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# **INTERIM GLOBAL OIL AND GAS PRICE BENCHMARKS AND THE FEASIBILITY OF A PARTY TO PARTY BARGAINING MODEL**

**By**

**John L Simpson<sup>1</sup>**

## **ABSTRACT**

This study further develops a party to party gas price bargaining model (expanded in a research paper by Okugu, 2002) by using proxies of prices of these replacement fuels in OPEC spot oil prices and Henry Hub (HH) spot gas prices. The study finds a significant relationship between the variables. When optimally lagged data are analysed in a vector autoregressive model, a significant longer-term cointegrating relationship is found together with spot OPEC oil price exogeneity. Despite the market inefficiency in cartel driven oil prices and in gas markets that are lacking in global development, as well as statistical problems with the data, a party to party bargaining model using such global price benchmarks is feasible for the future, provided cartel or cooperative behaviour among gas producers is avoided.

**Key words: gas prices, OPEC, Henry Hub, party to party, bargaining, oil and gas prices**

**JEL code: Q41**

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## INTRODUCTION

The growth of a global natural gas market is currently restricted. There are lagging production, processing and transport infrastructures and consequent supply bottlenecks. There are problems with contracting procedures, contracts are opaque and there is no discernable global market. This may change when sufficient Foreign Direct Investment (FDI) is mobilised to monetise “stranded” reserves depending on whether or not the investment environment is taxation friendly. In addition, the price of gas in the US and Europe is starting to resemble a market price based on “gas on gas” competition.

Nevertheless, natural gas producing firms may be regarded as price takers indicating a degree of, or at least the potential for, market efficiency. In addition, the share of natural gas as a global energy source has been on the increase since the mid 1970s (Okugu, 2002) and it will increase substantially over the next decade with new producers (such as, Australia) strongly developing their export capacity. With the present lack of openness of the global markets can it be said that gas prices should be fully indexed to oil prices when global oil markets are also not efficient?

International gas pricing is usually undertaken through negotiations between buyers and sellers on a bilateral basis. Okugu (2002) refers to a complex interplay of factors that relate to the general conditions in a country, the quality of the product, market conditions and taxation environments as well as a global pricing basis according to supply and demand. The factors include whether or not a country is gas poor or gas rich, who is to share the risks, the reliability of the supplies and flexibility of delivery, the quality of the product and what the competing fuels are.

A party to party bargaining model is expanded for gas pricing by Okugu (2002). The model posits that one of the principles of gas pricing is to relate the price of gas to its value in the market for competing energy sources (For example, oil).

It is evident that the caveat on strong global gas market expansion will be whether or not FDI can be mobilised in a high development cost environment to release “stranded” resources. Cuddington

(1996) provides evidence that technology had reduced the finding costs and had largely counteracted increased resource scarcity. Gas prices in the future may well be based on deregulation and the further opening of gas services markets (MacAvoy, 2000). Since these above two studies, more reserves of natural gas have been discovered. Natural gas reserves should substantially increase. Even greater competition with oil as an energy source will result. Gas is regarded as a cleaner and less expensive energy source than oil or coal. It is found along-side oil in many producing countries. It is logical that the relationship between gas prices and oil prices be tested. This is because part of the determination of the price of gas must be related to the price of oil as the most utilised alternative or substitute fuel.

The OPEC and Henry Hub (HH) spot prices are the only reasonable and available benchmark prices to compare but there are problems with each because of oil market inefficiency and gas market under-development. Smith (2002) in a study of oil market structure cites evidence of strong cooperation in behaviour among OPEC members. Adelman (2004) thinks there has never been an oil gap. He says that after the 1970s the real problem has been a strong but clumsy and damaging monopoly where the biggest exporters have cooperated to limit production. Simpson (2006), in a study of oil market efficiency in prices, provides evidence that none of the oil markets is weak-form efficient. Moreover, OPEC prices lead the world oil price which in turn leads the US oil price in a period from 1999 to 2004. In short, it is deemed that strongly cooperating or cartel behaviour of OPEC members has created an inefficient market with high transaction costs and unnecessarily high oil prices. The suggestion by Swamy (2006) that there should be an organisation of natural gas producing countries, in a similar way to OPEC, is rejected in this paper. Cartel pricing is market interference, adds to informational asymmetry in markets and creates price distortion.

Prominent research into energy and gas pricing has been previously undertaken by Hubbard and Weiner (1990) and Borenstein (1999) using arguments that relate to and differentiate between market power, competitive behaviour and cartel behaviour. For example Borenstein argues that firms exercise

market power when they either decrease output or raise the minimum price to alter the market price. The firm is then a price maker. Natural gas producers are included in categories of firms which are price takers (that is, they are unable to exercise market power). Borenstein feels that some industry observers suggest that OPEC has the ability to manipulate prices. That is, OPEC has the ability to exercise market power. As a group OPEC has not been able to persuade members or other non-OPEC producers to respond to higher prices by increasing production.

The broad base of opinion is that OPEC-controlled price hikes of the late 1970s caused the Latin American debt crisis and threatened systemic risk in Eurobanking systems. Many of the problems of floating USD debt in Latin America to fund oil import generated deficits remain (for example, in Brazil). With oil priced at over \$70 a barrel at the time of writing, a new round of inflation and global financial instability threatens (Simpson, 2006). Monopoly pricing in gas would exacerbate energy market inefficiency. In that case the formation of an organisation of petroleum (and gas) importing countries (as suggested by Deshpande, 2003) to fight back and reduce prices, might not be unreasonable due to the lack of any suitable alternative strategy. However, this paper takes the view that this too should be avoided as it would interfere with free market forces.

When domestic and regional gas markets are considered (rather than the global market) pricing of natural gas has become more efficient. Borenstein (1999) notes that natural gas producing firms may be included in a category of price taking firms. Therefore, gas markets prices may be more price efficient than oil markets dominated by the OPEC cartel, which exercises market power. In that sense natural gas markets possess a degree of efficiency because price takers are more likely to sell their product at the market price. There is a greater choice of natural gas contracts through deregulation and restructuring in several countries. For example, in the USA since 1984, there has been a separation of natural gas supply from interstate pipeline transportation, deregulated natural gas production and the wholesale market. Competition has been introduced in interstate pipeline transportation. In 1986 the

British government privatised British Gas. In 1992, Argentina separated and then privatised natural gas production, transportation and distribution. Mexico opened up its market to competition in 1993. Hungary separated and privatised distribution companies in 1994-95. Privatisation is increasingly being seen as a means of improving efficiency and increasing investment (Juris, 2005).

According to Mazighi (2005) the best available global benchmark for gas is the HH when compared to the UK's National Balancing Point (NBT). Nevertheless, the NBT is significantly related to oil prices. The greater suitability of the HH lies in the facts that the USA gas market is the largest; the most deregulated and operates within the largest and most powerful global economy. The USA market is around six times bigger than the UK market in volumes of gas consumed.

The issues of this paper are as follows:

1. In a single period regression model, is there evidence of a significant relationship between oil and gas prices?
2. In an optimally lagged univariate model is there evidence of a longer-term cointegrating relationship and any evidence of a shorter-term causal relationship between oil and gas prices?
3. Is the specification of a party to party gas price bargaining model feasible for the future, using spot OPEC oil and HH gas prices as global benchmark prices of these replacement fuels?

The model, method and data are described in the next section. Then limitations of the data are discussed. Major results are then provided and a conclusion and policy implications are put forward.

## **THE MODEL AND METHODOLOGY**

Relating the spot price of gas to the price of a competing fuel, as in Okugu (2002), produces the following model.

$$P_{G_t} = \alpha + \beta P_{o_t} + e \quad 1)$$

Where

$P_{G_t}$  is the price of gas at time t.

$\alpha$  is a base spot price of gas agreed at the outset.

$\beta$  is the pass-through price coefficient negotiated under the contract.

$P_{o_t}$  is the price of the competing fuel being oil.

$e$  is the residual term for the regression which represents an intertemporal gas price escalation coefficient where  $e=0$  except in those periods where there have been price adjustments.

A univariate vector autoregressive model (VAR) is then specified to test optimally lagged data for cointegration and causality.

$$P_{G_t} = \alpha P_{G_{t-1}} \dots \alpha P_{G_{t-n}} + \beta P_{o_t} + e \quad 2)$$

The data are examined using tests from the Eviews (2001) statistical package.

## **THE DATA**

Daily price data for a five day week are obtained from the Datastream database for the period 31<sup>st</sup> December 1999 to 24<sup>th</sup> June 2006. The spot OPEC oil price is an oil basket price in US dollars per barrel. These data are also obtainable from the United States Department of Energy, Energy Information Administration. The HH spot price is the Henry Hub price determined at the Louisiana central location in the USA. It represents a standardised quality of gas in methane content and a standardised quantity. The price is expressed in US dollars per billion cubic metres BTU. These prices are also quoted on the New York Metals Exchange (NYMEX).

## **LIMITATIONS OF THE STUDY**

Perhaps the greatest limitation of this study lies in the proxies available to represent gas and oil prices. If the model is to be greater than merely one of preliminary analysis it would be necessary that

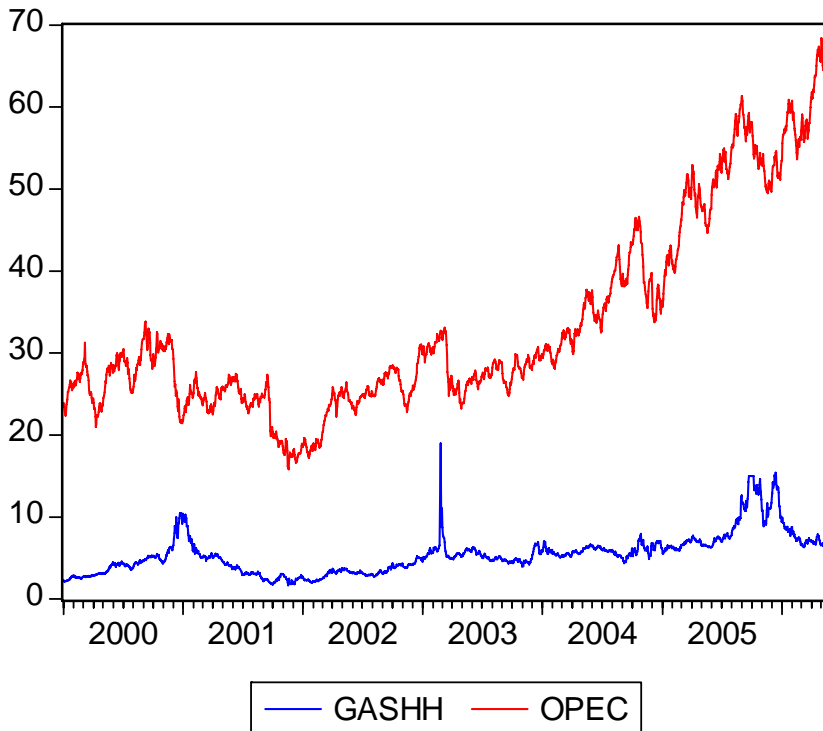
market power does not exist in each of the oil and gas markets. It is more likely in the current oil and gas producing markets that gas producers tend towards price taking and that oil producers are price makers. Nevertheless, Borenstein (1999) feels that some degree of market power in an industry is better than heavy handed regulation. In markets where there are lower barriers to entry, government policy of minimal interference will make any market power transitory. Again it is suggested in this paper that the transitory feature is more likely to occur in natural gas producing markets, providing cartel behaviour in future is avoided. Nevertheless it is beyond the scope of this paper to address the issue of market power. Another problem in this study relates to the data. On the examination of level series prices for uniformity and normality it is found that there are problems with skewness and kurtosis. The Jarque-Bera test statistics lead to rejection of the null hypothesis of normality and uniformity at the 1% level of significance. This is an initial indication of persistent serial correlation in each series. The level series prices are non-stationary, according to augmented Dickey-Fuller (ADF) unit root tests, as are the errors of the regression of gas prices. The t statistics for gas prices, oil prices and errors are significantly greater than the 1% MacKinnon critical values in each case at the 5% level of significance.

The errors of the regression are heteroskedastic according to White tests and correlogram Q statistics (The F statistics values of White tests lead to rejection of the null hypothesis of homoskedastic errors at the 1% level of significance). According to Durbin-Watson (DW) tests there is evidence of serial correlation in the errors. This indicates that the results of substantial explanatory power of the unlagged level series regression model may be spurious. Analysis of first differences show that the series and errors of regressions are converted to stationarity and problems of serial correlation are removed. Evidence of integrated processes is therefore provided. However, the explanatory power of the model is significantly reduced and heteroskedasticity remains persistent in the errors.

## MAJOR FINDINGS

Initial indications of the relationship between spot oil and gas prices are provided in Figure 1 where gas prices appear to peak with oil price peaks (with oil prices generally leading indicators) but show less volatility and upward movements over the period of the study.

**Figure 1**  
**Spot OPEC and HH gas price movements**



**Note:** GASHH is the spot HH gas price movement and is depicted in the bottom line. OPEC is the spot oil price with movement depicted in the top line.

Basic analysis of level series data indicates strong correlation between oil and gas prices with a coefficient of 0.7234. Correlation analysis also shows that substantial economic information is lost by first differencing with the correlation coefficient then at 0.1356. Table 1 demonstrates that whilst the unlagged level series and first difference regressions (See Equation 1) indicate a statistically significant relationship (see adjusted R square values, t statistics, standard errors and coefficient values at statistical significance levels of 1%) the results may be spurious (see DW statistics for level series errors).

**Table 1**  
**Level series and first differences gas price regressions**

	Level series	First differences
Adjusted R square value	0.5188	0.0184
Coefficient of oil prices	0.1614	0.0934
Standard error of oil prices	0.0012	0.0167
t statistics of oil prices	136.6135	5.5931
DW statistic	0.0563	2.0234

**Note: All results are significant at the 1% level.**

With evidence through ADF unit root tests of integrated non-stationary processes, the analysis moves to VAR analysis (See Equation 2) and the examination of optimally lagged data. Testing over twenty lags, a VAR stability condition check shows that no root lies outside the unit circle and that the VAR is therefore stable. The optimal lag for the VAR tests is seven days according to the likelihood ratio, the final prediction error and the Akaike and Hannan-Quinn information criteria. Trace and maximum Eigenvalue test statistics for Johansen cointegration tests (at 17.6256 with significance levels at 1%) indicate one cointegrating equation at the 5% critical value. It is evident that oil prices and gas prices have similar stochastic trends and in due course move together to equilibrium on an optimal lag of seven days. However, a pairwise Granger causality test (with the maximum F statistic value of 12.7613 value at a 1% significance level) indicates optimal exogeneity of spot oil prices on a one-day lag.

## **CONCLUSION**

This paper provides evidence of the feasibility of the future application of a party to party price bargaining model for natural gas pricing as studied by Okugu (2002). The model is expanded in this paper to use spot OPEC oil and HH gas prices as proxies for prices of the replacement fuels of oil and gas. Whilst the proxies for oil and gas prices are in non-price-taker markets, and whilst there are statistical problems with level series unlagged data, the study demonstrates that spot OPEC oil prices are significantly related to spot HH gas prices. In addition, when optimally lagged data are examined in a

univariate VAR model, the series of spot OPEC oil and HH gas prices show similar stochastic trends and move together to equilibrium in the longer-term. In addition it is found that OPEC oil prices are exogenous in such a univariate model on a one day lag.

It is therefore demonstrated that spot OPEC oil prices and HH gas prices are reasonable interim global benchmarks for the prices of the replacement fuels of oil and gas. This is despite the intrinsic inefficiency of cartel driven oil markets and the lack of global development of gas markets. Gas markets, though regionally more efficient, have global problems with supply bottlenecks and contract opaqueness. However, the global market does not need another cartel to drive gas prices as it would add to energy market inefficiency and lack of transparency.

Within the present limitations to global market efficiency, this study provides support for the future application of a party to party bargaining model. It is also therefore, feasible that, as the gas market develops, any global benchmark gas price will largely depend on a basic spot price for gas, a pass through price multiplier on a global benchmark price for oil (as a replacement fuel) and a factor reflecting intertemporal gas price escalations. In this model a fair and reasonably accurate starting gas price benchmark is crucial to minimise intertemporal adjustment errors. The exogeneity of the selected spot oil price benchmark is also important and this is logically the case due to oil's importance as a global fuel. Though oil will decline in importance at the expense of gas it will remain the most important fossil fuel for some time to come.

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