural sector had been put in place by successive governments since 1970s. Despite the policies and programmes, Nigeria is still a huge net importer of agricultural products, with imports of approximately $3.7billion and exporting $600 in 2007. Obviously there has been a disconnect between the policies and the goals they were set to achieve. The study therefore assessed the response of agricultural outputs and prices to trade and exchange rate reforms in Nigeria.

A Structural Vector Autoregression (SVAR) model based on Nerlovian Model as modified by Karbasi and Tavana framework that captures the impact of trade and exchange rate policies on agricultural output was employed. The model captured the effects of trade and exchange rate policy indicators (real exchange rate, degree of commercial openness, average price of agricultural commodity, acreage, labour and cost of agricultural machinery) on agricultural output.

On aggregate, real exchange rate was found to be positively related to aggregate agricultural output, while the trade policy proxy by the degree of commercial openness was found to be negatively related to output. Cost of agricultural machinery was also found to be negatively related to aggregate agricultural output.

Agricultural output responds more to price factors of trade and exchange rate policies than non -price factors of land and labour. Exchange rate stability that will aid farmers' planning is imperative. Improved seedlings and farming techniques and the use of machinery may be more significant in terms of contribution to agricultural production than conventional labouring work on farms. Trade liberalisation should emphasis more on export expansion.

1 **1. Introduction**

2   An examination of the economic history of Nigeria shows a twist in the fortune of the

3 economy's two leading sectors; agriculture and petroleum. Pre-independence and a few post-

4 independence years show that agriculture was the leading sector in the country until the

5 discovery of oil in commercial quantities in the late 1960s. In this period, Nigeria was the

6 world's second largest producer of cocoa, largest exporter of palm kernel and largest

7 producer and exporter of palm oil. Nigeria was also a leading exporter of other major

8 commodities such as cotton, groundnut, rubber and hides and skins (Alkali, 1997). In sum,

9 Nigerian economy could reasonably be described as an agrarian economy because agriculture

10 served as the engine of growth of the overall economy (Ogen, 2003). Presently, agriculture

11 and other solid mineral sectors have been relegated to the background. This is as a result of

12 the stupendous amount of wealth being generated from oil. Available statistics from CBN

13 Statistical Bulletin 2013 show that revenue from oil in 2008 was N6,530.60 billion while that

14 of non-oil revenue (agriculture inclusive) was N1,336.10 billion. By the end of 2013, the oil

15 revenue figure had risen to N6,809.23billion while that of non-oil revenue rose to

16 N2,950.56billion. However, with the increasing realisation of the country to diversify her

17 economic base, the apparent manifestation of the danger in monoculture nature of an

18 economy as well as the warning of possible exhaustion of oil, the direction of non-oil export

19 and in particular agriculture is being looked at.

20   Several policies, strategies and efforts have been put in place by successive governments

21 to see to the improvement of agricultural output and export performance. The policies such as

22 the fiscal, monetary, trade, exchange rate and general macroeconomic policies have been

23 made at one point in time to directly or indirectly influence positively, the performance of

24 agricultural sector in the country. The policies have acted most of the times as incentives to

25 alter the production pattern and hence the supply pattern of agricultural commodities in

26 Nigeria.

27   The problem of agricultural supply response is found in the disparity between

28 agricultural policies and the result obtained from those policies. Reports from Food and

29 Agricultural Organisation (2011), show that Nigeria is a huge net importer of agricultural

30 products, with imports of approximately $3.7 billion and exports of only about $600 million

31 in 2007. Nigeria is predominantly a bulk/intermediate commodity market and major imports

32 are wheat, rice and sugar. The United States is a leading exporter of agricultural products to

1 Nigeria ($725 million in 2007 compared to less than $500 million in 2006), the bulk of this

2 export to Nigeria is wheat. Even with the Agricultural Transformation Agenda that began in

3 2007, wheat importation in 2009 was 3,804 metric tonnes valued at US$926million. By 2011,

4 the importation has risen to 4,040 metric tonnes valued at US$1,475million.   In the case of

5 rice, quantity imported in 2009 was 1,161 metric tonnes valued at US$731million. Two years

6 later, 2,187 tonnes were imported valued at US$1, 242 million.

7   Of the fiscal, monetary, trade and exchange rate policies, two are germane to the issue of

8 agricultural production and export. These two policies are the trade and exchange rate

9 policies. Central to the two policies is the issue of pricing which is major determinant of

10 agricultural supply response to reforms and policies. (Kwanashie et al 1998, Adubi and

11 Okumadewa 1999, Bautista, 1987). The problem from the foregoing is that despite successive

12 governments' efforts, policies, strategies and recommendations to enhance the performance

13 of agricultural sector, agricultural output is yet to meet domestic demand and has greatly

14 reduced the export potentials of the country. The objective of this study is to assess the

15 response of agricultural output to trade and exchange rate reforms in Nigeria.

16

17

18 **2.   Background to the Study**

19   Nigeria has a highly diversified agroecological condition, which makes possible the

20 production of a wide range of agricultural products. Hence, agriculture constitutes one of the

21 most important sectors of the economy (Manyong et al, 2005). The sector accounts for about

22 70% of the nation's employment and it is divided into four main subsectors. These subsectors

23 are crop production, livestock, forestry and fishery in order of contribution to the nation's

24 gross domestic product. In 2013, the subsectors' contribution to agricultural GDP stood at

25 N18,883.08bn, N1875.78bn, N236.25bn and N528.39bn for crop production, livestock,

26 forestry and fishery respectively. (CBN Statistical Bulletin, 2016).

27   Crop production, which is largest subsector consist of mainly subsistence farmers who

28 depend heavily on the traditional farming tools of hoes and cutlasses and have little or no

29 knowledge about modern agricultural machineries and farming methods. This is one of the

30 many reasons why low agricultural productivity still prevails in comparison with the

31 agricultural outputs of comparable economies. In terms of climatic condition, the country is

32 blessed with diverse climate. From the tropical and swampy area in the southern part of the

1   country, to the very dry climatic condition in the north, it makes the cultivation of most crops

2   possible in the country.

3   The existence of small farmers notwithstanding, the presence of large scale mechanised

4   farming is being felt in the country beginning from 1999. Many agricultural based companies

5   are springing up in all the zones in the country. The efforts of the government in supporting

6   agricultural research and development has equally aided in this direction. The country can

7   boast of universities and colleges established mainly for the study of agriculture,   a bank of

8   agriculture supported by other financial institutions established with purpose of supporting

9   small and medium scale farming in the country. A lot of agricultural credit schemes are put in

10   place in virtually all the tiers of government. All these and many more constitute government

11   intervention programmes in boosting agriculture. Currently, although in recovery from

12   recession, the performance of Nigeria's agriculture is poor, given its past records and

13   abundant agricultural resources. (Ogunkola: 2008)

14

15   **2.1. Structure of the Nigerian Agriculture**

16

17   As stated earlier, the Nigerian agriculture is divided into four subsectors. The crop

18   production, livestock (animal husbandry), forestry and fishery. Each of these subdivisions of

19   has its own unique contribution to the overall growth of the sector. The contributions of each

20   subsector to overall agricultural gross domestic product are presented in table 2.1:

21

22   **Table 2.1.** *Structure of the Nigerian Agriculture*

Period	Crop Production	Livestock	Forestry	Fishery	Total
1981-1987	73.59	19.50	4.53	2.38	100.00
1988-1994	83.71	12.48	1.65	2.16	100.00
1995-2001	84.49	11.71	1.29	2.51	100.00
2002-2008	89.72	7.30	1.05	1.93	100.00
2009-2016	88.42	8.28	1.09	2.21	100.00

23   *Source: Calculated on the basis of CBN Statistical Bulletin 2016*

24

25   Crop production is the leading subsector in the agricultural sector. It constituted about

26   73.59% in the period between 1981 and 1987. By the period between 2009 and 2016, the

27   share of crop production in total agricultural production had risen to 88.42%. This subsector

28   was followed by livestock subsector that accounted for about 19.50% between 1981 and

1   1987. Livestock subsector however has been declining in its contributions to the overall

2   agricultural output as witnessed by the fall to 8.28% in the period between 2009 and 2016.

3   Fishery is about the third largest component of the whole agricultural output with 2.38%

4   share of contribution to total agricultural output between the period of 1981 and 1987. The

5   sector's contribution to overall agricultural output has been fluctuating since 1981 to 2016 as

6   evidenced by the rise to 2.51% between 1995 to 2001 and a fall to 2.20% between 2009 and

7   2016. Forestry is the least contributing subsector declining from 2.38% between 1981 and

8   1987 to 1.09% between 2009 and 2016.

9

10   **2.2. Agricultural Sector Performance in Nigeria**

11   The country's agricultural sector's performance can be viewed from many angles. These

12   include the sector's contribution to the GDP, the sector's contribution to total export

13   (especially non-oil export) and by extension, the sector's contribution to external reserves.

14   The sector is equally reputable for its contribution to employment generation, its contribution

15   to food security as well as provision of raw materials for the manufacturing industries. The

16   summary of the performance of agricultural sector is given in the table below.

17

18   **Table 2 .2.** *Agriculture's contribution to the Nigerian Economy (1981-2016)*

Indicators / Years ⟶	1981-1987	1988-1994	1995-2001	2002-2008	2009-2016
Agriculture (Percentage) of GDP	16.56	22.83	26.22	27.85	21.81
Agriculture (Percentage) of Non-Oil GDP	16.74	24.75	31.35	33.87	25.37
Agricultural Export (Percentage) of Export	47.6	41.9	21.5	17.7	31.18
Agricultural Export (Percentage) of Non-Oil Export	77.8	89.7	86.3	71.3	81.28
Agricultural Import (Percentage) of Import	10.6	15.21	10.8	11.76	12.09
Agricultural Import (Percentage) of Non-Oil Import	10.9	16.29	13.80	43.82	21.20
Growth Rate Of Percentage Of Agric Population In Total Population	-13.43	-16.82	-21.2	-26.9	-19.59

19   *Source: CBN Statistical Bulletin (Various Issues)*

20   Agriculture's contribution to gross domestic product has been steady for the past four

21   decades. Between 1981 and 1987, the sector's contribution to GDP stood at 16.56%. It rose

5

1   to 27.85% between the periods of 2002 and 2008, only for it to fall again to 21.81% between

2   2009 and 2016. The sector's contribution to non-oil GDP was a bit higher. The reason for this

3   was obvious. The bulk of what constitutes non-oil GDP is aggregate of the revenue from

4   agriculture and solid mineral resources. While agriculture had been the mainstay of the

5   Nigerian economy, solid mineral exploitation is just gaining attention. As a matter of fact,

6   attention to solid minerals resources became apparent from 2003, when the government

7   started intensifying efforts for economy diversification as the nation was too much dependent

8   on oil sector. With a 16.74% contribution in the periods between 1981 and 1987, the

9   contribution rose to 43.01 between 2009 and 2016. In terms of the contribution of

10   agricultural sector to employment, the population of agricultural sector declined by 13.43%

11   from the periods before 1981 to 1987. This further declined by 26.9% in the periods between

12   2002 and 2008. The drop in the agricultural population is partly because of the people's

13   attitude towards white collar jobs at the expense of farming jobs.

14   **2.3. Policy Environment for Agricultural Production**

15   The performance of agricultural sector is driven by various policies put in place by the

16   government. These policies have been problem specific and have been implemented over the

17   years to take care of agricultural sector related problems as they emerged. The policies range

18   from trade policy (export ban, import substitution, import prohibition etc) to fiscal policy

19   (export tax, export subsidies, import tariff) to monetary policy (government spending on

20   agriculture, controlling of cost and volume of agricultural credit and host of other agricultural

21   sector specific policies. All these policies are generally known to have been implemented to

22   solve problems relating to food crises, protection of domestic industries, encourage

23   competitiveness in the world market and balance of payment problem.

24   **2.3.1. Trade Policy Reforms**

25   External trade policy regulates external trade in line with the national objectives

26   (Analogbei, 2000). Nigeria's trade policies have been formulated to scuttle between trade

27   restrictions and liberalization, depending on the health of the economy. Some factors

28   influenced the choice of trade policy in Nigeria over the years. These factors include; revenue

29   generation, protection of domestic industries, protection of balance of trade position and the

30   maintenance of price stability, and lately, commitments to regional and multilateral trade

31   agreements (Adewuyi, 2006). The main focus of trade policies is on mechanism to regulate

1   export and import trade through such measures as tariffs, export and import quotas and

2   prohibitions. They influence the investment climate in many ways. For example, a liberal

3   trade policy constitutes an incentive for foreign investors who may need to import raw

4   materials and / or export products. But a protectionist trade policy may also serve as an

5   incentive for investors in non-tradable products that are largely locally consumed, or

6   investors in import -substitute products. The major policy instruments of trade policy include

7   import tariffs, export duties, quantitative restrictions on both export and import, import

8   licencing, import duties on agricultural commodities especially food items as well as import

9   prohibition strategy.

10   In the 1960s and early 1970s export duties, in the range of 5-60% were applied to

11   agricultural export crops such as cocoa, rubber, cotton, palm oil, palm kernel and gorundnuts.

12   (Ogunkola, 2008). These duties were abolished in 1973, however, as a result of oil boom and

13   the need to promote agricultural export as part of of the export diversification strategy. Thus

14   by the 1980s, there were no more export duties on agricultural crops. Export bans were

15   placed on many food crops in the early 1980s. Other major policy shift in trade policy is

16   initiation of interim tariff reduction introduced after the introduction of Structural Adjustment

17   Programme in 1986. Import prohibition is another important policy intstrument adopted by

18   Nigerian government to effect trade policy in the country. The list of items on the import

19   prohibition had been subjected to review and counter review over the years since pre-

20   independence years. By 1978, the number of import items on the list was about 76.

21   (Ogunkola, 2009). The number of items increased further, particularly during 1982 to1985.

22   Various trade policy reforms in Nigeria since independent are presented in schema

23   form below.

24

1   **Table 2.3.** *Schema of Trade Policy Reforms from 1977 to 2016*

S/N	Year	Policy	Policy Thrust	Remark
1	1977/1978	Trade restrictions were introduced.	Import licensing requirement and outright ban of some commodities were introduced.	Policies aimed at solving the BOP deficit.
2	1982	Restrictive trade policy continued.	Enactment of Economic Stabilisation Act	More items on import prohibition list
3	1995	Trade liberalization policy pursued.	Abrogation of the Nigerian Enterprises Promotion Decree of 1989 and the Exchange Control Act of 1962	Policy aimed at attracting foreign investors.
4	1999-2007	Trade policy as enshrined in the NEEDS[1].	The policy sought an improved investment in agriculture, its competitiveness in local and international market.	Policy aimed at making local industries more competitive.
5	2007-2015	Trade policy as contained in the 7-point agenda	The policy was a conscious efforts at revamping every sector of the economy	Policy aimed at technology transfer through trade liberalization
6	2015 till date	Trade Policy as contained in Economic Recovery and Growth Plan (ERGP)	The policy sought for diversification and inclusive growth in a market economy	Policy aimed at economic diversification driven by the private sector, and government initiatives to strengthen infrastructure - including the recently adopted power sector recovery plan

2   *Source: Author's compilation from Adewuyi (2006), Ogunkola (2008), Azih (2011), WTO 2017*

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[1] National Economic Empowerment Development Strategies of the Obasanjo Administration

1   **2.4. Exchange Rate Policy**

2   Exchange rate policy involves choosing an exchange rate system and determinig the

3   particular rate at which foreign excahange transaction will take place (Barth, 1992). It

4   encompasses the design and deployment of strategies to ensure the achievement of a stable

5   and realistic exchange rate for the country's domestic currency consistent with overall

6   macroeconomic policy objectives (Mordi, 2006). In determining exchange rate policy of

7   country, it is important to take cognisance of the country's economic features and peculiarity.

8   Among factors to be considered include reliance or not on primary production and export,

9   structural weakness as reflected in heavy reliance on the external sector for essential imports,

10   especially intermediate goods and raw materials and relatively low coefficients of price

11   elasticity of domestic and foreign demand for imports and exports respectively. Nigeria's

12   exchange rate policy had undergone series of changes since 1960 till date. Table 2.4

13   summarises the trends of exchange rate management in Nigeria.

14   **Table 2.4.** *Schema of Reforms in the Exchange Rate Management in Nigeria*

S/N	Year	Event	Remark
1	1959-1967	Fixed parity solely with British Pounds	Suspended in1972
2	1968-1972	Included the US dollars in the parity exchange	Aftermath of the 1967 devaluation of the pounds and the emergence of a strong US dollar
3	1973	Revert to fixed parity with British pounds	Devaluation of the US dollars
4	1974	Parity to both Pounds and Dollars	To minimise the effects of devaluation of the individual currency.
5	1978	Trade (import) weighted basket of currency approach	Tied to 7 currencies-British Pounds, US Dollars, German Mark, French Franc, Japanese Yen, Dutch Guilder and Swiss Franc.
6	1985	Referenced to the US dollars	To prevent arbitrage prevalent in the basket of currencies.
7	1986	Adoption of Second Tier Foreign Exchange Market (SFEM)	Deregulation of the economy
8	1987	Merger of First Tier and Second Tier market	Merger of rates

9	1988	Introduction of interbank foreign exchange market	Merger between the autonomous and the FEM rates
10	1994	Fixed exchange rates	Regulate the economy
11	1995	Introduction of the Automous Foreign Exchange Market (AFEM)	Guided deregulation
12	1999	Re-introduction of IFEM	Merger of the dual exchange rates, following the abolition of official exhange rate from Jan. 1, 1999.
13	2002	Re-introduction of Dutch Auction System	Retail DAS was implemented at first instant with CBN selling to end users through the authorised users (Banks)
14	2006 till date	Introduction of wholesale DAS	Further liberalised the market.

1   *Source: Adapted from Mordi, (2006).*

2   The effects of each of these policy regimes varied depending on the macroeconomic

3   objectives it set out to achieve. According to Obadan (2006), the exchange rate policies of the

4   1970s were aimed at equilibriating the balance of payments and preserving the values of

5   external reserves.The major impact of the policies during the period therefore was an

6   appreciation of the nominal exchange rates during the period. This led to heavy reliance on

7   import and discouraged the non-oil export especially agricultural products.

8   **2.5. Review of Related Literature**

9   Trade, exchange rate and other macroeconomic policies are important determinants of

10   the rate of overall economic growth. The broad performance of macroeconomic policies,

11   including fiscal discipline, adequate incentives for savings and investment, and an outward-

12   looking trade policy, is overwhelmingly conducive to economic growth. In addition to setting

13   the economic environment for overall growth, these policies also have a profound impact on

14   the performance of individual sectors of the economy such as agriculture. The connection

15   between trade, exchange rate and macroeconomic policies and their effects on agricultural

16   output and export as studied by scholars are abound in economic literature.

17   They include Nerlove (1958), Griliches (1959), Griliches (1960), Oyejide (1990), Hallam

18   and Zanoli (1993), Hag Elamin and El-Mak (1997), Kwanashie, Ajilima and Garba (1998),

19   Hallam (1998), McKay, Morrisey and Vaillant (1998), Fugazza (2004), Idsardi (2010) and

1   Ogunkola et al (2010). A thorough examination of the various studies on supply response

2   shows that in terms of theory, the studies of Nerlove (1956) and Griliches (1960) gave the

3   foundation upon which various studies were built upon. While Nerlove (1956) addresses the

4   supply response in relation to individual crops, Griliches (1960) addresses the supply

5   response in terms of aggregate crops.

6   According to Hallam (1998), the concern of supply response analysis is the response of

7   domestic agricultural production to changes in output and input prices, which may be policy-

8   induced. The focus may be aggregate agricultural output and its responsiveness to changes in

9   barter terms of trade where analysis of overall agricultural growth is the primary objective.

10   Alternatively, the focus may be on individual products to allow exploration of the effects of

11   price movements on the commodity composition of agricultural output, or to consider certain

12   products of particular quantitative importance in their own right.

13   McKay, Morrisey and Vaillant (1998) traces the response of agriculture to changes in

14   macroeconomic variables by examining the Nerlove (1958) model for single commodity and

15   the method developed by Griliches (1960) for aggregate supply response. According to the

16   study, the Nrlove's model describes the dynamics of agricultural supply by incorporating

17   price expectations and or adjustment costs. The model assumes that agricultural output is a

18   function of expectation of the price of the commodity at time t, where the expectation was

19   formed at time t-1. The model also assumes that the dynamic of supply is also driven by

20   adjustment cost. The adjustment cost can cause lags in the response of output to changes in

21   prices. This is important because when estimating supply response at aggregate level, moving

22   factors across sectors is likely to be a long and costly process. The study in terms of

23   theoretical underpinning concludes that both adaptive price expectation and the partial

24   adjustment hypothesis result in the same dynamic specification.

25   A further modification to McKay, Morrisey and Vaillant (1998) was developed by

26   Kidane (1999). In order to adapt standard economic theory to study supply response of

27   coffee, the study developed a model that provides a structural base for estimating response

28   relationships. The model that was applied was developed by French, King and Minami

29   (1985) and has five components. Four of the components of the study that are relevant were

30   considered. These include equations that explain desired production and acreage and new

31   plantings equation that shifts average towards the desired level. The other two components

32   are an equation that explains acreage removed each year and an equation that explains

33   variation in the values of average yields. According to the study the major determinants of

1   desired production are the expected profit of the tree crop and the profitability of alternative

2   uses of the land. On the other hand, expected profitability is a function of prices and costs.

3   While examining the effects of trade and exchange rate policy on agriculture in Nigeria,

4   Oyejide (1986) employed a wide range of theories to establish in terms of relative prices, the

5   degree of protection accorded by trade and exchange rate policies on agriculture. The theories

6   also examined how the dominant sector of petroleum affected production incentives in

7   agriculture. Government interventions in agriculture are intended to directly or indirectly

8   influence production, factor use, income and prices. Direct intervention is viewed from the

9   external and the domestic angles. The external involves government intervention in the

10 import of agricultural products, while the domestic entails government intervention in the

11 production and export of agricultural commodities. These interventions have incentives and

12 disincentives for agricultural sector.

13   The resource boom channel of the dutch disease model was used to analyse the impact of

14 petroleum sector on the agricultural sector. According to the theory, the rapid expansion of

15 the resource sector in a resource-exporting country affects the overall economy through a

16 network of interactions. The resource sector uses factors particularly labour and capital,

17 which if not brought in from abroad must be withdrawn from other sectors of the economy.

18 Expansion of the resource sector creates additional income, which generates expenditures.

19 The effects of these expenditures depend on the types of goods on which the increased

20 income is spent. The resulting spending pattern affects the demand and supply conditions in

21 the product's market. The sector's withdrawal of factors also impinges on the economy's

22 factor market. Thus expansion of the resources affects not only relative product prices but

23 also factor prices and exchange rate. The effect on exchange rate occurs because of the

24 expanding resource generates an inflow of capital, the spending which affect exchange rate.

25 Over the long run, a booming resource sector leads to changes in the sectoral structure of the

26 overall economy. The resource boom theory is subdivided into the spending pattern

27 mechanism and the resource movement mechanism. Each tries to establish a linkage between

28 the boom resource sector and its impact on other sectors, particularly agriculture.

29   One study to have responded to the frontier of research opened by Oyejide (1990) was

30 McKay, Morrisey and Vaillant (1998). Following the liberalization of agriculture policy

31 adopted in the wake of the introduction of structural adjustment programme in the country in

32 mid 80s, several price and non-price incentives were put in place by government in

33 anticipation of a positive response from the sector. The paper assesses that claim by

34 examining the supply response of agricultural output in Tanzania. The estimates suggest that

1 agricultural supply response is quite high so that the potential for agricultural sector response
2 to liberalisation of agricultural prices and marketing may be quite significant. The long-run
3 elasticity of food crop output to relative prices was almost unity; both food and aggregate
4 short-run response was estimated at about 0.35. The study concluded among others that
5 liberalisation of agricultural markets, where it increases the effective prices paid to farmers,
6 can be effective in promoting production, although complementary interventions, to improve
7 infrastructure, marketing, access to inputs and credit, improved production technology etc,
8 are probably necessary.

9   As a deviation from the estimation of the usual short and long run supply responses of
10 individual crop to changes in output and input prices, Kwanashe, Ajilima and Garba (1998)
11 estimate price and non-price supply response coefficients for selected tradeable and non-
12 tradeable crops. Adopting two-stage least squares method (TSLS) and seemingly unrelated
13 regression method (SURM), the study concludes among things that Short-run price
14 elasticities of individual crops are smaller than the long-run elasticities, and that Non-
15 tradeables are more responsive to short-run changes in prices than tradeables.

16   In response to frontiers opened by the study of Oyejide (1990), Kidane (1999) studies the
17 relationship between RER, price and supply response of coffee in Ethiopia. The objective is
18 to see if devaluation affects RER agricultural price and supply of coffee—a perennial crop
19 that is the major source of foreign exchange of Ethiopia. After developing a model of
20 perennial crop supply, panel data were gathered from small-scale farmers. Both descriptive
21 statistics as well as the econometric estimates (where fixed effect model was applied) showed
22 that there was positive response for both the short run and the long run. In the former farmers
23 were able to increase yield through increased use of labour and fertilizer on existing stock of
24 trees. There was also an increase in the uprooting of old trees and replacing them by new
25 ones, as well as the use of extra acreage at the expense of other perennials and annuals.

26   The model of Karbasi and Tavana (2008) defines the mechanism channels through which
27 the impact of trade and macroeconomic policies are transmitted to agriculture. Mechanically,
28 first macro policies are linked to agricultural prices and then production function for the
29 agricultural sector is specified. The link between macro policies and agricultural sector was
30 captured in a price function, where aggregate price for the sector was specified as a function
31 of the price of exportable and importable agricultural products as well as the domestic price
32 of the agricultural product. This price function is then subsumed into a production function
33 that includes other macroeconomic and trade variables that influence agricultural
34 performance.

1   **2.6.   Theoretical Framework and Methodology**

2   Agricultural supply response to trade and exchange rate policies has its theoretical roots

3   from the traditional supply theory, trade policy theory and exchange rate policy theory. The

4   supply of typical commodity all things being equal is a function of the price of the

5   commodity, prices of other commodities, prices of factors of production, the objective of the

6   producer, state of technology and a host of other related factors (Anyanwu et al, 1999). The

7   most important of the supply factors, the price is positively related to the quantity supplied.

8   According to Lipsey and Chrystal (2006), the quantity of any product that firms will produce

9   and offer for sale is positively related to the product's own price, rising when price rises and

10 falling when price falls, ceteris paribus. The extension of this hypothesis is found in

11 Kwanashie et al (1998). The basic position of the two studies is that agricultural supply

12 responds to both the price and the non-price factors.

13   The study however adopted the Nerlove (1956) model as modified by Karbasi and

14 Tavana (2008). The model adopted by the study defines the mechanism channels through

15 which the impact of trade and macroeconomic policies are transmitted to agriculture.

16 Mechanically, first macro policies are linked to agricultural prices and then production

17 function for the agricultural sector is specified. The link between macro policies and

18 agricultural sector is specified as;

19
$$P_a = P_x^{a_1} P_m^{a_2} P_h^{1-a_1-a_2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

20   Where P_a is the aggregate price index for the sector, a_1 and a_2 represent the shares of

21 exportable and importable agricultural products, respectively, in total agricultural output. The

22 production function for the agricultural sector is specified as:

23
$$y(x, \beta) = A\prod_{i=1}^{n} x_i \beta_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

24 Where

25
$$\ln A = a_0 + \sum_{k=1}^{m} a_k s_k + U_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

26 And

27
$$\beta_i = b_0 + \sum_{k=1}^{m} b_{ik} s_k + U_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

28 Y is the maximum level of output that can be produced from any given set of $X=(x_1, x_2, \ldots x_n)$.

29 $S=(s_1, s_2, \ldots s_n)$ is a vector of state variables and u's are the error terms. It is this production

1   function that the relative prices, and therefore macroeconomic and trade variables influence

2   agricultural performance.

3

4   **2.7. Model Specification and Estimation Procedure**

5   This study adopted the model of Karbasi and Tavana (2008) as presented in equation 2.

6   An investigation into the agricultural supply response to trade and exchange rate reforms

7   begins with empirical examination of the impact of the two policies on the prices of

8   agricultural commodities. The prices, which act as the incentives then inform the decision of

9   agricultural producers on what to produce. Following from the generic model in 2, the vector

10   of endogenous variables in the output-policies channel is presented as:

11

12   $AGRQ_t = f(APRC_t, REXR_t, DCO_t, MCTV_{it}, ACR_{it}, LAB_{it},)$…………………………… 5

13   Equation 5 is the model specified for the aggregate agricultural production function. Where

14   the seven variables in the model are the prices of the selected agricultural commodity

15   $(APRC_t)$, the average price of the agricultural commodities, REXR is the real exchange rate,

16   DCO is the degree of commercial openness, MCTV is the total value of agricultural

17   machineries, ACR is the acreage and LAB represents agricultural labour employed during the

18   period of study. The estimated equation gives answer to the broad objective of the study.

19   In terms of estimation procedure, despite the superfluity of methodologies so far use in

20   analysing supply response, this study has adopted the methodology of Structural Vector

21   Autoregression (SVAR). The SVAR model has proven to be especially useful for describing

22   the dynamic behaviour of economic and financial time series and for forecasting. It often

23   provides superior forecasts to those from univariate time series models. Following the

24   Cholesky ordering and based on economic theory; equation 5 can be represented as follows:

25   $AGRQ = f(REXR, MCTV, APRC, DCO, LAB, ACR)$........................6

26   Taking a cue from the Structural VAR equations above, $n(\frac{n+1}{2}) = 7(\frac{7+1}{2}) = 28$

27   restrictions on the model, and hence, $7^2 - 28 = 21$ more restrictions are required to identify the

28   structural matrix *B*

1
$$\tilde{Y} = \begin{bmatrix} b_{11}AGRQ & +b_{12}REXR & +b_{13}MCTV & +b_{14}APRC & +b_{15}DCO & +b_{16}LAB & +b_{17}ACR \\ b_{21}AGRQ & +b_{22}REXR & +b_{23}MCTV & +b_{24}APRC & +b_{25}DCO & +b_{26}LAB & +b_{27}ACR \\ b_{31}AGRQ & +b_{32}REXR & +b_{33}MCTV & +b_{34}APRC & +b_{35}DCO & +b_{36}LAB & +b_{37}ACR \\ b_{41}AGRQ & +b_{42}REXR & +b_{43}MCTV & +b_{44}APRC & +b_{45}DCO & +b_{46}LAB & +b_{47}ACR \\ b_{51}AGRQ & +b_{52}REXR & +b_{53}MCTV & +b_{54}APRC & +b_{55}DCO & +b_{56}LAB & +b_{57}ACR \\ b_{61}AGRQ & +b_{62}REXR & +b_{63}MCTV & +b_{64}APRC & +b_{65}DCO & +b_{66}LAB & +b_{67}ACR \\ b_{71}AGRQ & +b_{72}REXR & +b_{73}MCTV & +b_{74}APRC & +b_{75}DCO & +b_{76}LAB & +b_{17}ACR \end{bmatrix} \text{Thi}$$

2   s matrix can be represented as follows:

3
$$\begin{bmatrix} b_{11} & b_{12} & b_{13} & b_{14} & b_{15} & b_{16} & b_{17} \\ b_{21} & b_{22} & b_{23} & b_{24} & b_{25} & b_{26} & b_{27} \\ b_{31} & b_{32} & b_{33} & b_{34} & b_{35} & b_{36} & b_{37} \\ b_{41} & b_{42} & b_{43} & b_{44} & b_{45} & b_{46} & b_{47} \\ b_{51} & b_{52} & b_{53} & b_{54} & b_{55} & b_{56} & b_{57} \\ b_{61} & b_{62} & b_{63} & b_{64} & b_{65} & b_{66} & b_{67} \\ b_{71} & b_{72} & b_{73} & b_{74} & b_{75} & b_{76} & b_{77} \end{bmatrix} \begin{bmatrix} AGRQ \\ REXR \\ MCTV \\ APRC \\ DCO \\ LAB \\ ACR \end{bmatrix} = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \\ \varepsilon_7 \end{bmatrix}$$

4

5   To arrive at the recursive restriction matrix, the followings restrictions were made to

6   retrieve the structural shocks.

7   1. Aggregate agricultural output (AGRQ) is affected by all the variables in the model.

8   This is in consonance with the production function specified in equation 18.

9   2. Real exchange rates (REXR) are strictly exogenous in the contemporaneous period.

10   This implies that AGRQ, MCTV, APRC, DCO, LAB and ACR are not determinants

11   of REXR at time t.

12   3. MCTV is affected by only REXR. The reason as stated earlier.

13   4. Average price of the aggregate agricultural commodity (APRC) is affected by output

14   (AGRQ), real exchange rate (REXR) and cost of agricultural machinery (MCTV).

15   5. The restriction on the degree of commercial openness (DCO) is as stated in the

16   previous equation. The degree of commercial openness (DCO) is also affected by all

17   the variables in the model.

18   6. Both labour (LAB) and acreage are exogenous, as the two variables are not affected

19   by any of the variables that make up the model.

20   From the assumptions above, the following are applicable. In the case of REXR, LAB

21   and ACR that are assumed to be exogenous,

22   $b_{21}=b_{23}=b_{24}=b_{25}=b_{26}=b_{27}=b_{61}=b_{62}=b_{63}=b_{64}=b_{65}=b_{67}=b_{71}=b_{72}=b_{73}=b_{74}=b_{75}=b_{76}=0$. On the

1   restriction placed on MCTV, the implication is that other variables with the exception of real

2   exchange rates (REXR) do not affect cost of agricultural machinery. Therefore,

3     $b_{31}=b_{34}=b_{35}=b_{36}=b_{37}=0$. The average price of the commodity is assumed to be affected by

4   aggregate output (AGRQ), real exchange rates (REXR) and cost of agricultural machinery

5   (MCTV). This implies that $b_{45}=b_{46}=b_{47}=0$. Based on these restrictions, the resultant recursive

6   matrix is presented thus:

7

$$
B_0 = \begin{bmatrix}
b_{11} & b_{12} & b_{13} & b_{14} & b_{15} & b_{16} & b_{17} \\
0 & b_{22} & 0 & 0 & 0 & 0 & 0 \\
0 & b_{32} & b_{33} & 0 & 0 & 0 & 0 \\
b_{41} & b_{42} & b_{43} & b_{44} & 0 & 0 & 0 \\
b_{51} & b_{52} & b_{53} & b_{54} & b_{55} & b_{56} & b_{57} \\
0 & 0 & 0 & 0 & 0 & b_{66} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & b_{77}
\end{bmatrix}
$$

8   Expressing the restrictions in linear form, we have:

9   AGRQ= @e1 = C(1)*@u1

10   REXR= @e2 = C(2)*@e1 + C(3)*@u2

11   MCTV= @e3 = C(4)*@e1 + C(5)*@e2 + C(6)*@u3

12   APRC= @e4 = C(7)*@e1 + C(8)*@e2 + C(9)*@e3 + C(10)*@u4

13   DCO= @e5 = C(11)*@e1 + C(12)*@e2 + C(13)*@e3 + C(14)*@e4 + C(15)*@u5

14   LAB= @e6 = C(16)*@e1 + C(17)*@e2 + C(18)*@e3 + C(19)*@e4 + C(20)*@e5 +

15   C(21)*@u6

16   ACR= @e7 = C(22)*@e1 + C(23)*@e2 + C(24)*@e3 + C(25)*@e4 + C(26)*@e5 +

17   C(27)*@e6 + C(28)*@u7

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1 **2.8. Presentation and discussion of Results**

2 **2.8.1. SVAR Estimates of Aggregate Agricultural Output**

3

4 **Table 2.5.** *SVAR Estimates of Aggregate Agricultural Output*

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.013048	0.000677	19.28730	0.0000
C(2)	2.176015	0.302777	7.186852	0.0000
C(3)	-0.053879	0.002794	-19.28730	0.0000
C(4)	0.584957	0.521219	1.122287	0.2617
C(5)	- 0.072773	0.111668	-0.651697	0.5146
C(6)	- 0.082055	0.004254	-19.28730	0.0000
C(7)	1.607505	0.297524	5.402951	0.0000
C(8)	0.314494	0.063600	4.944861	0.0000
C(9)	-0.219161	0.041714	-5.253928	0.0000
C(10)	0.046681	0.002420	19.28730	0.0000
C(11)	-1.208410	0.111197	-10.86724	0.0000
C(12)	0.024966	0.023507	1.062092	0.2882
C(13)	0.038764	0.015533	2.495675	0.0126
C(14)	-0.123658	0.025478	-4.853585	0.0000
C(15)	0.016220	0.000841	19.28730	0.0000
C(16)	0.072374	0.010813	6.693503	0.0000
C(17)	-0.004181	0.001793	-2.331809	0.0197
C(18)	0.005340	0.001201	4.446640	0.0000
C(19)	-0.005065	0.002057	-2.462823	0.0138
C(20)	0.023475	0.005576	4.209870	0.0000
C(21)	0.001234	6.40E-05	19.28730	0.0000
C(22)	0.130146	0.035044	3.713765	0.0002
C(23)	-0.014181	0.005293	-2.679364	0.0074
C(24)	-0.012800	0.003675	-3.483211	0.0005
C(25)	0.014902	0.006080	2.450794	0.0143
C(26)	-0.072799	0.016979	-4.287552	0.0000
C(27)	0.177518	0.213337	0.832103	0.4054
C(28)	0.003589	0.000186	19.28730	0.0000

5 *Source: Author's Computation 2018*

6 Table 2.5 displays the estimates of SVAR model for the aggregate agricultural output

7 equation. It is the results of the model specified and estimated with the sole intention of

8 trying to examine the effects of trade and exchange rate reforms on aggregate agricultural

9 output. The twenty eight coefficients gives an insightful depiction of the kind of cross

10 relationships that exist among the variables that make up the model. The coefficients that are

11 of major concern to this analysis are C(2), C(3), C(4), C(5), C(6) and C(7). These are

12 coefficients of real exchange rates (REXR), cost of agricultural machinery (MCTV), average

13 price of the agricultural commodities (APRC), degree of commercial openness (DCO), labour

1   (LAB) and acreage (ACR). On the main variables of real exchange rates and the degree of

2   commercial openness, while real exchange rate was found to be positively related to output,

3   the degree of commercial openness was found to be negatively related to it. The impact of the

4   average price of the commodity on the aggregate output was equally positive and significant.

5   This relationship supports the traditional position of the law of supply that states that the

6   higher the price, the higher the quantity supplied all things being equal.

7   The implication of a real exchange rate being positively related to aggregate

8   agricultural output is that the nominal exchange rate is negatively related to it. This means

9   that the more the currency of the nation depreciates, the more the likelihood of agricultural

10   supply to increase. This is likely so, because of the fact that a currency depreciation means

11   more naira to the pocket of the farmers. This is enough incentive to increase production.

12   Trade policy captured by the degree of commercial openness also implies that the more the

13   country opens to the rest of the world, the less the agricultural production in the country. This

14   cannot be unconnected with the importation of everything agriculture especially food. A

15   policy which negatively affects agricultural production in the country. Other variables that

16   are of interest are the non-price variables of labour and acreage. While labour was found to

17   be negatively related to aggregate agricultural output, average was found to be positively

18   related to it.

19   The impulse response functions generated from the SVAR models reveals a total of

20   forty-nine impulses due to the fact that there are seven variables that are contained in the

21   model. Since the primary objective of the study was to examine the impact of trade and

22   exchange rate reforms on aggregate agricultural output, the variables of concern have been

23   extracted from the forty-nine impulses and presented in fig 1 below.

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1   **Fig 1.** *Impulse Responses of Aggregate Agricultural Commodity*
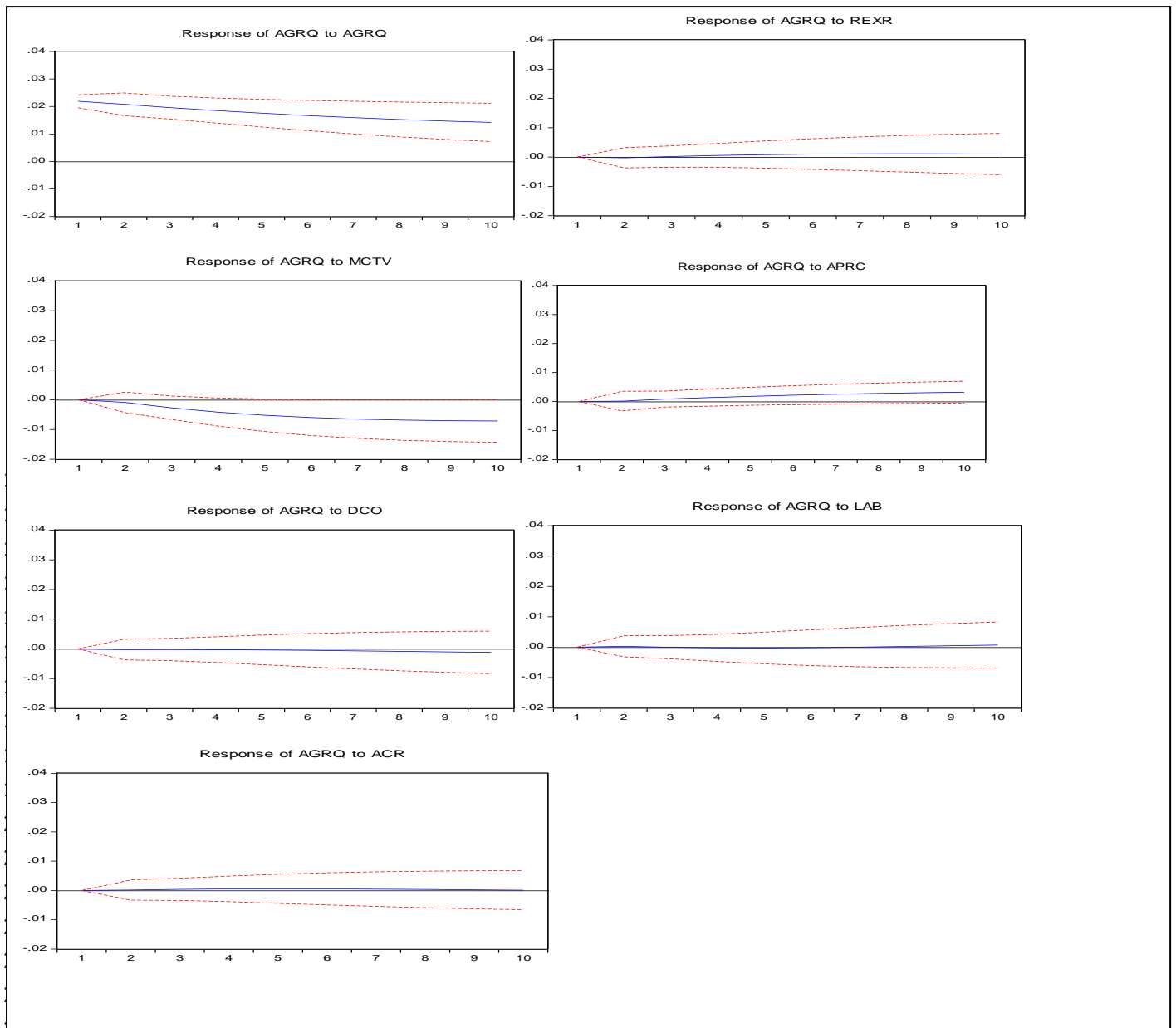
27
28

29   Figure 1 presents the impulse responses of aggregate agricultural output to exchange rate

30   and trade policy. The other variables that make up the system of SVAR include the average

31   price of agricultural commodity (APRC), land used for agricultural purposes represented by

32   acreage (ACR), agricultural labour force represented by (LAB) and cost of agricultural

33   machinery (MCTV). The first figure of figure 1 shows the response of agricultural output to

34   its own shock. A one standard deviation shock to agricultural output leads to a fall in

35   agricultural output from the first period to the tenth period, albeit positive movement.

1 The second figure of figure 1 shows the response of agricultural output to the shock from

2 real exchange rate. When the impulse is real exchange rate, response of agricultural output is

3 slightly positive. This is an indication of a positive relationship between real exchange rate

4 and agricultural output, although a very slight positive relationship. In the third figure, the

5 response of agricultural output to cost of agricultural machinery is such that a one standard

6 deviation shock in MCTV makes the agricultural output to fall up till the third period and

7 from the 4th period maintained a constant negative period till period 10. This is an indication

8 of a negative relationship between cost of agricultural machinery and agricultural output.

9 The fourth and the fifth figure of fig 1 explain the impact of the average price of

10 agricultural commodity and the degree of commercial openness on agricultural output. A one

11 standard deviation shock to average price of the commodity shows that agricultural output

12 does not respond to shock in the price between period one and two. From period three

13 upward to the tenth period, agricultural output steadily shows a positive response to the shock

14 in the price of agricultural commodity. Trade policy variable of degree of commercial

15 openness in the figure above shows that an insignificant negative relationship exists between

16 agricultural output and the degree of commercial openness. This type of relationship was

17 what was witnessed between agricultural output and other non-price variables of land and

18 labour.

19 **Table 2.7.** *Variance Decomposition of Aggregate Agricultural Output*

Variance Decomposition of AGRQ:							
Period	S.E.	AGRQ	REXR	MCTV	APRC	DCO	LAB	ACR
1	0.022	100.0000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.030	99.888	0.007	0.087	0.002	0.005	0.009	0.002
3	0.036	99.289	0.008	0.623	0.055	0.007	0.006	0.013
4	0.041	98.258	0.026	1.522	0.150	0.009	0.008	0.027
5	0.045	96.980	0.057	2.616	0.285	0.014	0.010	0.038
6	0.048	95.594	0.093	3.785	0.450	0.022	0.010	0.045
7	0.051	94.127	0.128	4.950	0.638	0.035	0.009	0.048
8	0.054	92.828	0.159	6.059	0.842	0.054	0.010	0.048
9	0.057	91.535	0.182	7.083	1.057	0.081	0.016	0.045
10	0.059	90.329	0.197	8.009	1.278	0.115	0.030	0.042

20 *Source: Author's Computation*

1   Table 2.7 shows the reports of variance decomposition of the first ten period horizon into the

2   future. The table shows that in the first period, variations in output are wholly explained by

3   own shocks. This implies that variations in output are hardly affected by other variables in the

4   first year. The table also shows that beside own contribution, variations in aggregate output

5   can only be attributed marginally to variations in labour, degree of commercial openness,

6   land and price. From the table, cost of agricultural machinery and average price of the

7   commodity are the most significant variables that affect variation in aggregate output apart

8   from its own shock. They accounted for 3.75% and 0.45% respectively in period 6 and by

9   period 10, it was 8.01% and 1.28% respectively. The major implication of this finding is that

10   price factors are more significant in explaining the variations in aggregate output than non-

11   price factors.

12   **2.9. Summary and Conclusion**

13   In a country that strictly wants to adhere to the principle of comparative advantage in the

14   production of commodities in which it has relative advantage over other countries, Nigeria

15   seems to be in the right direction in the choice of commodities that she is focusing on in

16   international market. Richly blessed with abundant natural resources, the focus was initially

17   on agriculture until another natural resource in crude oil took its place in the late 1960s

18   through the early 1970s. Not minding the successes recorded in oil trading with the world

19   body, successive governments in Nigeria seriously place premium on the development of

20   agricultural sector for all the benefits derivable from its enhancement. The provision of jobs

21   for teeming jobless masses, provision of food for the populace, provision of raw materials for

22   many established and upcoming industries and a host of other advantages associated with a

23   vibrant agricultural sector are the reasons why government have made policies and

24   programmes aimed at bettering the lots of the sector.

25   On the broad objective of analysing the effects of trade and exchange rate reforms on

26   aggregate agricultural output in Nigeria, the structural VAR estimates, the impulse response

27   function and variance decomposition of the aggregate agricultural output equation were

28   analysed. Agricultural output was specified as a function of real exchange rate, degree of

29   commercial openness, labour, average price of the commodity, acreage and cost of

30   agricultural machinery. While the real exchange rate was found to be positively related to

31   aggregate agricultural output, trade policy was found to be negatively related to aggregate

32   agricultural output. The implication of this is that nominal exchange rate was found to be

1 negatively related to aggregate agricultural output. This is because trade policy or exchange

2 rate will not directly affect the outputs of the commodities, but first affect the prices of those

3 commodities. As regards the negative relationship between trade policy and agricultural

4 output, this result is not unconnected with the weight of agricultural import over export as

5 reported in the background of the study. The fact that net agricultural trade is negative

6 explains why there is negative relationship between trade openness and the output of

7 aggregate agricultural commodity. Beginning from the 1980s, agricultural import has been on

8 the increase and has not abated till date. The increasing import over the dwindling export

9 exerts negative pressure on agricultural output. Thus the trade liberalisation policy of opening

10 the nation's agricultural trade to the rest of the world has not achieved the purpose for which

11 the policy was initiated.

12   While the above findings relate to the price factors in the aggregate agricultural output

13 equation, the cases of the non-price factors of acreage and labour as another important factors

14 in the output equation showed that while agricultural output responded positively to acreage,

15 the reverse was the case in the response of output to labour. Aggregate output responded

16 negatively to labour. An inference that could be drawn from this is that other non-price

17 factors of weather, improved seedlings and farming techniques and the use of machinery may

18 be more significant in terms of contribution to agricultural production than land and labour.

19 Cost of agricultural machinery was also found to be negatively related to the output of

20 agricultural commodities. This also is consistent with the effects on the domestic prices of the

21 commodities. Once the cost depresses the domestic prices of the commodities, its impact

22 would be on the supply for agricultural products will be negative.

23 **2.10. Policy Recommendation**

24   The findings noted above are not without policy implications. The first major finding is

25 that the impact of real exchange rate on the output of agricultural commodities is positive.

26 This is an indication of a negative relationship between nominal exchange rate and aggregate

27 agricultural output in Nigeria. It is therefore recommended that the monetary authorities

28 should design a mechanism for stable exchange rate that will aid farmers in their production

29 planning.

30   The country's trade policy over the years had been structured towards either restrictive

31 trade policy or liberalisation. Analysis from the available data shows that the country profits

32 more in terms of agricultural production under the liberalisation policy than restrictive.

However, empirical evidence shows that the liberalisation policy was biased in favour of agricultural import more than export. A situation that causes disincentives for farmers to produce for export. Therefore it is recommended that agriculture support programmes that focus on agricultural export be promoted over those presently used that focus on self-sufficiency in agricultural production. If the country must integrate with the rest of the world, we should be seen to be more active in exportation than importation.

It is also recommended that improved seedlings, fertilizer and modern farming and storage technology be given priority over the use of more land labour if agricultural output is to be enhanced in the country. This recommendation is not unconnected with the result of the empirical findings of the little relevance of labour and land in agricultural production in Nigeria.

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