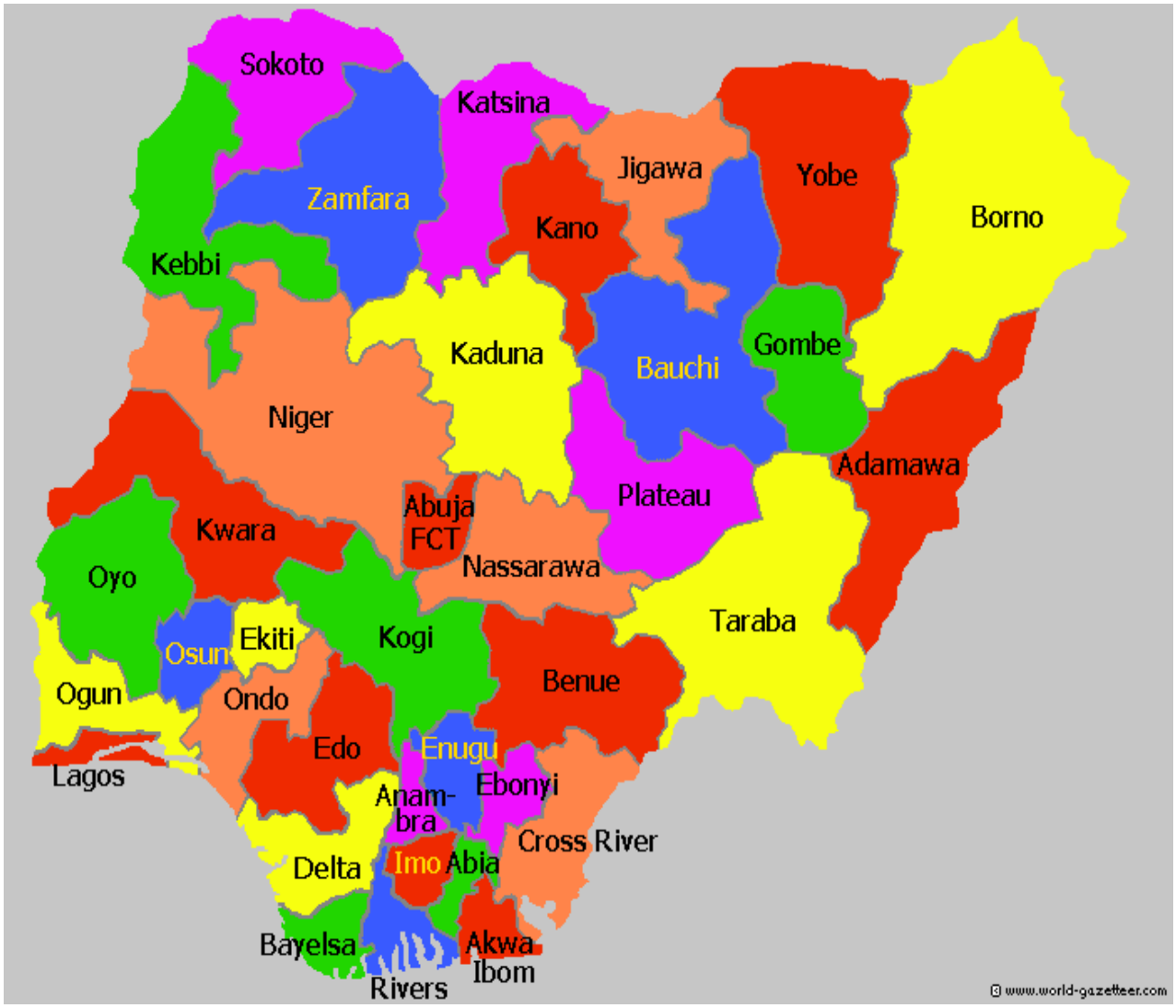
Nigerian Economy in the First Half of 2012 & Revised Economic Outlook for 2012 - 2015

September 2012

NATIONAL BUREAU OF STATISTICS

Administrative map of Nigeria showing the 36 States of the Federation and the Federal Capital Territory. Abuja



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Executive Summary

Against the background of the uncertain international economic environment, the first half of 2012 has witnessed positive rebound particularly greater activity in the financial markets (especially the bond market), increased lending to SMEs, improving power supply situation, recovery in real estate growth among others. However, there have also been a number of shocks in the Nigerian economy such as the continued pass-through effects of the increase in pump prices as a result of the partial removal of fuel (PMS) subsidy, periodic fuel scarcity across the country, increase in electricity tariff, increase in import tariffs of some major food items, security challenges and weather variations which support a cautious optimism regarding the country's growth projections in the very short term.

An assessment of the cumulative effect of all the above has necessitated a mid-year review of the projected levels and growth rates of major macroeconomic variables, specifically the gross domestic product, inflation rate and value of total trade. The Bayesian Vector Autoregression (BVAR) model which was used in the earlier forecast (April 2012 edition) has been updated with actual half year 2012 data for the relevant variables contained in the model.

In the first and second quarters of 2012, real GDP growth was estimated at 6.17% and 6.28%. This performance, which depicts a more resilient economy than expected, has resulted in an upward review of the forecast growth for 2012 to 6.77% compared to the earlier forecast of 6.5%. The revised forecast takes into consideration on-going government efforts at improving electricity generation and consumption, strengthening domestic production and maintenance of fiscal stability in the economy. Between 2013 and 2015, the economy is expected to grow in real terms at over 7% given the constraints experienced in 2012 (See table 1).

Table 1: Historical and Projected Growth rates for GDP, Inflation and Trade

Year	2007	2008	2009	2010	2011	2012f	2013f	2014f	2015f
GDP (%)	6.45	5.98	6.96	7.98	7.36	6.77	7.67	7.43	7.25
Trade (%)	5.08	16.88	-3	57.49	47.87	-6.5[1]	5.86	20.6	16.44
Inflation (%)	5.57	11.98	11.97	13.59	10.91	13.05	12.21	12.04	11.91

During the year, the average price level trended generally upward, as a result of the partial repeal of the PMS subsidy, higher transportation costs, as well as higher cost of certain services of which transportation forms a key component. The increase in electricity tariff took effect on June 1, 2012. However, the increase in electricity index was not significantly reflected in the all items index due to its relatively small weight. Overall, headline inflation rate was recorded at 12.9% by June 2012, an increase from the 10.3% recorded in December 2011. Over the first half of the year, the average inflation rate was recorded at 12.5%, up from 11.6% average during the same period last year. Based on revised estimates, the average inflation rate in 2012 is forecast at 13.05% and 12.21% in 2013.

In the first half of the year, the value of total merchandise trade stood at N13,929.2 billion compared to N13,224.4 billion recorded in the same period of the preceding year, an increase of N704.8 billion or 5.3%. The marginal increase in the value of total trade was largely as a result of declining imports while exports surged. Based on revised forecasts, total trade is expected to decline by 6.05 percent, and then rebound in 2013 to 5.86 percent. The decline in trade in 2012 could be partially due to the recent declines exhibited by the value of imports seen since the latter part of 2011 and which continued into early 2012, as well as the implementation of the import ban on certain products. Also, expected declines in crude oil exports will cause the value of total trade to decline. However beyond 2012, the value of total trade is expected to rebound driven by non-oil exports.

[1] Second Quarter Trade Estimates are Provisional

PART A 2012: THE First Half of the Year in Review

Introduction

This section provides a review of economic developments in Nigeria and trends in the major macroeconomic variables for the first half of 2012. The variables discussed in this section include Gross Domestic Product (GDP), Inflation and the Value of Total Trade.

A. Gross Domestic Product

Real GDP grew by 6.17 percent in the first quarter and 6.28 percent in the second quarter of 2012 as against 7.13 percent and 7.61percent in the corresponding quarters of 2011. The decrease in real GDP growth recorded in the first half of 2012 was as a result of slower growth in both oil and non oil sectors (notably Agriculture and wholesale and retail trade sector).

In the first half of the year, the average daily production was estimated at 2.37 million barrels per day (mbpd), as against 2.48 mbpd produced in the first half of 2011, according to NNPC. The decline of 4.4% in crude production levels was attributed to disruptions in production due to cases of oil theft and vandalization in the oil producing areas.

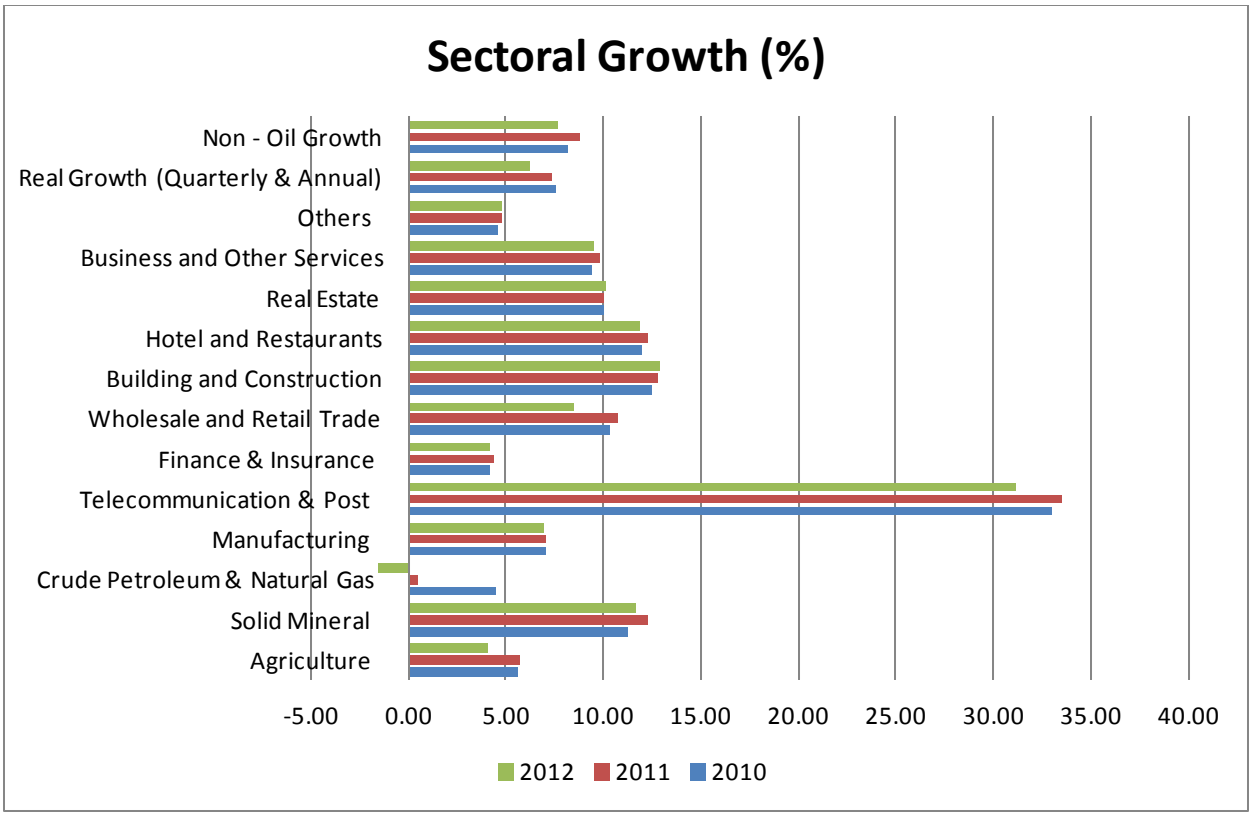
Agriculture growth was also slower in the first half of 2012. Agriculture is typically slower during the first quarter of the year but this was even more so this year due to security challenges. In the second quarter, security challenges in some northern states of the country which affected movement of farmers and in some cases, the relocation of their farm lands, coupled with flooding in some areas of the country contributed to the further decline in agricultural productivity.

Sector-specific summary analysis

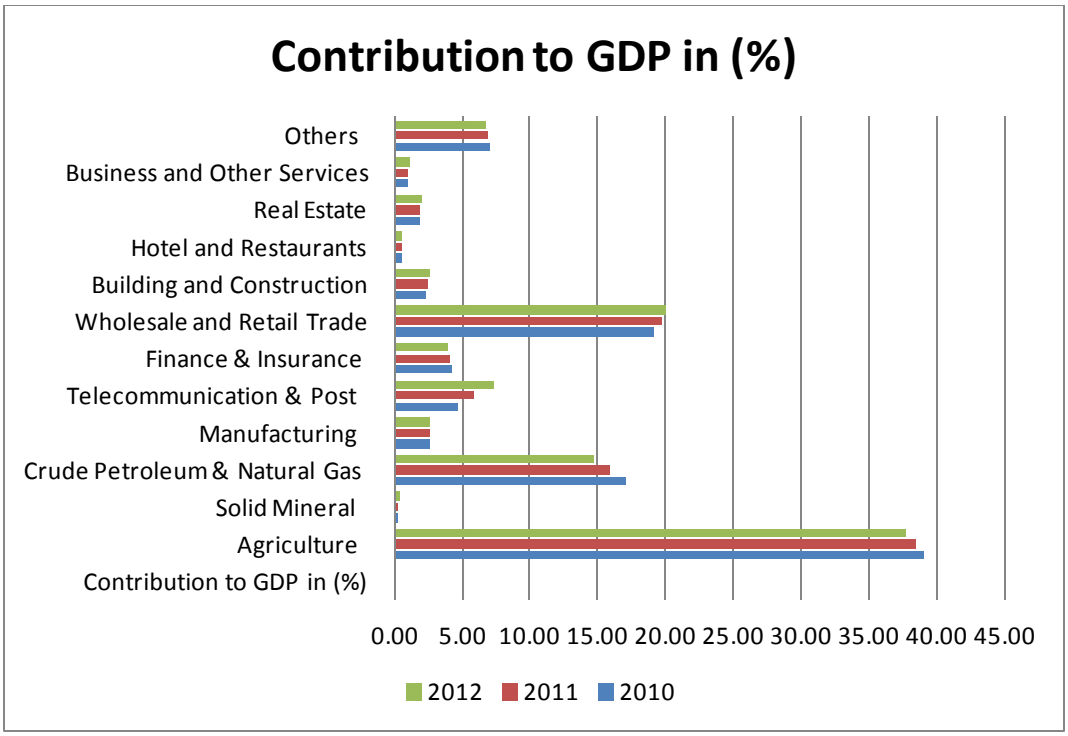
	2011				2012	
Sectoral Growth (%)	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**
Agriculture	5.54	5.95	5.6	5.74	4.15	3.97
Solid Mineral	12.86	11.82	11.56	10.31	11.69	11.75
Crude Petroleum & Natural Gas	0.05	0.98	-0.38	-0.4	-2.32	-0.73
Manufacturing	6.16	7.34	8.38	7.5	5.15	7.45
Telecommunication & Post	33.36	33.7	35.13	36.31	32.83	29.77
Finance & Insurance	4.11	4.61	3.95	3.22	3.53	4.77
Wholesale and Retail Trade	10.13	11.47	11.82	11.8	8.35	8.61
Building and Construction	13.22	12.24	11.32	12.05	13.25	12.47
Hotel and Restaurants	12.2	12.39	11.79	12.01	11.45	12.3
Real Estate	9.46	10.48	10.57	11.01	9.39	10.87
Business and Other Services	8.61	11.03	8.51	9.81	7.68	11.27
Real Growth (Quarterly & Annual)	7.13	7.61	7.3	7.68	6.17	6.28
Non - Oil Growth	8.73	8.85	8.7	9.07	7.93	7.5

While the Telecommunication and Post sector declined, by 2.33 percentage points during the half year, the sector still posted impressive growth rates at 31.21percent for the half year. This was as a result of muted consumer demand. Weaker consumer demand was also responsible for a decline in the wholesale and retail sector which declined by 2.26 percentage points to 8.47 for the half year from 10.72 percent the year before. Brighter spots were Building and Construction as well as Real Estate sectors which increased by 0.12 and 0.17 percentage points respectively.

Quarter-on-quarter analysis revealed a positive momentum in the economy after a turbulent first quarter. In particular, the manufacturing sector recorded an uptick from 5.15 percent to 7.45 percent, as electricity delivery improved reducing operating costs. The Finance and Insurance sector recorded an increase in growth there was increased activity in the bond market. Hotel and restaurants, Real Estate, and business and other services increased from 11.45 percent, 9.39 percent and 7.68 percent to 12.3percent, 10.87 percent, and 11.27 percent.



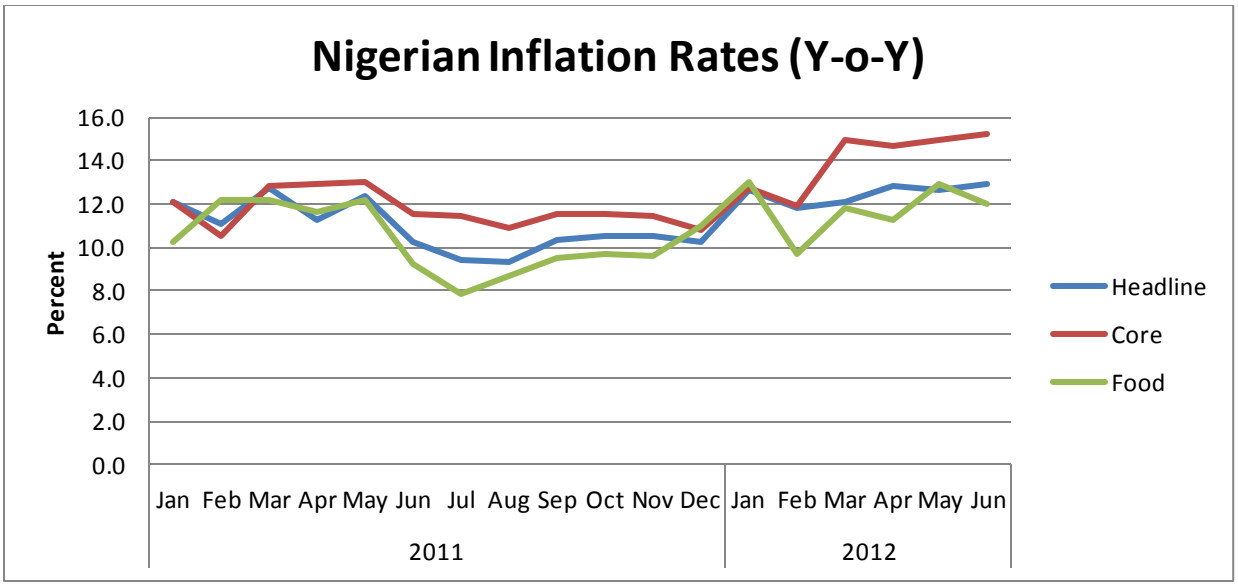
Analysis of contributions to GDP in the first half of 2012 indicates that there were declines in the contribution of the Agricultural sector by 0.79 percentage points year on year, as well as declines in the Crude Petroleum and Natural Gas sector by 1.17 percentage points. Sectors which recorded positive increases their share to GDP include Telecommunication and Post (1.39 percentage points), wholesale and retail (0.42 percentage points), building and construction (0.15 percentage points) as well as marginal increases in Manufacturing, and solid minerals



B. Inflation:

a. All items index

The Nigerian economy has experienced numerous shocks this year. Through August 2012, the country has been through a partial repeal of the Premium Motor Spirit subsidy, and the accompanying nationwide strike, increase in electricity tariffs, and an increase on the tariffs on wheat and flour. In light of the above developments by June 2012, the country's headline inflation rate trended higher during the first half of this year compared to 2011. The headline index was recorded at 12.9% in June 2012, an increase from the 10.3% recorded in December 2011. Over the first half of the year, the average inflation rate was recorded at 12.5%, up from the 11.6% average during the same period last year, and an average of 10.5% recorded in 2011 calendar year. By June 2012, the all items index increased by 12.6 percent from 10.3 percent in December 2011.



b. The "all items less farm produce" (Core) index

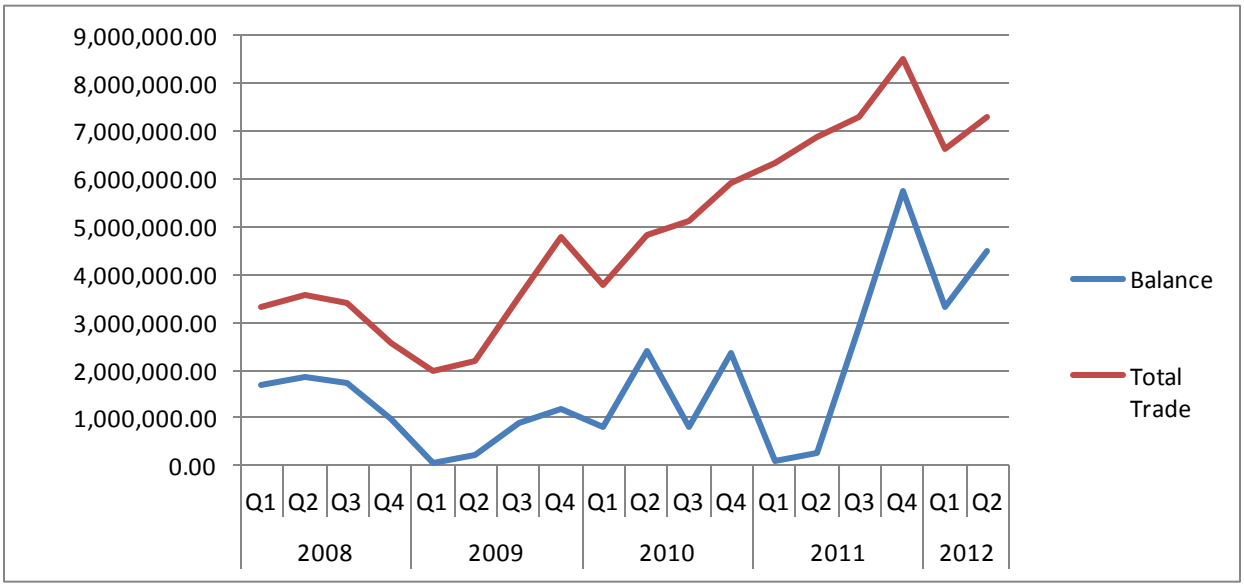
The "all items less farm produce" index (also known as the "core" index) which excludes prices of more volatile agricultural products has also trended higher during the first half of the year. The core index was recorded at 15.2% in June 2012, up from 11.5% recorded in June 2011. The build up in the core index has been as a result of the partial repeal of the PMS subsidy, higher transportation costs, as well as other related services of which transportation forms a key component, and higher price levels across other divisions that form part of the core index. The electricity tariff increase took effect 1st of June, 2012. However the increase in electricity index was not significantly reflected in the all items index due to its relatively small weight. The electricity tariffs are one of seven classes in the Classification of Individual Consumption according to Purpose (CPICOP) divisions titled "Housing, water, electricity and gas" and weights 1.6% of the overall index. The core index rose by 15.2 percent year-on-year in June 2011, up from 14.9 percent in May. On a month on month basis, the core index increased by 1.0 percent in June 2012. Over the half year, the core has averaged 14.1 percent, up from 12.2 percent in the half year of 2011.

c. Food index

After an initial spike to 13.1% in January, the Food index, which records prices of agricultural products, declined in June 2012 to12.0%. The food index has averaged 11.8% through June 2012, up by 0.5 percentage points from the corresponding period last year, and higher than the average for 2011 by 1.5 percentage points. The increases in prices were partially as a result of the planting season, as well as other secondary effects from the increase in PMS prices as a result of the partial repeal of the PMS subsidy.

C. The Value of Total Trade[2]

In the first half of the year, the value of total merchandise trade stood at N13,929.2 billion compared to N13,224.4 billion recorded in the same period of the preceding year, an increase of N704.8 billion or 5.3%. The marginal increase in the value of total trade was as a result of declining imports and increasing exports. Over the period, imports declined by 52.4% year on year to N3,060.7 billion, while exports increased by 60% to N10,868.4 billion. The increase in exports were as a result of increases in the value of both crude and non-crude oil exports which increased by 38.2% and 145.9% respectively over figures reported for the first half of 2011.



[2] Second Quarter Trade Estimates are Provisional

Figure5: Balance of Trade and Value of Total Trade 2010-2011 (Nmillion)

C. 1 Imports

The value of imports in the first half of the year stood at N3,060.7 billion compared to N6,432.9billion recorded in the corresponding part of the previous year, a decline of N3,372.2billion or 52.4%. On a quarterly basis, the value of imports were recorded at N1,652.3 billion recorded in the first quarter and N1,408 billion in the second quarter, a decline of 14.8%. The decline in imports over the 2012 half year was attributed to declines in Mineral Fuels, Crude inedible Materials, Manufactured goods and Transport Equipment. Asia ranked first with N1175.9 billion or 38.4%, according to imports by region over the first half of this year. This was followed by Europe contributing N879.7 billion or 28.7% and The Americas contributing N805.3 billion or 26.3%, of the total imports during the period under review. Africa contributed N113.7 or 3.7% of the total imports of which ECOWAS contributed N19.4 billion or 17% of the total imports from Africa.

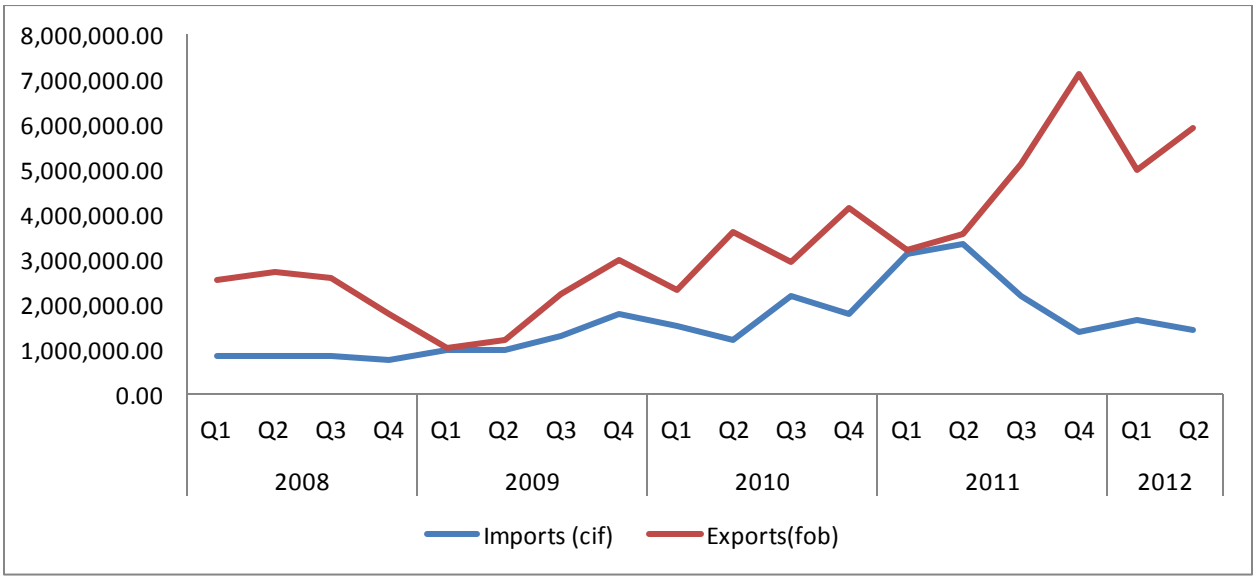


Figure 6: Total Import and Export Values (N'Millions)

C.2 Exports

In the first half of 2012, exports increased by 60% from N6,791.5 billion to N10,868.4 billion. The increase in exports were as a result of increases in the value of both crude and non-crude oil exports (in particular Plastics and Rubber articles, Prepared Foodstuffs, Vegetable products and Raw hides categories) which increased by 38.2% and 145.9% respectively over figures reported for the first half of 2011. Export by region in the first half of the year revealed that America recorded a value of N3,943.8 billion or 36.3% of exports. This was followed by Europe with N3676.4 billion or 33.8% and Asia with N2,124.6 billion or 19.6% respectively. ECOWAS contributed N313 billion or 39% of the total exports from Nigeria.

PART B: REVISED ECONOMIC OUTLOOK FOR 2012 – 2015

1. Introduction

In this section, the report provides further analysis of the trends described in Part A, and makes *revised* projections on the likely direction of the macroeconomic variables for 2012 to 2015. In addition, econometric evidence using a Bayesian vector autoregressive (BVAR) model is provided. The objective is to give baseline projections of the Nigerian economy over 2012 to 2015 given historical data.

The key macroeconomic variables used in projections are GDP, the headline inflation rate, exchange rate, interest rate, oil exports, nonoil exports and value of total trade. In addition, for GDP, inflation, and trade, we consider it important to forecast their growth rates as well. That Nigeria is a small open economy informs that it is necessary to incorporate a measure of foreign demand into the projections. This is proxied by GDP estimates of the United States of America. Also important to the analysis is that Nigeria is a major oil exporting economy. Hence an attachment of the importance of crude oil price in forecasting the future trends of the endogenous variables. In this section of the report, results of the analysis and some pointers on what the results suggest for the economy are presented.

2. Overview of methodology[3]

In going about the set objective, the estimation technique used is called the Bayesian vector autoregressive (BVAR) approach. This method was chosen after the classical VAR failed the stability test. In forecasting, it is a basic prerequisite that the estimated system be stable, otherwise such instability will filter into the data, implying that the forecasts cannot be carried out with an acceptable measure of reliability. An associated problem also is that one is not able to control much of the classical VAR model conventionally and generally used for this purpose. Hence, the BVAR is employed. In BVAR, the analyst is granted some measure of control through the use of prior information. What is done is to downplay past influences on the present

[3] More detailed technical notes on the BVAR model are provided in Appendx II.

by weighing the lags appropriately. The model emphasizes the importance of own-lags of a variable relative to those of the other explanatory variables. Stability was achieved by invoking the Litterman priors and the model yielded more reliable results in comparison with the VAR.
It is important to highlight that the following projections are based on quarterly data from 1996 through 2011. Specifically, the projected growth rate for real GDP are computed from the trends of the historical GDP series, extracted using the HP filter. Thus, the report presents a "base-line" forecast from 2012-2015 given historical trends in the economy up through 2011.

3.

The projections for the annual growth rate of real GDP, annual inflation rate, and the annual growth rate of the Value of Total Trade from 2012 through 2015 are reported in Table 1 (See Appendix I), while Table 2 presents their quarterly projections. Table 3 gives the forecast levels for real GDP and Value of Total Trade from the BVAR model. The projected growth rates are calculated based on a year-on-year approach. We now highlight the projected series for the variables.

3.1 Gross Domestic Product

The growth rate of the nation's GDP derived from the BVAR model projections (based on the trends extracted from the HP filter) are adjusted in light of actual economic estimates for the first and second quarters of 2012. The revised projected growth rate of real GDP in 2012 is 6.77%, a decrease from 7.36% posted in 2011. Figure 7 below graphically illustrates the average annual growth for real GDP up to 2015.

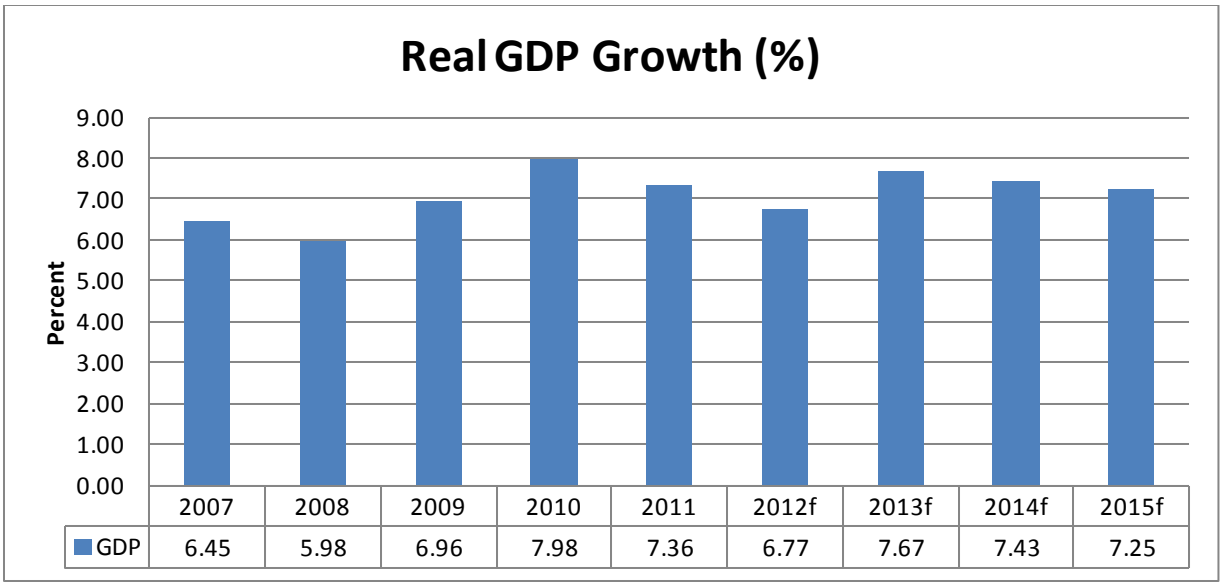


Figure 7: Historical and Projected growth rate of real GDP (2007-2015)

External shocks remain a concern for the Nigerian economy. According to the IMF's World Economic Outlook, the global economy is expected to marginally slow by 0.1 percentage points (compared to the April 2012 forecast) to 3.5 percent. In the United States, GDP growth slowed by 0.5 percentage points from the first quarter of this year to 1.5 percent in the second quarter. The Eurozone's economy contracted by 0.2 percent in the second quarter of this year. While oil prices (OPEC basket) have rebounded in the second half of the year, prices declined by 15 percent during the first half of the year.

Against the background of the uncertain international economic environment, the year 2012 has seen numerous shocks in the Nigerian economy some of which include economic losses as a result of the nationwide strike in January 2012, the continued pass-through effects of the increase in pump prices as a result of the partial removal of fuel (PMS) subsidy, increase in electricity tariffs, increase in import tariffs of some major food items, security challenges, and weather variations among others, which continue to dampen GDP growth projections. Nevertheless, the reported growth for the second quarter of 6.28% compared to 6.17% reported in the first quarter indicated a resilient economy gaining some positive momentum. Revised GDP growth rates for 2012 forecast a real growth at year end at 6.77% taking into consideration on-going efforts at addressing the critical bottlenecks including increased electricity generation and consumption,

increased financial intermediation and determined government efforts to strengthen maintain fiscal stability in the economy spelled out below:

i. With increased water level at the hydro power stations and better supply of gas to the thermal stations, electricity generation continues to improve in some parts of the country, which is expected to boost activities in other sectors especially manufacturing and services.
ii. Available data from the Central Bank of Nigeria point to improved financial intermediation by banks and other financial institutions arising from the timely intervention of the regulatory agency in protecting the national currency, and sustaining the accretion in external reserves.
iii. Increased government intervention in critical sectors of the economy, under the Transformation Agenda of the Federal Government indicates a concerted effort aimed at developing and improving critical infrastructure across the country to engender growth. Some other major efforts include interventions in agriculture, port reforms, road construction, job creation and employment initiatives, as well as joint effort by the other tiers of government and legislative arms to ensure substantial implementation of the budget.

In summary, the revised growth rates obtained from the Bayesian Vector AutoRegression model for other projected years are 7.67 percent in 2013; 7.43 percent in 2014; and 7.25 in 2015. While the non-oil sector has experienced some shocks this year, it is expected that the sector will continue to be the major driving growth. Key underlying sectors will continue to be telecommunications, wholesale and retail trade, building and construction, and hotels and restaurants – which have exhibited double digit growth over 2010 and 2011. On the downside, inflationary pressures will continue to be a threat to a more robust economic growth given the likely removal of the subsidy on Premium Motor Spirit (PMS) and its effect on household incomes.

3.2 Inflation

The headline inflation rate reflecting the cost of living has remained double-digits and is expected to remain so in 2012. Based on the revised estimates from the BVAR model, the projected inflation rate in 2012 will be 13.05 percent; 12.21 percent in 2013; 12.04 percent in 2014; and 11.91 percent in 2015. The non-accommodative policy stance by the Central Bank, which targets single-digit inflation, is expected to keep higher rates of inflation in check as seen in the moderation of inflation rates in the third quarter of the year. A broader view of the historical and the projected series for inflation can be gotten from Figure 8.

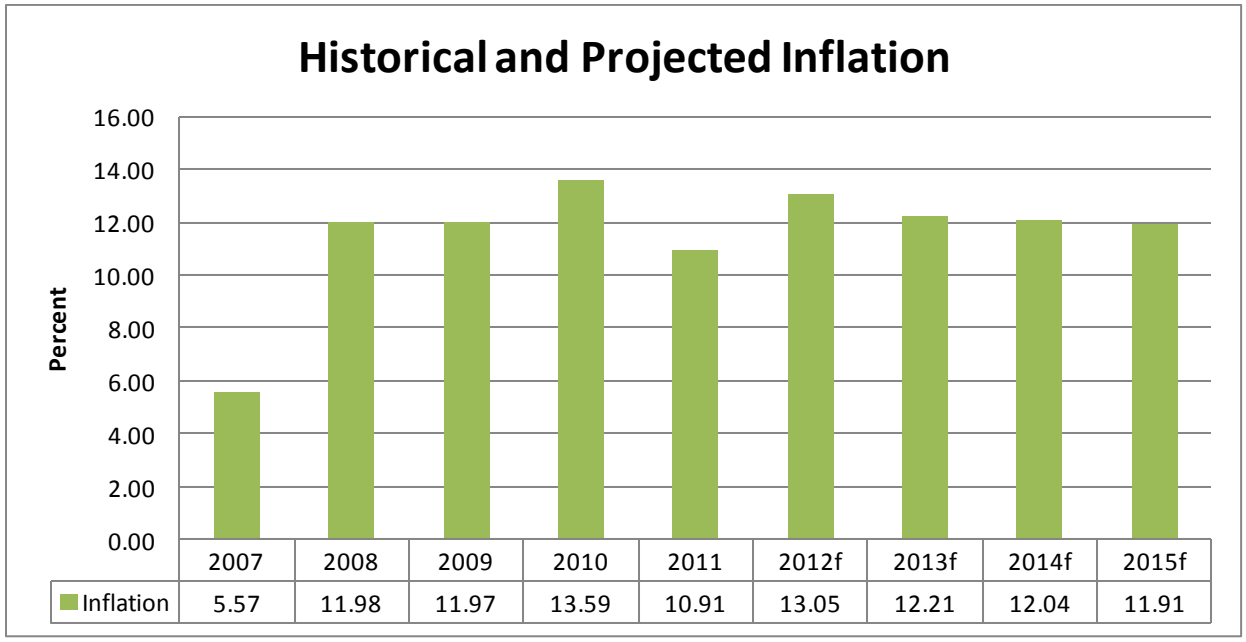


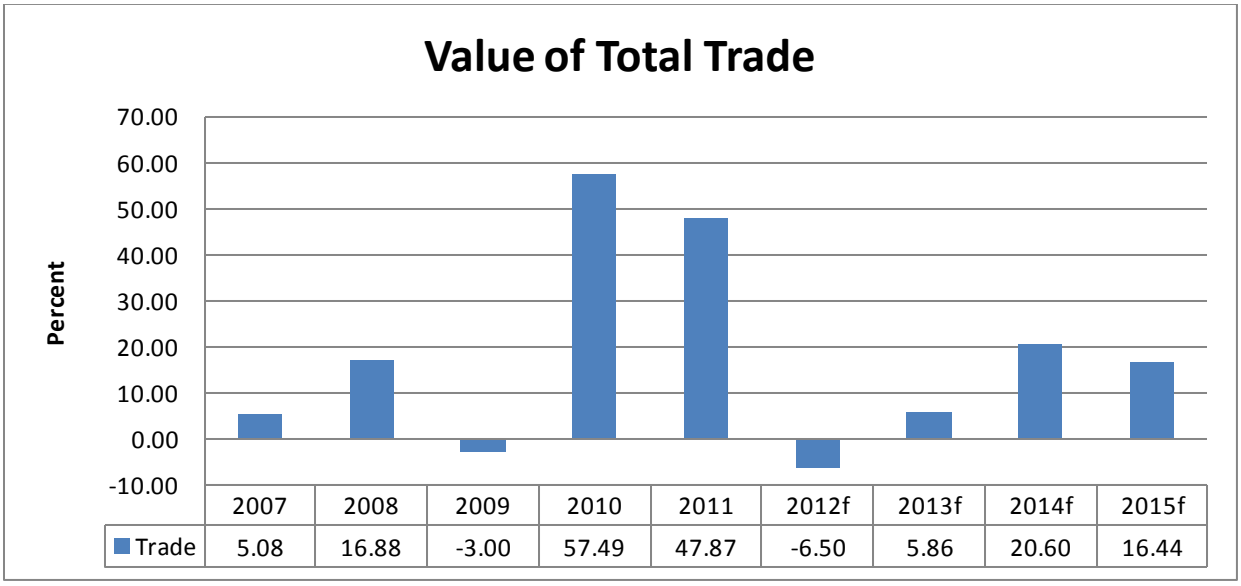
Figure 8: Average annual inflation rate, 2007-2015

Inflation is expected to remain higher than levels experienced in 2011 mostly due to the lingering effects of the partial removal of the fuel subsidy on food and non food prices as a result of higher transportation costs, and higher wheat and flour tariffs. When the PMS subsidy is fully removed, this could push revised rates higher. However, as stated earlier and experienced this year, the

Central Bank's restrictive monetary policies will continue to have an impact on inflation rates going forward.

Trade

In 2012, trade is expected to decline by 6.50 percent, and then rebound in 2013 to 5.86 percent. This is expected to be followed by 20.6 percent and 16.44 percent in 2014 and 2015 respectively. The decline in the value of total trade in 2012 could be partially due to the recent declines exhibited by the value of imports (in particular, mineral fuels) in the latter part of 2011 and the first half of the year and the implementation of the import ban on certain products. However beyond 2012, the value of total trade is expected to rebound driven by non-oil exports from 2013 to 2015.



	2007	2008	2009	2010	2011	2012f	2013f	2014f	2015f
Trade	5.08	16.88	-3.00	57.49	47.87	-6.50	5.86	20.60	16.44

Figure 9: Growth rate of the value of total trade

CONCLUSION

While the revised GDP estimates for 2012 indicate a yet slower growth rate for the nation's GDP compared to 2011, the revised estimates point to room for cautious optimism beyond the year. The global economic outlook while gloomy has yet to be a significant drag on the nation's economy. Also, the nation is faced with domestic internal challenges such as declining agricultural production as a result of floods, pass through effect of the partial repeal of the PMS subsidy and security concerns. Nevertheless, increased activity in the bond market, increased electricity supply and government interventions in numerous sectors provide support for economic growth in the future. Inflationary pressures remain on the horizon, in light of the eventual full repeal of the PMS subsidy and its pass through effect albeit monetary policy is expected to keep a lid on such pressure. Finally, the value of total trade is expected to remain positive beyond 2012 as non-crude oil export drive proceeds.

APPENDIX I: 2012- 2015 PROJECTION TABLES & CHARTS

Table 1: Historical and Projected Growth rates for GDP, Inflation and Trade (%)

Year	2007	2008	2009	2010	2011	2012f	2013f	2014f	2015f
GDP	6.45	5.98	6.96	7.98	7.36	6.77	7.67	7.43	7.25
Nominal GDP	11.27	17.62	2.05	37.07	8.46	8.24	25.29	15.53	14.19
Trade	5.08	16.88	-3.00	57.49	47.87	-6.50	5.86	20.60	16.44
Inflation	5.57	11.98	11.97	13.59	10.91	13.05	12.21	12.04	11.91

Table 2: Projected Quarterly Growth Rates for the period 2012- 2015

	2012Q1f	2012Q2f	2012Q3f	2012Q4f	2013Q1f	2013Q2f	2013Q3f	2013Q4f
Real GDP (%)	6.17	6.28	6.86	7.47	8.37	8.83	8.31	7.75
Nominal GDP (%)	15.27	10.69	5.77	2.81	17.92	22.66	28.16	31.59
Total Trade (%)	4.69	5.91	-11.86	-20.24	-3.78	-10.36	17.46	21.66
	2014Q1f	2014Q2f	2014Q3f	2014Q4f	2015Q1f	2015Q2f	2015Q3f	2015Q4f
GDP (%)	7.53	7.46	7.4	7.36	7.34	7.29	7.23	7.17
Nominal GDP (%)	15.98	15.71	15.41	15.11	14.77	14.41	14.04	13.65
Total Trade (%)	23.67	21.15	19.29	19.02	18.95	16.57	15.01	15.64

Table 3: Historical and Projected estimates for Real GDP and Trade (N' Millions)

Year	2008	2009	2010	2011	2012f	2013f	2014f	2015f
Real GDP	672,203.00	717,036.00	776,332.00	834,161.83	890,620.72	958,924.23	1,030,140.37	1,104,807.56
Nominal GDP	24,296,329.29	24,794,238.66	33,984,754.13	36,859,707.11	40,375,613.18	50,588,120.25	58,442,431.67	66,733,642.69
Trade	12,868,046.00	12,482,413.00	19,658,432.00	29,069,147.00	27,180,256.79	28,771,930.00	34,700,380.00	40,404,836.00

APPENDIX II: FORECAST METHODS OF ESTIMATION

I. Vector autoregressive (VAR) model

One of the major workhorses available for forecasting is the VAR model. In an N-variate VAR model, variable i∈N is expressed in terms of its own lag and the lags of the other N-1 variables and, if available, the exogenous variables. However, given that the number of parameters in a VAR model quickly increases, consuming the degree of freedom and rendering inference imprecise, an alternative VAR method grounded in the Bayesian tradition has been applied to estimate the model. The VAR(p) model estimated has a general form given by

$$y_t = \theta_0 + \theta_1 y_{t-1} + \theta_2 y_{t-2} + \cdots + \theta_p y_{t-p} + \varepsilon_t \qquad (1)$$

It is sometimes convenient to put this model compactly as a VAR(1) model such as

$$\mathbf{Y}_t = \boldsymbol{\theta}_0 + \Phi \mathbf{Y}_{t-1} + \boldsymbol{\varepsilon}_t \qquad (2)$$

with Φ is the companion matrix in which the p matrices containing the coefficients are stacked together to form order 1 matrix.

$$\Phi = \begin{bmatrix} \theta_1 & \theta_2 & \cdots & \theta_p \\ 1 & 0 & \ddots & 0 \\ \cdots & \cdots & \cdots & \cdots \\ 0 & 1 & \cdots & 0 \end{bmatrix}$$

and $\mathbf{Y}_t = [y_t \; y_{t-1} \cdots y_{t-p}]'$ is also conformably defined. Since our goal is to forecast over h periods ahead, our forecast is generated by the following system

$$\mathbf{Y}_{T+h} = \hat{\Phi}^h \mathbf{Y}_T + \sum_{i=0}^{h-1} \hat{\Phi}^i (\boldsymbol{\theta}_0 + \varepsilon_{T+h-i}) \qquad (3)$$

with the forecast starting from the end of the historical data , *T*.

If the system is stable in the sense that the eigenvalues of $\hat{\Phi}$ are all within the unit circle, then forecasting with the above system will be reliable. However, if the system is unstable, the

powering up of $\hat{\Phi}$ will magnify the instability and render the forecasts from the system unreliable. Hence, we need to ensure that the system is stable so that the forecasts too are accurate enough. We examine the stability of the system by examining the placement of eigenvalues in relation to the unit circle. The occurrence of eigenvalues outside the unit circle indicates that the system is unstable. If the system contains unit roots or the variables are near cointegration, the equilibrium-correction model (EqCM) becomes a better choice of estimation.

Due to the proliferation of parameters in the VAR model as stated above, the degree of freedom is quickly consumed up as a higher order is entertained. One way not feasible in our case is to use longer dataset to be able to estimate the system and ensure the adequacy of the forecasts. In particular, given the small sample size we have had to work with, an alternative approach might need to be adopted. In this respect, Doan, Litterman and Sims (1984) have suggested a Bayesian alternative, namely Bayesian VAR, to the pure frequentist approach outlined previously. A major difference between these approaches is that the BVAR model is grounded in the Bayesian paradigm, in which the variables are considered as fixed, while the environment (the set of model parameters) is seen as stochastic. This is a diametrically opposing paradigm to the classical where the environment is considered as fixed and the variables stochastic. This method is thought superior to the classical VAR estimation method because it allows a fair control over the estimation procedure. In particular, it allows us to input our judgments regarding the importance of a given variable in the dynamic equation endogenizing another variable and the importance of the past in influencing the present. In the BVAR model, as time goes by the past will have less and less impact on the present such that the further in the past the less influence on the estimated and consequently the predicted time series. This is achieved by imposing a Minnesota prior on the VAR model specified in Equation (1) above.

The Bayesian VAR model warrants some conceptual clarifications, which are now discussed. Let $\alpha_i \sim N(1, \sigma^2_{\alpha_i})$ be the priors on the coefficients associated with the lagged dependent variable in each of the equations and $\alpha_j \sim N(0, \sigma^2_{\alpha_j})$ the priors on the coefficients of any other dependent variable in the equation. The assumed priors therefore assign a mean value of 1 to the lagged dependent variable since this variable is thought to be most important in dynamically determining its own future behavior. The mean value of 0 assigned to the coefficients of other

variables featuring in this equation, on the other hand, is indicative of the lesser role they are to play in driving the dynamics of the dependent variable. If the assumed variances are tight enough, therefore, one can downplay the importance of these other variables as desired. To overcome the proliferation of parameters, which informs our choice of the BVAR method of estimation in the first place, we used the method suggested by Doan, Litterman and Sims (1984) to shrink the deviation of variable j in equation i at lag k:

$$\sigma_{ijk} \sim \phi\omega(i,j)k^{-\eta}\left(\frac{\tilde{\sigma}_{\varepsilon_j}}{\tilde{\sigma}_{\varepsilon_i}}\right)$$

where $\frac{\tilde{\sigma}_{\varepsilon_j}}{\tilde{\sigma}_{\varepsilon_i}}$ is a scaling construct adjusting for the varying magnitudes across the equations, ϕ is a measure of overall tightness and $0 \leq \eta \leq 1$ gives the rapidity with which lags in the model get discounted in the shrinkage formula. Lastly, $\omega(i,j)$ is the weighting function assigning tightness to variable j in relation to the own-lags in each equation.

II. The Bayesian Vector Autoregression Model

We estimate the BVAR model on endogenous variables over the period between the first quarter of 1996 and the last quarter of 2011. The seven endogenous variables are those for which the data were available. The National Bureau of Statistics (NBS) supplied the data on real GDP, inflation rate, exchange rate, interest rate, oil exports, nonoil exports, trade, price of crude oil and US real GDP. The last two variables – real GDP and US GDP – were considered as exogenous variables. Real GDP, exchange rate, oil exports, nonoil exports, trade, price of crude oil and US real GDP were transformed to their logarithm for estimation. Figure 1 displays the historical data at level.

We adopt a two-stage estimation approach to forecasting using the BVAR model. The approach can be understood as follows. In the first stage, we estimate a BVAR model for the exogenous

variables considering these variables as endogenous variables at this stage. In that case, the model estimated has the form:

$$X_t = AX_{t-1} + \xi_t$$

where $X = [USGDP, OILPRIOCE]$. Based on the estimated model, we carry out the forecast for the projection period. We therefore obtain the forecast, X_t^f, for the US GDP and crude oil price. In the second stage, we bring on the historical as well as the projected series in the first stage for the two exogenous variables. These projected estimates serve as new information in estimating the BVAR at the second stage. Thus, at the second stage, we employ the seven endogenous variables namely real GDP, inflation rate, exchange rate, interest rate, oil exports, nonoil exports and trade. We the estimate the BVAR model again using the model of the form stated above with the modification that the variables now include the seven endogenous variables as well as the exogenous term:

$$Y_t = AY_{t-1} + BX_t^f + \varepsilon_t$$

Given the above formulation, we then forecast the endogenous variables as reported in this paper.

Reference

Doan, T., Litterman R.B. and Sims C., 1984. Forecasting and conditional projection using realistic prior distribution, *Econometric Reviews*, vol. 3, pp 1-100