Boundary Applicability of the Ghana's Oil Block Fiscal Regimes*

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Abstract

Attractiveness of fiscal regime has become more important in oil and gas investment decision than the rather geological prospectivity of the province. The terms and conditions contained in the fiscal system influence the investor's evaluation of project. As Ghana determines to benefit greatly from the exploitation of the oil and gas resources, a robust fiscal system attractive in all economical and technical conditions needs to be designed. Ghana has recently become one of the frontiers in the oil and gas industry following its commercial discoveries of hydrocarbons in Deepwater Tano-Cape Three Point, the Jubilee field. Ghana's oil industry is very young and some of the basins are under exploration surveillances waiting for commercial discoveries. Ghana's Jubilee field uses various terms and conditions in her fiscal arrangement to govern the upstream operations. For continuous realisation of economic benefits to the State as well as the contractor, it is important the applicability of Ghana's fiscal regime at varying boundary conditions of oil price and field reserves are evaluated. Discounted cash flow economic model which considers the major uncertainties was developed to evaluate the economic implications of the Jubilee field fiscal regime. Different price scenarios and varying field sizes were taken through rigorous sensitivity analysis. It was determined that for all field sizes considered at oil prices above $ 40/bbl, contractor's NPVs are positive. The project take statistics are averagely around 64% for Government and 36% for contractor under the various scenarios except for oil prices less than $40/bbl where the State's take statistic is above 80% and contractor's take below 20%. The State receives Additional Oil Entitlement(AOE) only when the oil price is above $40/bbl and the AOE increases steadily with the oil price for all the various field sizes. In general, the Jubilee field fiscal regime is fairly attractive and flexible and ensures stable shares of economic rents between the State and the contractor as the profitability of the field increases.

Keywords: Reserves, Fiscal Regime, Cash Flow, Take Statistics, Net Present Value

1 Introduction

There are different types of fisal systems ((Iledare, 2004; Karasalihovic-Seldar *et al*., 2017), and whether simple or sophisticated, a fiscal system should address the expected boundary conditions of oil and gas project under consideration. A fiscal system becomes less efficient if it either gives more to the contractor at the expense of the host government (HG) or vice versa (Mian, 2010). Therefore, impact of fiscal variables on the end result of the fiscal system must be sufficiently scrutinised during its formulation (Johnston, 2010). Fiscal systems that are progressive finds a focus for both government and the contractor by optimising effort and benefits (Onwuka *et al*., 2012). The structure and conduct of the global Exporation and Production (E&P) industry have changed significantly in recent years to the extent that the search for and development of petroleum resources have become mostly driven by the attractiveness of the fiscal regimes rather than geological prospectivity only (Echendu *et al.,* 2012). The petroleum fiscal system contains the terms and conditions which constitute an important factor that influences investor's project evaluation (Onwuka *et al.,* 2012). Oil and gas markets are becoming more competitive and many diverging interests are emerging, therefore, an attractive and efficient fiscal system for oil and gas exploration and production is paramount. Even though many of the variables that affect the profitability of a petroleum project are beyond the control of both the host government and the investing companies, the host government can take actions to minimise uncertainty. Project uncertainty correlates directly with the cost of the investment. Thus, reducing uncertainty results in a reduction of the cost of capital, which in turn increases the rent potentially available for government's taxation (Tordo *et al.,* 2009).

Ghana has recently become one of the fontiers in the oil and gas industry in West Africa following her major commercial discovery of hydrocarbons in Deepwater Tano-Cape Three Point, the Jubilee field. Ghana's oil industry is very young, and some of the basins are under exploration surveillances for possible commercial discoveries. Thus, there is no doubt that the presence of petroleum in commercial quantities should have important economic, developmental, and strategic consequences for Ghana. These offshore Cape Three Point discoveries are gift of nature but they require investment and effort to translate the resource into saleable crude oil before the government can realise the hydrocarbon revenues. In other words, Ghana as a state has the sovereign jurisdiction over these subsurface resources and responsibility to maintain an attractive and efficient fiscal system to generate maximum economic benefits. Adequate fiscal regime flexible will make Ghana to have competitive advantage for influx of foreign investments over her counterparts in the region (Tordo *et al.,* 2009). Adopting a particular fiscal regime is a choice that depends on many factors and according to Iledare (2010) and Johnston (2010), two fiscal systems may have the

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same overall tax burden, but their relative effectiveness, efficiency and impact on investment decisions may differ significantly. The attractiveness of fiscal contracts has a fundamental effect on profitability of any petroleum projects, and thus an important indicator for evaluating investment feasibility in the country (Li, 2016). To ensure greater long-term stability in the system, it should account for any future changes in oil prices (Ghebremusse, 2014). Moreover, the discovery of 'giant' oil/gas fields is becoming rare recently. It is important that more attention is focused on developing "small" fields. The economic development of these small fields such as in Ghana requires flexible fiscal terms to provide high levels of government take in case of a profitable development and a reasonable rate of return to investors if the product prices are low (Mian, 2011).

Ghana 's benefit from the exploitation of the oil and gas resources can only be realised through robust fiscal system which is designed to be attractive in all economical and technical conditions with regards to exploration and production of the hydrocarbons beneath Ghana's soil. Ghana's Jubilee field uses various terms and conditions in the fiscal arrangement to govern the upstream operations. For continuous realisation of economic benefits to the State as well as contractor, it is important the applicability of Ghana's fiscal regime at varying boundary conditions of oil price and field reserves are evaluated.

The questions being asked are the following: how robust are the current Ghana's fiscal regime against the low or high oil price environment? and will Ghana continue to maximise resource rent from the deepwater fiscal regimes while still attracting investors to go ahead with the very high cost project even for small field sizes? Good economic outlooks of the current fiscal system as answers to these questions are important for government's annual budget and development strategies and potential investors decisions.

2 Resources and Methods Used

The Ghana's fiscal regime governing the offshore Cape Three Point was investigated to account for its applicability for varying boundary conditions such as field size and product prices. Different field reserves and oil prices were used to develop discounted cash flow model to investigate the various fiscal terms. The investigation was done to evaluate impact of the fiscal terms on the end benefits to the contractor and the government of Ghana.

2.1 Discounted Cash Flow Model Analysis

Discounted cash flow model as a tool for project economic evaluation, consists of forecasting the production levels, estimating initial investments and the product potential price levels and generating revenues. Once the cash flow model has been built, the merit of any proposed fiscal terms can be evaluated based on certain economic indicators. These are discussed in the following sections.

2.1.1 Production Forecast

In forecasting the production levels, initial build-up rate was considered during the development of the field. Peak production levels follow when the field is fully developed. How long the production stays at peak level depends on economic, technical as well as reservoir factors. Production levels will begin to decline eventually. Production forecasts of oil and gas wells aid in the economics of the project (Mian, 2011). Figs. 1 to 3 show the production forecasts for the various field sizes considered. The decline portion of the forecasts considered exponential decline curve amongst various curves given by Arps. This is adopted because it is the conventional method applied by the oil and gas companies.

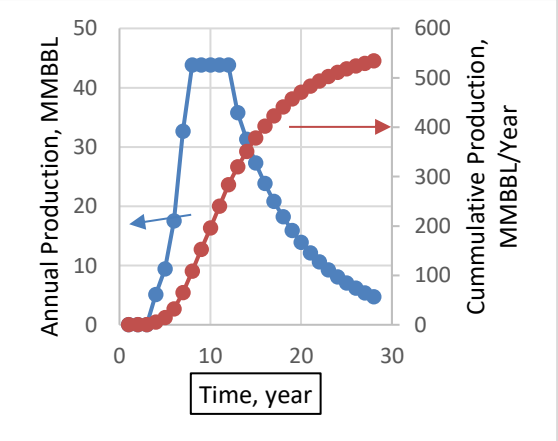

Fig. 1 Production Forecast for Oil Field of 530 Mmbbl Reserves

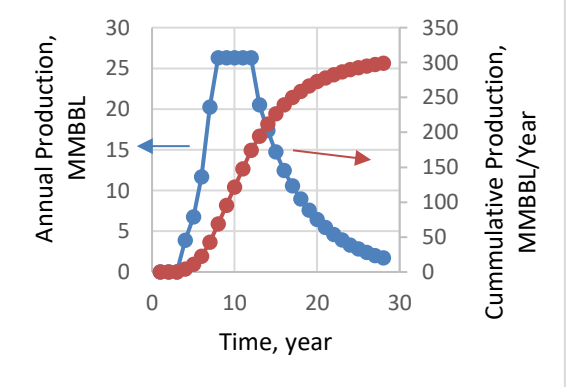

Fig. 2 Production Forecast for Oil Field of 300 MMbbl Reserves

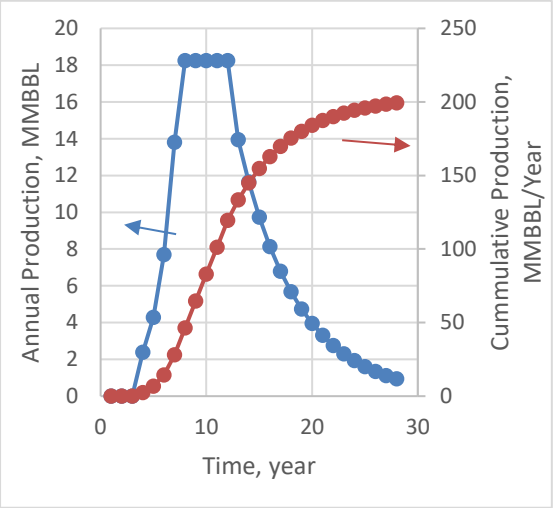

Fig. 3 Production Forecast for Oil Field of 200 Mmbbl Reserves

2.1.2 Petroleum Operation Cost Estimates

The assumptions used to estimate the petroleum operation costs is listed in Table 1. The exploration and appraisal cost was obtained from Anon (2016). The cost estimates were maintained for all the field sizes and the various oil price levels of $ 20, 30, 40, 50, 60,80, and 100 per barrel were used.

2.2 Terms of the Cape Three Point Fiscal Regime

2.2.1 Carried Interest and Additional Interest

According to Anon (2000), the contractor has the responsibility of executing the petroleum operations of the contracted areas subject to the clause that Ghana National Petroleum Corporation (GNPC) is able to execute appraisal activities of the contracted area after a discovery is declared. GNPC has initial interest of ten percent (10%) in all petroleum operations.With respect to all exploration and development operations, such interest is carried interest, thus GNPC does not pay any exploration and development costs. Contractor bears the entire cost of the operations.

Table 1 Petroleum Costs Estimates

Petroleum Cost	Value	Unit
Exploration Appraisal Cost MM$	340	MM$
Development Costs MM$	10% of Field size at $80/bbl	MM$
Fixed OPEX	20% of CAPEX	MM$
Variable OPEX	10% of gross revenue	MM$
Royalty	5%	
Income Tax Rate	35%	
Capital Allowance	20%	SLD

(Source: Anon, 2016)

However, for production operations the interest becomes a paid interest and GNPC pays for its proportionate share of development and production costs. GNPC has additional participating interest of 3.64%, which means GNPC contributing proportionate share of 3.64% of all development and production costs (Anon, 2016).

2.2.2 Corporate Income Tax

Jubilee Petroleum Agreement gives 35% as the corporate income tax rate. The costs incurred during all petroleum operations are capitalised until production. At that time, costs may be recovered and used as deductions against petroleum revenue. These capital allowances come to play from the year of commercial production on petroleum capital expenditure, and it is at a rate of 20% on a straight line basis.

2.2.3 Royalty Payments

Jubilee contractors make royalty payable to the Government of Ghana through GNPC at a rate of 5% on gross revenue for all petroleum production. The royalties paid by the contractor are a tax deductible element in assessing tax liability.

2.2.4 Additional Oil Entitlement (AOE)

The Jubilee fiscal system makes provision for the government of Ghana through GNPC to have share or percentage in contractor's share of remaining revenue as and when the contractor is making profit. This share is called the Additional Oil Entitlement (AOE) which seeks to measure Ghana's entitlement to the crude oil and serves as an additional production tax. This share is based on the after-tax inflation – adjusted Rate of Return (ROR) that the Contractor achieved with respect to contracted area (Anon, 2000; Anon, 2016). The agreed rates of ROR that trigger new level of Additional Oil Entitlement is shown in Table 2. This provision enables the State to participate in profits in excess of the contractor's expected risk adjusted rate of return (Akyeampong, 2009).

Table 2 Additional Oil Entitlement Basis

ROR		AOE Rate
<	12.5%	0%
12.5%	17.5%	10%
17.5%	22.5%	12.5%
22.5%	27.5%	20.0%
27.5%	32.5%	25.0%
>	32.5%	30%

(Source: Anon, 2016)

2.2.5 Surface Rental and Training Obligations

Contractors of Jubilee field make surface rental payments to the Government of Ghana for the use of government property, public lands, and they are required to make statutory payments for the training of Ghanaians. These amounts payable by the contractor are tax deductible elements.

2.3 Cash Flow Models

The following are the modelled equations based on the Deepwater Tano Cape Three Point fiscal terms and conditions. These were used to evaluate the implications on the end benefits to both the State and the contractor.

State' share is given as shown in Equation 2.1.

$$ST = Roy + IPIs + APIs + CIT + AOE - TCg \quad 2.1$$

Contractor's share of revenue is given as shown in Equation 2.2.

$$CT = CS - TCc - CIT \quad 2.2$$

and

$$CIT = CS - CA - OPEXc\text{-CLF} \quad 2.3$$

The basis for achieving AOE levels are given by Equations 2.4 to 2.5

$$FA_n = \left[\mathrm{FA}_{n-1}\left(1 + (12.5\% + i)\right)\right] + NCF \quad 2.4a$$

$$SA_n = \left[\mathrm{SA}_{n-1}\left(1 + (17.5\% + i)\right)\right] + \left(NCF - AOE_{FA_n}\right) \quad 2.4b$$

$$TA_n = \left[\mathrm{TA}_{n-1}\left(1 + (22.5\% + i)\right)\right] + \left[NCF - \left(AOE_{FA_n} + AOE_{SA_n}\right)\right] \quad 2.4c$$

$$AOE_{FA_n} = 10\% \times FA_n \quad 2.5a$$

$$AOE_{SA_n} = 12.5\% \times SA_n \quad 2.5b$$

$$AOE_{TA_n} = 20\% \times TA_n \quad 2.5c$$

Achieved AOE within a year is by Equation 2.6

$$AOE = AOE_{FA_n} + AOE_{SA_n} + AOE_{TA_n} + \cdots \quad 2.6$$

Net present value is presented in Equation 2.7.

$$NPV = \frac{ATNCF}{(1+10\%)^t} \quad 2.7$$

where

FA_n, SA_n, TA_n respectively represent the first, second, third amount within the current year and $\mathrm{FA}_{n-1}, \mathrm{SA}_{n-1}, \mathrm{TA}_{n-1}$ account for amount in the previous year.

Roy = state's royalty,

IPIs = State initial participating interest

IPAs = State additional participating interest realised

CIT= Corporate Income tax

TCg = State's share of total petroleum costs

TCc = contractor's share of total petroleum costs

CS= contractor's share of revenue

CA = capital allowance of petroleum expenditure

CLF = cash loss carried forward

ATNCF = after tax net cash flow

NPV = project's net present value

OPEXc = contractor's share of OPEX

"i" = inflation rate

t = time measured in year

3 Results and Discussion

One way to determine if a particular fiscal regime is efficient is to plot the NPV of net cash flow from an oil field development after government take against NPV of the same before government take. The flexibility and effectiveness of the fiscal terms is normally evaluated at various field sizes and different oil price levels. Once the cash flow model has been built, the merit of any proposed fiscal terms can be evaluated.

3.1 Take Statistics

Figs. 4 and 5 show the impact of oil field reserves on the Take statistics of the State and the contractor respectively at varying oil price levels.

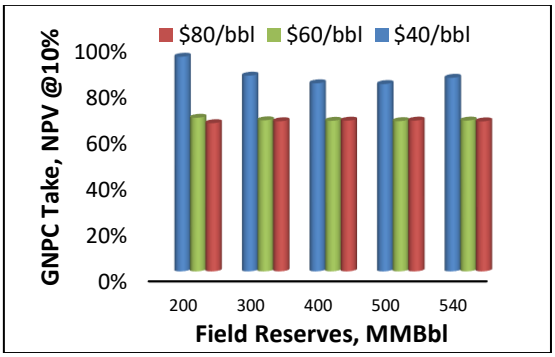

Fig. 4 Reserves Impact on the State's Takes at Varying Oil Price

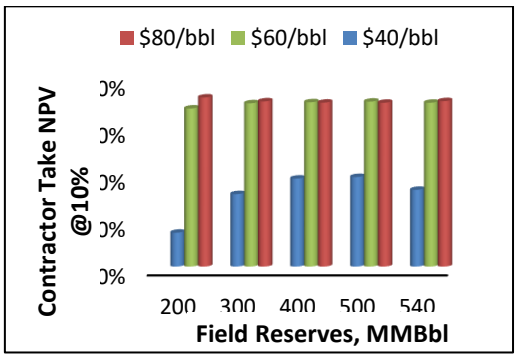

Fig. 5 Reserves Impact on the Contractor's Takes at Varying Oil Price

From both graphs the state take is averagely 65%

and contractor's take is averagely 35% for all field sizes scenarios considered at oil price of $60 and $80 per barrel. This is a fair sharing of economic rents at high profitability environments. However, at $40 per barrel, the State's take is very high for all oil field sizes. This makes the fiscal regime inadequately attractive in low profitability environments. The high state takes at low price conditions is as a result of the fact that the royalty and initial participating shares of the revenues is not based on the profitability levels of the project.

3.2 Additional Oil Entitlement

How the state achieves additional economic rent as boundary conditions of oil price and field size change was investigated and illustrated in Fig. 6. It is seen that generally State's AOE increases with increasing both field reserves and oil price. This is good since AOE of the Ghana's fiscal regime is linked to the project profitability through the contractor's after tax inflation –adjusted ROR. Though the fiscal regime fails to recover additional oil for the state for all field size cases when oil price drops below $40 per barrel even at the contractor's minimum agreed 12.5% rate of return, this fiscal term makes the fiscal regime progressive and flexible. Thus as the profitability level of the project increases the state receives more additional oil entailment and vice versa.

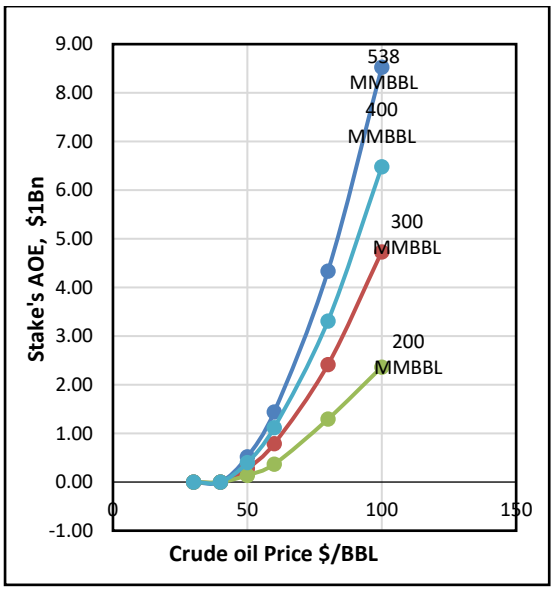

Fig. 6 Price and Reserves Impacts on the State's AOE

3.3 State and Contractor NPVs

To establish how flexible a fiscal system is, the contractor's NPV is plotted against the project total NPV. The general flexibility of the Ghana Cape Three Point's fiscal regime was investigated and illustrated in Figs. 7 and 8 at oil price of $ 60 and $ 80 per barrel of oil respectively. Both Figs. 7 and 8 show that the contractor's NPV increases as the field reserves increase for $ 60 and $ 80 per barrel of oil for all oil reserves cases. One unique thing about the NPV plots in Figs. 4 and 5 is that the interval between the Stake NPV and Contractor's NPV is seemingly stable with increasing the profitability of the projects. This explains further fair distributions of economic rents between the state and the contractor.

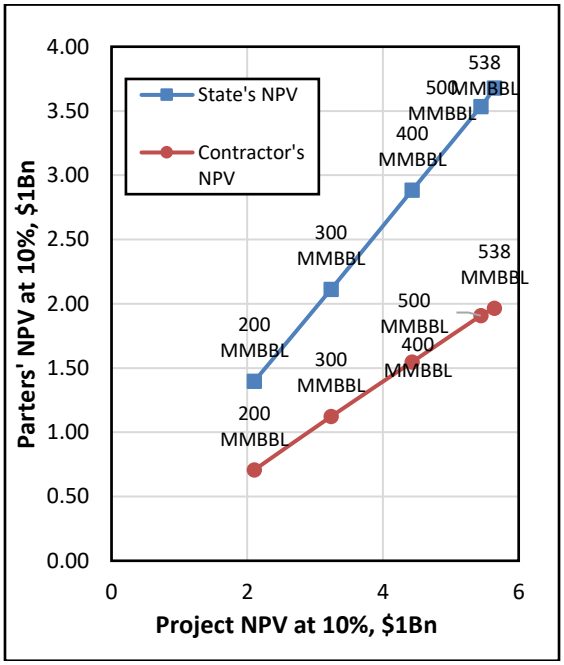

Fig. 7 Partners' NPV at 10% against the Field Reserves at $ 60/BBL

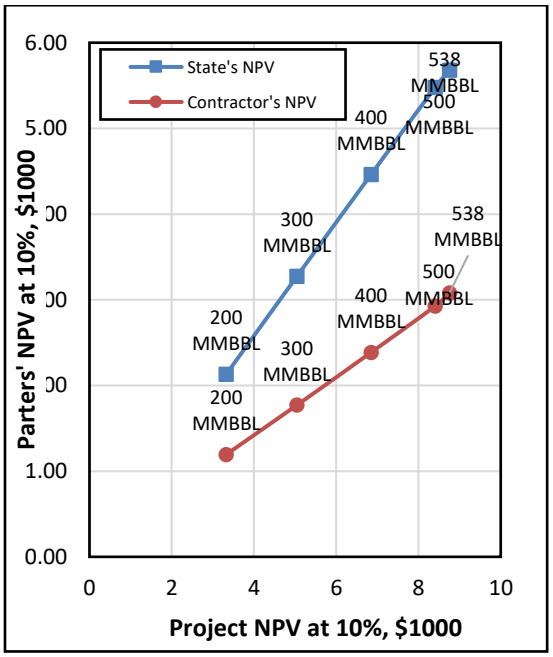

Fig. 8 Partners' NPV at 10% against the Field Reserves at $ 80/BBL

3.4 Impact of Field Size and Oil Price Level on Contractor's NPV

The general flexibility of the fiscal system was investigated and illustrated in Fig. 9 The contractor's NPV corresponds to increase in the field size and product price. The critical aspect of the model shows how the project NPV is impacted as field size and oil price change. Mostly, oil investors are attracted by flexible fiscal systems which are applicable in low field size and price boundary conditions. From Fig. 9, the investments in all the field size cases at oil prices below $30 per barrel will produce negative NPV and would render such fields marginal at these low oil price environments. This normally occurs when some fiscal terms are not linked to the profitability levels of the project. Generally, flexible fiscal regimes make way for the development of fields of any size at varying oil prices. Moreover, in the phase of keen competition between crude oil consumption and renewable energy players, the realisation of high oil price will be predictably difficult. Therefore, fiscal regimes should be formulated such that they are flexible enough to cover these lower boundary conditions for faster developments.

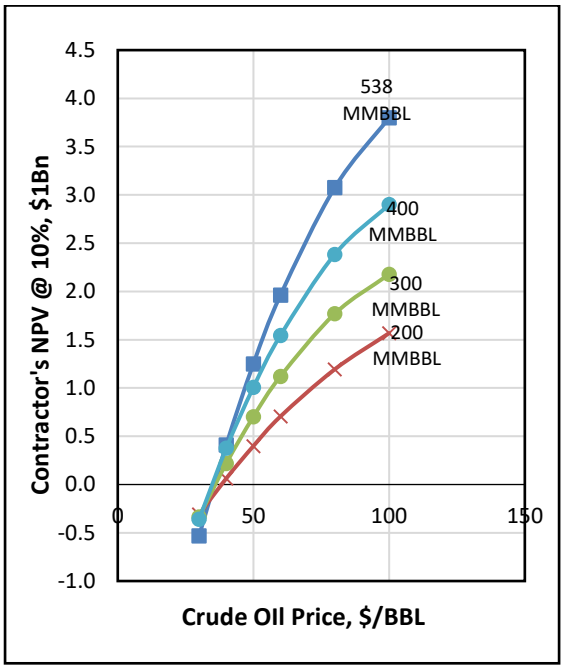

Fig. 9 Impact of Field Reserves and Oil Price on the Contractor's NPV at 10%

4 Conclusions and Recommendations

How robust and attractive and whether government of Ghana will continue to assess benefits at low price level under the Jubilee field fiscal regime have been ascertained. This was carried out through discounted economic cash flow model based on the fiscal terms. The model shows how the project NPV is impacted as field size and oil price change. Mostly, oil investors are attracted by flexible fiscal systems which are applicable in low field size and price boundary conditions. It was determined that for all field sizes considered at oil prices above $ 30/bbl, contractor's NPVs are positive. The project take statistics are averagely around 64% for Government and 36% for contractor under the various scenarios except for oil prices less than $40/bbl where the State's take statistic is above 80% and contractor's take below 20%. The high State's takes at low price conditions is as a result of the fact that the royalty and initial participating shares due to the State are not based on the profitability levels of the project.
The State receives AOE only when the oil price is above $40/bbl and the AOE increases steadily with the oil price for all the various field sizes. In general, the Jubilee field fiscal regime is fairly attractive and flexible and ensures stable shares of economic rents between the State and the contractor as the profitability of the field increases.

In the phase of keen competition between crude oil consumption and renewable energy players, the realisation of high oil price will be predictably difficult. Therefore, the Deep Water Tano fiscal regimes should be formulated such that they are flexible enough to cover these lower boundary conditions for faster developments.

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