The Long and Short Run Impacts of Food and Energy Price Shocks: Evidence from Nigeria

G.C. Aye[a,b]

[a]**Research Fellow, Department of Agricultural Economics, Extension and Rural Development, University of Pretoria, 0002 Pretoria South Africa**

[b] **Lecturer, Department of Agricultural Economics, University of Agriculture, Makurdi, P.M.B. 2373, Makurdi, Nigeria**

Email: aye_goody@yahoo.co.uk

Contributed paper presentated at the 56th AARES annual conference, Fremantle, Western Australia, February 7-10, 2012

The Long and Short Run Impacts of Food and Energy Price Shocks: Evidence from Nigeria

G.C. Aye[a,b]

[a]Research Fellow, Department of Agricultural Economics, Extension and Rural Development, University of Pretoria, 0002 Pretoria
South Africa

[b] Lecturer, Department of Agricultural Economics, University of Agriculture, Makurdi, P.M.B. 2373, Makurdi, Nigeria
Email: aye_goody@yahoo.co.uk

Abstract

The current global food crisis presents a puzzle, thus raising concerns among researchers and policymakers. A number of causes have been identified. However, the relative importance of each factor is still uncertain. In this study, the link between food prices and the various interconnected factors are modelled. The study also quantifies the current and future poverty impacts of rising food and energy prices under a number of scenarios. In general, it was observed that rising food and energy prices have adverse effects on the Nigerian economy and household welfare. Thus, the need for appropriate policy responses cannot be overstressed.

Keywords: fuel price, food price, climate change, poverty, Nigeria

Introduction

The world witnessed severe food crisis during 2007 and first half of 2008. Thereafter, food prices declined sharply partly due to the deflationary impact of the global financial crisis. This decrease is short-lived as international food prices again increased steeply from mid-2010 to early 2011, raising concerns across the developing world about a repetition of the

food price crisis of 2007-2008. As the world is trying to curb the menace of food price increase, oil price is also soaring (figure 1). This trend in food and oil prices is worrisome because of their potential impact on inflation, poverty and economic growth.

Rising food and oil prices can have detrimental impacts. Any policy capable of curbing the negative impacts needs to focus on the factors behind the hike in prices. A number of factors have been identified. However, the relative importance of each factor is still uncertain. Moreover, the quantitative estimates vary from one country to another (Olomola and Adejumo, 2006; Blanchard and Gali, 2007; Aksoy and Isik-Dikmelik, 2008; Dessus et al. 2008; Ivanic and Martin 2008; Wodon et al., 2008; Aliyu, 2009; De Janvry and Sadoulet, 2009; Kumar, 2009; Asian Development Bank, 2011; Fezzani and Nartova, 2011; Freire and Isgut, 2011; Heady, 2011; Ortiz et al., 2011). The large variations in quantitative estimates of impact of the food and oil price crisis can be explained by differences in methodologies and assumptions – which often are not clearly understood by policymakers. Against this background, this study develops a state-of-the art dynamic macroeconomic model that will effectively link food and oil prices to the various interconnected factors. The study also quantifies the current and future poverty impacts of rising food and oil prices under a number of scenarios.

The rest of the paper is organized as follows: the methodology and data used in analysis are presented in section 2. Estimation results are discussed in section 3. Section 4 Concludes.

Methods

The study develops a dynamic system of equations comprising both the long and short run behaviour of the variables of interest. The long run behaviour was modelled using cointegration approach. The short run behaviour was modelled using Granger error correction model (ECM). To model food and oil prices, the idea that demand and supply are equal to each other and also equal to price at equilibrium is employed. The system of equations also comprises other economic variables which may be impacted on by oil and food prices. The long run and short run equations do not necessarily contain same variables or number of variables. What determines the variables used in the final analysis are theory, ability to achieve both cointegration and error correction and also to pass the relevant diagnostic tests. Therefore, for brevity, the implicit form of the final equations estimated is given as:

$$foodp_t = f(m2_t, rgdppc_t, domfood_t, exch_t, open_t, oilp_t, \text{int}\, rate_t, foodp_{t-1}) \quad (1)$$

$$domfood_t = f(r\&d_t, rain_t, credit_t, domfood_{t-1}) \quad (2)$$

$$oilp_t = f(oilss_t, ref\_cap_t, US\_cpi_t, US\_reer_t, US\_bond_t, world\_temp_t, oilp_{t-1}) \quad (3)$$

$$rgdppc_t = f(oilp_t, foodp_t, findeep_t, savrate_t, open_t, exch_t, rgdppc_{t-1}) \quad (4)$$

$$cpi_t = f(oilp_t, foodp_t, rgdp_t, m2_t, \text{int}\, rate_t, cpi_{t-1}) \quad (5)$$

$$cab_t = f(oilp_t, foodp_t, rgdppcgr_t, popgr_t, depend_t, cab_{t-1}) \quad (6)$$

$$poverty_t = f(oilp_t, foodp_t, rgdppc_t, umemp_t, poverty_{t-1}) \quad (7)$$

where, $foodp$ is real food price index, $oilp$ is the real average spot price of Brent, Dubai and West Texas Intermediate crude oil, $m2$ is broad money supply; $rgdppc$ is real GDP per capita; $domfood$ is domestic food production; cpi is consumer price index; $exch$ is real exchange rate; $open$ is a trade policy variable calculated as ratio of export and import to GDP; $\text{int}\, rate$ is weighted lending rates; $r\&d$ is research and development investment; $rain$ is average annual rainfall; $credit$ is volume of credit by CBN's agricultural credit guarantee scheme fund; $oilss$ is oil supply worldwide; ref_cap is total refining capacity worldwide, US_cpi is United States consumer price index; US_reer is US real effective exchange rate; US_bond is US 10-year government bond; $world\_temp$ is average annual world temperature; $findeep$ is financial deepening indicator given as the ratio of M2 to GDP; $savrate$ is weighted savings rate; cab is current account balance; $depend$ is age dependency ratio; $poverty$ is poverty head count; $umemp$ is unemployment rate. Variables ending with gr are in their growth rates; t is time subscript.

All variables were tested for unit root using Augmented Dickey Fuller and Phillip-Perron unit root tests[1]. Result shows that they are all non-stationary in levels and integrated of order one. Hence, the log of first differences of the variables was used in estimating the ECMs. The annual time series data used were obtained from several sources. These include the FAO web data base, Central Bank of Nigeria, World Bank, ASTI, US Energy Information Administration and International Financial Statistics. Data was obtained for the period 1990

[1] Results for the unit root tests are available upon request from the author

to 2010. However, there were few cases of missing data which were imputed using the relevant average growth rates.

Results and Discussion

The procedure followed in doing the analysis is to ensure that all variables included in both the cointegrating and ECM equations are statistically significant. This is done to ensure the model produces a good and reliable forecast. Results of the long and short run estimates of the real food price equations are presented in Table 1. Domestic food production and openness contributed more to real food price than any other factor with both having price decreasing effects. In the short run, a 10% increase in domestic food production would cause real food price to decrease by 6.5% whereas it will decrease by 7.8% in the long run. With a 10% increase in trade liberalization, real food price will reduce by 5.3% and 5.7% in the short and long run respectively. The oil price has an increasing effect on food price both in the short and long run. For a 10% increase in real crude oil price, real food price would increase by 2.4% and 3.3% in the short and long run respectively. Money supply and exchange rate has increasing effect on food prices in the long run only while interest rate has a decreasing effect in the short run only. For a 10% increase in the previous year food price, the current food price would increase by 4.1 and 4.6% in the short and long run respectively.

Results show that investment in research and development and production credit contributed positively to domestic food production. Whereas the impact of climate change proxied by rain was negative in the long-run but positive in the short run (Table 2). Results of the long and short run estimates of the real oil price equations are presented in Table 3. Demand, supply and financial factors are included. With exception of US CPI, all other demand factors, namely US real effective exchange rate, US 10 year bond and average world temperature have an increasing effect on oil prices. The US CPI has both long and short run impact and these impacts are larger than any other factor included in the equation. The impact of US CPI is negative. This is not surprising because CPI inflation will reduce US demand for oil and being a major player in the oil market, oil price would likely decline. The least contributing factor is average world temperature.

Results for the real GDP per capita, consumer price index and current account balance are presented in Tables 4, 5 and 6 respectively. Food prices have short and long run effects on

real GDP per capita, CPI and current account balance. For a 10% increase in food prices, real GDP will decline by 7.5% and 9.4% in the long and short run respectively. Similarly, current account balance will decline by 2.3% and 2.8% in the long and short run respectively. However, CPI inflation will increase by 6.6% and 4.7% in the long and short run respectively. Oil price has an increasing effect on real GDP. The positive effect of crude oil price on GDP is not surprising because Nigeria is a crude oil producing country. For a 10% increase in crude oil price, real GDP would increase by 3.4% and 2.7% in the long and short run respectively. Similarly, for a 10% increase in oil price, the current account balance would increase by 1.4% and 1.6% in the long and short run respectively. For a 10% in oil price, CPI would increase by 5.4% and 3.2%.

The poverty respond estimates are presented in Table 7. Both oil and food prices have an increasing effect on poverty. However, oil price effect is only felt significantly in the short run. In the long run, a 10% increase in food prices will result into a 7.4% increase in poverty. In the short run, a 10% increase in food and oil prices increases poverty by 5.3% and 4.1% respectively.

In each of the estimated short run equations, the speed of adjustment is negative as expected and greater than -0.5. This implies that more than half of any disequilibrium will be removed in the short run in each case. This is interesting because any deviation from equilibrium can easily be restored.

To understand the future impacts of oil and food prices, the study developed three scenarios for forecasting the goal variables. In scenario 1, an annual 24% food price shock was introduced. This corresponds to the domestic food price average growth rate for the period studied. In scenario 2, oil price was increased annually by 12.3% which is the value for average growth rate of international crude oil price for the period under analysis. In scenario 3, food and oil prices were increased annually by 24% and 12.3% respectively. The forecast period is 2011 to 2015. The average percentage change in the goal variables are presented in Table 8. Under scenario 1, real GDP per capita and current account balance will drop by 16.4% and 5.4% respectively. CPI, naira to US dollar exchange rate and poverty will increase by 14.2%, 6.1% and 13.3% respectively. In scenario 2, all goal variables will increase. However, the percentage changes of goal variables in scenario 2 are higher than those of scenario 2 with exception of exchange rate. In scenario 3, real GDP per capita and

current account balance will decline by 11.7% and 4.1% respectively. CPI, exchange rate and poverty will increase by 10.2%, 8.5% and 11.9% respectively.

Table 1: Parameter Estimates of the Real Food Price Equation

	Long-run estimates		Short-run estimates	
Variables	Coeff.	T-ratio	Coeff.	T-ratio
$m2_t$	0.36	1.97	-	-
$rgdppc_t$	-	-	-0.34	2.88
$domfood_t$	-0.78	4.35	-0.65	5.60
$exch_t$	0.21	2.61	-	-
$open_t$	-0.57	2.64	-0.53	3.18
$oilp_t$	0.33	2.01	0.24	1.79
int $rate_t$	-	-	-0.15	1.73
$foodp_{t-1}$	0.46	2.56	0.41	2.08
Ecm(-1)	-	-	-0.68	4.46
Constant	2.87	5.03	1.93	6.11
Adj R2	0.97		0.86	

Table 2: Parameter Estimates of the Domestic Food Production Equation

	Long-run estimates		Short-run estimates	
Variables	Coeff.	T-ratio	Coeff.	T-ratio
$r\ \&\ d_t$	0.76	3.67	0.68	3.50
$rain_t$	-0.22	2.31	0.24	3.02
$credit_t$	0.57	5.01	0.42	4.43
$domfood_{t-1}$	0.15	1.67	0.13	1.98
Ecm (-1)	-	-	-0.82	4.80
Constant	7.23	3.97	7.41	3.64
Adj R2	0.97		0.93	

Table 3: Parameter Estimates of the Real Oil Price Equation

	Long-run estimates		Short-run estimates	
Variables	Coeff.	T-ratio	Coeff.	T-ratio
$oilss_t$	-0.06	3.33	-0.08	5.90
ref_cap_t	-0.02	2.51		
US_cpi_t	-0.72	5.01	-0.67	4.43
US_reer_t	-	-	-0.02	1.86
US_bond_t	0.15	1.71	-	-
$world\_temp_t$	-	-	0.01	1.64
$oilp_{t-1}$	0.02	2.56	0.11	2.03
Ecm (-1)	-	-	-0.72	3.80
Constant	5.23	1.97	7.42	2.62
Adj R2	0.78		0.84	

Table 4: Parameter Estimates of the Real GDP Per Capita Equation

	Long-run estimates		Short-run estimates	
Variables	Coeff.	T-ratio	Coeff.	T-ratio
$oilp_t$	0.34	1.67	0.27	1.96
$foodp_t$	-0.75	3.55	-0.94	2.05
$findeep_t$	0.65	3.62	0.44	2.67
$savrate_t$	-	-	0.14	1.82
$open_t$	0.41	2.33	-	-
$exch_t$	-	-	-0.63	1.84
$rgdppc_{t-1}$	-	-	0.72	3.25
Ecm (-1)	-	-	-0.86	5.06
Constant	3.44	2.85	3.21	2.54
Adj R2	0.88		0.92	

Table 5: Parameter Estimates of the Consumer Price Equation

	Long-run estimates		Short-run estimates	
Variables	Coeff.	T-ratio	Coeff.	T-ratio
$oilp_t$	0.54	2.17	0.32	1.66
$foodp_t$	0.66	2.64	0.47	1.98
$rgdp_t$	-0.59	3.78	0.40	3.44
$m2_t$	0.21	1.99	-	-
int $rate_t$	-	-	-0.14	3.12
cpi_{t-1}	0.62	2.51	-	-
Ecm(-1)	-	-	-0.71	2.04
Constant	3.08	4.11	2.34	2.34
Adj R2	0.79		0.84	

Table 6: Parameter Estimates of the Current Account Balance Equation

	Long-run estimates		Short-run estimates	
Variables	Coeff.	T-ratio	Coeff.	T-ratio
$oilp_t$	0.14	3.45	0.16	2.36
$foodp_t$	-0.23	2.03	-0.28	1.97
$rgdppcgr_t$	0.11	1.69	0.25	3.52
$popgr_t$			-0.33	1.98
$depend_t$			-0.44	1.64
cab_{t-1}	0.49	2.78	0.45	2.67
Ecm(-1)	-	-	-0.62	3.76
Constant	2.12	2.38	2.43	3.21
Adj R2	0.72		0.65	

Table 7: Parameter Estimates of the Poverty Equation

	Long-run estimates		Short-run estimates	
Variables	Coeff.	T-ratio	Coeff.	T-ratio
$oilp_t$	-	-	0.41	2.11
$foodp_t$	0.74	3.63	0.53	3.49
$rgdppc_t$	-	-	-0.58	5.47
$umemp_t$	0.89	3.12	-	-
$poverty_{t-1}$	0.08	2.06	0.02	2.36
Ecm(-1)	-	-	-0.54	3.05
Constant	7.04	3.33	5.67	3.77
Adj R2	0.63		0.66	

Table 8: Forecast of Food and Oil Price Shocks

	Scenario 1	**Scenario 2**	**Scenario 3**
rgdppc	-16.42	3.50	-11.74
cpi	14.23	5.36	10.21
exch	6.05	7.64	8.45
cab	-5.41	1.22	-4.09
poverty	13.26	4.93	11.87

Conclusion and Policy Implications

The study analysed the long and short run impacts of oil and food price shocks in Nigeria using a dynamic macroeconomic model. Results show that domestic food production is the most important determinant of food price in Nigeria. In general, food and oil prices were found to have an increasing effect on consumer price inflation and poverty in Nigeria. The results show that although Nigeria is an oil producing nation and therefore might benefit from increases in crude oil price shock, the benefits are far below the negative impacts of food price shock. This result is not surprising as agriculture contributes about 41% to the country's GDP. Moreover, Nigeria's share of world crude oil supply is very small, has little or no refining capacity and heavily imports refined fuel. These findings call for policies that will

improve agricultural productivity growth in Nigeria. This might range from price stability to R&D, monetary and climate change policies. Nigeria's continued dependence on crude oil revenue might plunge it into more crisis situations in the future if appropriate policy and reform measures are not taken.

References

Kumar, S. (2009) The Macroeconomic Effects of Oil Price Shocks: Empirical Evidence for India", *Economics Bulletin*, 29(1):15-37.

Fezzani, B. And Nartova, D. (2011) Oil Prices Fluctuation Impact on Iraq's Economy *European Journal of Social Sciences,* 26(4):626-632.

Olomola, P.A. and Adejumo, A.V. (2006) Oil Price Shock and Macroeconomic Activities in Nigeria. *International Research Journal of Finance and Economics,* 3: 28-34.

Aliyu, S.U.R. (2009) Impact of Oil Price Shock and Exchange Rate Volatility on Economic Growth in Nigeria: An Empirical Investigation. *Research Journal of International Studies*, 11: 4-15.

Blanchard, O.J and Gali, J. (2007) The Macroeconomic Effect of Oil Shocks: Why Are the 2000s So Different from the 1970s? National Bureau of Economic Research Working Paper 13368. http://www.nber.org/papers/w13368.

Freire, C. And Isgut A. (2011) High Food and Oil Prices and Their Impact on the Achievement of MDG 1 in Asia and the Pacific. Macroeconomic Policy and Development Division (MPDD) WP/11/18

Aksoy, M. A. and Isik-Dikmelik, A. (2008) Are Low Food Prices Pro-poor? Net Food Buyers and Sellers in Low Income Countries, World Bank Policy Research Working Paper No. 4642, June.

Asian Development Bank (2011) Global Food Price Inflation and Developing Asia, Manila. http://www.adb.org/documents/reports/global-food-price-inflation/food-priceinflation. pdf.

Dessus, S, Herrera, S. and de Hoyos, R. (2008) The Impact of Food Inflation on Urban Poverty and its Monetary cost: Some Back-of-the-Envelope Calculations. World Bank Policy Research Working Paper No. 4666, July.

Headey, D. (2011) Was the Global Food Crisis Really a Crisis? Simulations versus Self-Reporting, IFPRI Discussion Paper 01087, May 2011.

Ivanic M. and Martin, W. (2008) Implications of Higher Global Food Prices for Poverty in Low-income Countries. World Bank Policy Research Working Paper No. 4594, April.

De Janvry, A. and Sadoulet, E. (2009) The Impact of Food Prices on Household Welfare in India. Mimeo University of California at Berkeley, March.

Ortiz, I., Chai, J. and Cumming, M. (2011) Escalating Food Prices: The Threat to Poor Households and Policies to Safeguard a Recovery for All, UNICEF. Social and Economic Policy Working Paper, February.

Wodon, Q., Tsimpo, C., Backiny-Yetna,P., Joseph, G., Adoho, F. and Coulombe, H. (2008) Potential Impact of Higher Food Prices on Poverty: Summary Estimates for a Dozen West and Central African Countries. World Bank Policy Research Working Paper No. 4745, October.