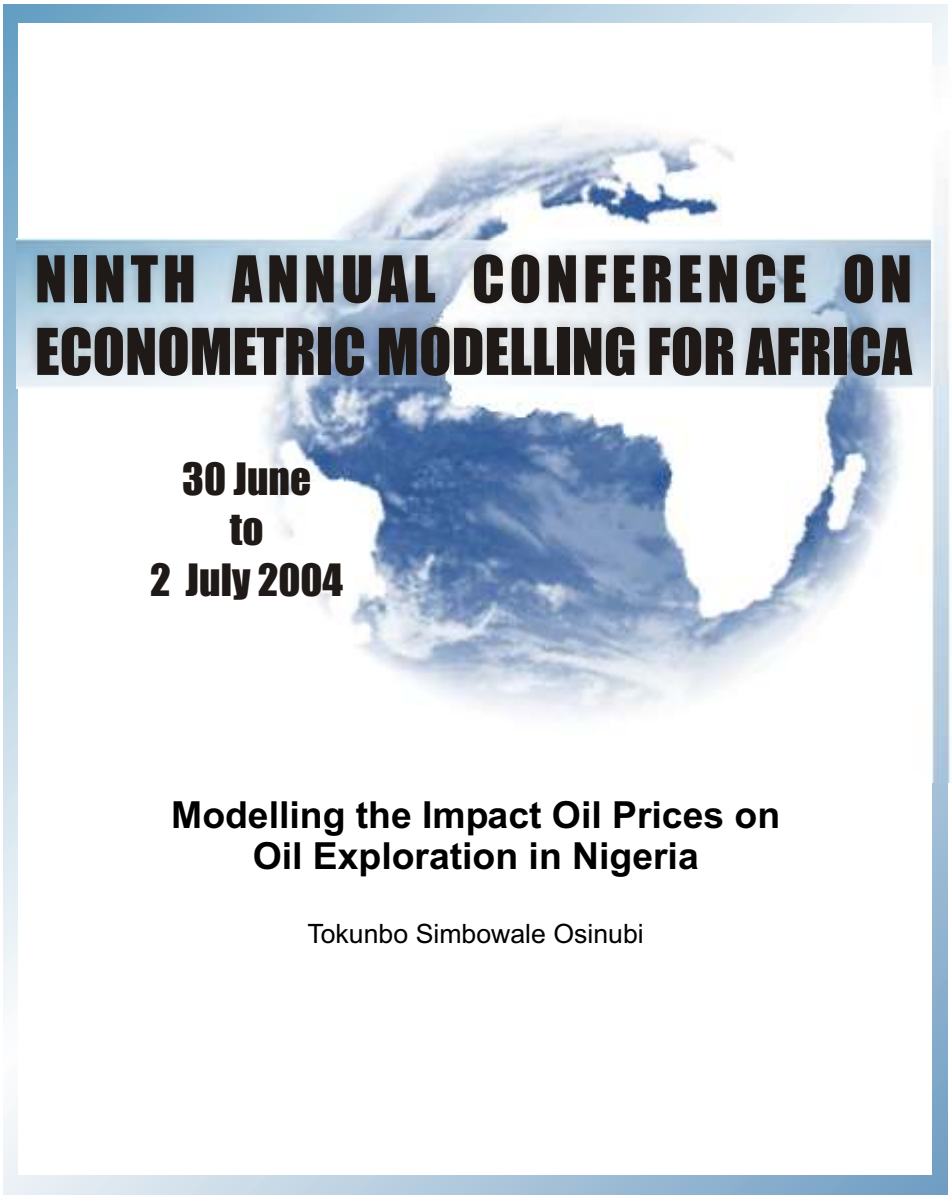

NINTH ANNUAL CONFERENCE ON ECONOMETRIC MODELLING FOR AFRICA

30 June
to
2 July 2004

Modelling the Impact Oil Prices on Oil Exploration in Nigeria

Tokunbo Simbowale Osinubi

MODELLING THE IMPACT OIL PRICES ON OIL EXPLORATION IN NIGERIA

TOKUNBO SIMBOWALE OSINUBI
Department of Economics
Faculty of the Social Sciences
University of Ibadan, Ibadan
Oyo State, Nigeria.
E-mail: tokunbosinubi@yahoo.co.uk

An abstract submitted for consideration for presentation at the Ninth Annual Conference on Econometric Modelling for Africa, 30 June to 2 July 2004 at the School of Economics, University of Cape Town, South Africa.

January 2004

Introduction

Oil exploration started in Nigeria in 1908, but was interrupted by the two World Wars. However, in 1956 commercial oil was discovered in *Oloibiri* field east of the Niger Delta. Production started in 1958 with a modest output of 5,000 barrels. Until Nigeria's independence in 1960, Shell retained sole concession rights for the exploration and production of crude oil in Nigeria, at that time production stood at 17,000 barrels per day. In 1961, Nigeria admitted non-British subjects into the exploration scene and by the 1970 production had risen to 1 million barrels per day. Apart from oil, Nigeria has abundant gas reserve estimated at about 120 trillion cubic feet. This has place Nigeria among the top gas producing countries in the World.

Problem Statement

One of the issues in petroleum econometric modeling that has remained empirically interesting particularly among oil industry and oil-related government agencies is how to explain econometrically the impact of oil prices on oil exploration parameters. This is particularly important for Nigeria because her crude oil reserves are relatively small compared to other exporting countries (OPEC Bulletin, 2000).

Given the relatively small crude oil reserves of Nigeria, the need to model the impact of crude oil prices on the country's ability to discover new reserves in the long run cannot

be over emphasized. This is because projections made from such econometric model will be useful in establishing sound planning for both the government [including the National Oil Company (NNPC)] and its allied agencies. For instance, the price of Crude Oil increased considerably from $2.4 in 1970 to $36.75 in 1981, the addition to reserves also increased from 6,939 million barrels in 1970 to 16,500 million barrels in 1981. After 1981, the price of Crude Oil started to decline, it fell from $36.75 in 1981 to $14.42 in 1988; this also affected reserves as it fell to 16,000 million barrels in 1988. Between 1988 and 1995 crude oil price tended to fluctuate between $17 and $20. However, between 1995 and 1998, crude oil prices still fell further, falling as low as $9.00 per barrel, this was attributable to the fall in oil price in the world market, presently it fluctuates between $15 and $25 per barrel. The fall in the crude oil price recently affected Nigeria so much and in three ways. Firstly, it affected the development of projects, which the government had proposed to embark on, because the actualization of these projects was calculated based on the revenue that will accrue from the sale of crude oil. Secondly, government could no longer afford to make its monthly cash calls to the multinational oil prospecting companies, thus affecting the country's ability to discover new reserves. Finally, this has led to insufficient supply of petroleum products, unavailability of cash to pay workers and a general rise in price level. This portrays oil as an important and significant aspect of the Nigerian economy because it is the backbone on which the other sectors depend.

It therefore becomes imperative using annual data from Nigerian National Petroleum Corporation, Annual Reports of the Department of Petroleum Resources, the Nigerian Oil Industry Statistical Bulletins, Central Bank of Nigeria Statistical Bulletins, OPEC Annual Statistical Bulletins, IMF and World Bank publications to examine econometrically from 1961-2000, using the cointegration approach with Fisher econometric oil discovery models, the factors that affect exploration activity, the success ratio of wells and the average size of oil discovery. The specific objectives are to obtain the elasticities of oil discovery with respect to price and thus identify other determinant of crude oil discovery in Nigeria. Thus the impacts of oil prices on oil exploration parameters will be enable us to determine the Nigerian situation. This will properly position the Nigerian oil industry among the comity of oil states in the world.

Relevance of the Study

Fisher (1964) proposed an economic model of oil discovery in the United States by considering economic and technical time series variables in estimating the price elasticity of finding new oil reserves. He proposed that the barrels of new oil discovered are assumed to be result of the multiplication between the numbers of wildcat (discovery) wells, the success ratio and the average size of oil found.

Several studies on modeling of oil discoveries using the Fisher oil discovery econometric model have been largely conducted in the western countries of the world (Fisher, 1964; Uhler, 1976, 1979; Erickson, 1968), and this relatively new technique (cointegration and error correction mechanism) have been applied to the Indonesian oil discovery variables; such cannot be said to have been conducted in sub-Saharan African and especially in Nigeria. In addition, since exploration, development and production are upstream activities, an evaluation of this sub-sector is equally significant for the formulation of various government policies including taxes, penalties and sanctions in the industry.

Methodology

The fundamental methodology to be used in the study is the cointegration and error correction approach. Traditional economic theory is based on the assumption that the underlying data processes are stationary. However, the mean variance of most economic variable is not constant, that is, the variables are non-stationary. The cointegration and error correction mechanism were first proposed by Granger (1981) and developed further by Hendry and Richard (1982, 1983), Engle and Granger (1987), Engle and Yoo (1987, 1991), Stock and Watson (1988), Philips and Hansen (1990), Johansen and Juselius (1988, 1990) and Johansen (1991, 1995). A popular approach to cointegration has been to use unit root tests such as the Dickey-Fuller (DF) or the Augmented Dickey-Fuller (ADF) test (see Dickey and Fuller, 1981) to determine the degree of integration of the relevant variables and then to apply the Engle and Granger (1987), two step procedure based on an Ordinary Least Square (OLS) estimation of the cointegrating vectors and unit test of its residuals.

In estimating the parameters of the three components of Fishers oil discovery equations, the Cointegration and Error Correlation techniques will be applied to the Nigerian oil discovery related time series variables. The reason for using this relatively new technique is to estimate the long run equilibrium relationship between non-stationary variables avoiding the problem of spurious regression. The procedure will involve testing for the order of integration of each of the variables in their natural logarithms; the second will involve the testing for cointegration between each of the dependent and independent variables while the final step will involve the used of the error correction model with all equations specified in log form.

Expected Results and Benefit

The exploration wells are expected to have a positive relationship with oil prices. Both Seismic activities and success ratio are expected to have positive signs, which means that as seismic activities and the success ratio go up, the number of exploratory wells drilled will go up too. Cumulative oil reserves ought to have a negative sign as expected, because as new reserves are found the remaining oil resources in the ground diminish. Exploration expenses are expected to have a positive sign, which means that as more dollars are spent, more exploratory wells will be drilled. The coefficient of the error correction term is expected to be negative so as to serve as a feed back mechanism amongst the variables and also ensure a long-run relationship. The expected results will assist the government and policy makers in taking into consideration the price of crude oil before embarking on exploratory activities, such that, when the price of crude is low, they will be able to control the quantity of crude oil produced at any point in time. This would help them to know when it is profitable to explore for oil. It will also serve as guide to know if the marginal cost of lifting a barrel is greater than the price or not. It is therefore important to have estimates of price elasticities in exploration in order to know which necessary development efforts to embark on to boost oil production capacity, thereby taking advantage of the expected upturn in oil markets. By implication, the government and policy makers are expected to constantly review the economic climate in which their joint venture partners operate, so that they can be stimulated to continue exploration and development activities.

References

Dickey, D. A. and W. A. Fuller (1981), "Likelihood Ratio Statistics for Auto regressive Time Series with a Unit Root", Econometrica Vol. 49, No. 4

Fisher, F. M. (1964), "Supply and Cost in the U.S. Petroleum Industry", Baltimore: John Hopkins University Press.

Hendry, David F. (1980), "Econometrics – Alchemy or Science", Economica. Vol 47 Pp, 387 – 406

Hendry, David F. and Jean – Francois Richard (1982), "On the formulation of Empirical Models in Dynamic Econometric". The Journal of Econometrics Vol 20 Pp 3 – 33

Hendry, David F. (1983), "Econometric Modeling: The Consumption Function in Retrospect". The Swedish Journal of Political Economy. Vol 30 No. 3 (November). Pp 193 – 219.

Hendry, David F. and A. J. Neale (1988), "Econometric Analysis of Small Linear Systems Using PC-FIML". Journal of Econometric. Vol 38, Pp 203 – 226

Kurtubi (1998), "Modeling Indonesian Oil Discoveries Using Cointegration Approach". A Paper presented at the Annual Internal Conference on Experiment with Freer Markets: Lessons from the last 20 years and prospects for the future, organized by the International Association for Energy Economics.

Uhler, R. S. (1976), "Costs and Supply in Petroleum Exploration: The Case of Alberta". Canadian Journal of Economics. Vol ix, No. 1, pp 72 – 90

Uhler, R. S. (1979), "The Rate of Petroleum Exploration and Extraction", Advances in the Economics of Energy and Resources. Vol 2, pp 93 – 118

Uhler, R. S. (1977), Economic Concepts of Petroleum Energy supply. University of British Columbia.