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Research Article

A NEW PRICING MODEL FOR CRUDE OIL PRE-SALE UNITS VIA SPF (STANDARD PARALLEL FORWARD) IN IRAN

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Abstract

Nowadays energy has an important role as a driving sector of economy. Forecasting 150 billion dollars investment in energy sector during the fifth development program in Iran, the banking and financial system require a dynamic and modern economy and financial instruments. Obviously, this approach needs to remove legal barriers and modification of contracts. Financing in the oil industry has faced with serious challenges in recent years. On the other hand, investing in common offshore oil and gas resources is indispensable. In this article we are going to prepare a proposal for the Iran Ministry of Petroleum (MOP) and present a model for pricing the oil Standard Parallel Forward (SPF) contract based on Black and Scholes option pricing model. In order to proper price estimation, a proposal is presented based on empirical research and statistical models. Finally, we have some recommendations to develop the oil SPF contract and also suggest to the other researchers working on pricing the oil SPF contracts according to this model.

Keywords: Oil Standard Parallel Forward (SPF), Black and Scholes, Call and Put option, Pricing, Financing, Iran

Introduction

There is a positive relationship between financial market development and economic growth. Financial market efficiently helps to conductance the flow of savings and investment in ways that facilitate the accumulation of capital and production of goods and services. Nowadays new financial instruments are inseparable part of advanced financial markets. Each instrument has its special charm. In fact SPF contract is a kind of financial innovation which using the proper and scientific design, can turn into an effective financial instrument for financing large national projects. In this research, we will try to look more closely at this instrument. Following, a scientific and suitable model will be presented expressing the importance of research and reviewing literature of the subject.

Literature review

Economic growth and sustainable development depends on investing at a macro, national, targeted and precise plan in each economy. The oil industry is one of the most important economic sectors of Iran, which itself finances the other sectors

of economy. Although economic policymakers generally pursue oil-fewer programs in long-term horizons, instead in the short and medium term the impact of oil is quite evident in domestic economy and international relations. Since its inception in 1951 as the second largest oil company in the world, and the main member of OPEC, the National Iranian Oil Company has always tried to develop exploration, drilling, oil production and production in the world's regional and global partnerships in the Middle East. (NIOC, 2017) But procrastination in exploiting of common offshore oil and gas resources is along with the loss of national wealth. Therefor investment is necessary for this sector and it is clear that investment requires the capital formation and applying financial instruments.

The tremendous advances in national economy require a deep and new look at the energy economy. Considering the oil and gas industry is the main source of exchange in Iran and given the possibility that fiscal policy remains procyclical in the short term, the vulnerability of the Iran's income, output and real exchange rate to oil price shocks underscores the importance of adopting an exchange rate regime which facilitates increased nominal exchange rate flexibility. The basic question is: will a tiger economy be possible according to governor's expected new approaches?

This is clear that the oil industry has human resources, equipment, technical and engineering services but one of the biggest challenges in this regard is financing. Furthermore this industry is suffering from lack of modern methods and non-use of the principles of financial economy which make the problems worse.Forecasting 150 billion dollars investment in energy sector during the fifth development program, banking and financial system require a dynamic and modern economy and financial tools. Actually, this approach needs to remove legal barriers and modification of contract. Recently, financing of the oil industry has faced serious challenges. On the other hand, joint oil and gas fields' investment is indispensable and inevitable. This is why the Ministry of Petroleum has designed a new contract (with two options under betting condition) known as oil forward and attempts to collect required funds. (DIFC, 2009)

Definition

A derivative is a financial contract which derives its value from the performance of another entity such as an asset, index, or interest rate, called the "underlying". Derivative is one of the three main categories of financial instruments, the other two being equities (i.e. stocks) and debt (i.e. bonds and mortgages). It includes a variety of financial contracts, including futures, forwards, swaps, options, and variations of these. A forward contract or simply a forward is a non-standardized contract between two parties to buy or to sell an asset at a specified future time at a price agreed upon today, making it a type of derivative instrument. The time line of a forward contract is as follow:

Features of forward contracts

- The price fixed now for future exchange is the forward price.
- The buyer obtains a "long position" in the asset/commodity.
- Traded over the counter (not on exchanges)
- Custom tailored
- No money changes hands until maturity
- Non-trivial counter-party risk

In fact forward securities are designed based on forward contracts. Participation papers are financial project-based securities and their proceeds should be consumed exclusively in a particular project but forward proceeds can be owned by security publisher. (Ross et al, 2002) Consequently, it allows the National Iranian Oil Company (NIOC) to finance the

projects, short-term investments and to provide working capital, through the pre-sale of future products. We should consider that if the forward securities publish inside the country, earnings will also assign to domestic investors without losing the national wealth. Investment in oil sector caused the Ministry of Petroleum proposes oil SPF contract. This proposal has special features that distinguish it from commonly used forward securities in some Islamic countries. SPF contract refers to a sale in which payment is made in advance by the buyer, and the delivery of the asset is deferred by the seller. Total payment shall be made upon making the transaction.

Experiences in Forward contract

- Bahrain: Forward contract has been issued by the CBB at three monthly intervals since 2002 as part of the short-term financing facilities arranged on behalf of the Government of Bahrain.
- Yemen: The Central Bank of Yemen issued some Forward contracts worth 50 billion Yemeni riyals ($234 million) in April 2012. The first forward security devoted to the purchase and sale of petroleum products.
- Gambia: The Central Bank of Gambia has issued many Forward contracts which are on similar terms and conditions as the conventional T-Bills. The volume of Gambian Forward contract has increased from $215.14 million in 2010 to $345.56 million in 2011.
- Iran Mercantile Exchange (IME): Various commodities are traded periodically in the form of structured Forward contracts by the foundation of IME in 2007. These contracts are in various maturities according to decision of the producer and their sales policies.(Naserpoor, 2015)

Table1. The Amount Of Financing By Forward Contracts In IME (Billion Rial)

Commodity Group	2011	2012	2013
Agricultural	1,512	373	0
Industrial and mineral	69,622	140,809	164,907
Petrochemical and oil products	22,603	37,002	37,957
Total	93,737	178,184	202,864

SPF contract

Let’s start with some questions: what is a SPF contract and why has called standard parallel forward security? Because of Standardized specified underlying asset and standardized specifications such as contract size, maturity it is called Standard. And because the person who buys a product through a forward contract can sell part of the product to a new buyer with a parallel independent forward contract thus this contract is called parallel forward.

According to the SPF modeling: the forward is an instrument which buyer of forward contract can sell a specified amount of asset before maturity, through another independent forward contract but for delivery of an asset in the maturity, refers the new buyer to the first forward security issuer by draft contract. This is initially because of a strong assurance by the government provided for investors due to the developing countries conditions. Accordingly secondary forward contract is called Standard Parallel Forward (SPF) and process can be continued this way and the buyer of an asset in the SPF can sell it to another's. There are some preconditions and features for SPF which is pointed out as follow:

- The goods sold need not be in existence at the time of contracting.
- The sale price should be paid immediately upon making transaction
- The byer cannot sell object of transaction prior to taking delivery
- The underlying asset must be described in enough detail, for the seller to deliver the required asset.
- The date and the location of delivery should be determined exactly and clearly

And about the SPF pillars we have:

- Participants: real producers of commodities can sell their product
- Counterparty risk: is covered with the required guaranties based on the IME's Clearing house. Most of companies are guaranteed by government institutions
- Maturity date: No time limitation for SPF contracts maturity date and it depends on market demand.(up to 6 month)
- Price: Commodities are sold at a discount rather than the cash price
- Delivery: All deals lead to physical delivery
- Secondary Market: we have planning a SPF secondary market for these contracts

A proposal for the Ministry of Petroleum: Oil SPF contract

Defining under SPF contract increases the liquidity of these securities (Compared with other ordinary domestic financial instruments) and attracts investors. A new SPF contract will be defined after each transfer and a seller referrals new buyer to the first seller (the Ministry of Petroleum). Our plan for Ministry of Petroleum is a new contract considering some changes and small size of contract scale.

In this plan, the National Iranian Oil Company (NIGC) will sell its four-year maturity oil SPF contracts to the applicants by agent bank in order to finance its investment plans. For funds received from buyers, a standard bill of exchange will be given to the buyers, which show the right of visit and receive the crude oil or cash settlement with the National Iranian Oil Company. Each pre-sold oil SPF security contains 10 barrels of crude oil on day price (for example, US $ 100). The supplied crude oil under oil SPF contract is "Iran heavy export crude oil". The base price is fixed and will be calculated based on Oman & Dubai Indices on the last trading day before the start of the supply period. Of course, given the oil market oscillating conditions, there are two general risks for this contract: first, the risk of non-rising oil price to favorable level (on the side of buyers) and second, the risk of excessive increase in oil price, (on the side of seller (the Ministry of Petroleum)). It seems important to explain about options here.

An option is a contract giving its owner the right to buy or sell an asset at a fixed price on or before a given date. For example, an option on a building might give the buyer the right to buy the building for $1 million on or any time before the Saturday prior to the third Wednesday in January 2010. Options are a unique type of financial contract because they give the buyer the right, but not the obligation, to do something. . (Ross et al, 2002) The buyer uses the option only if it is advantageous to do so; otherwise the option can be thrown away. There is also a special vocabulary associated with options. Here are some important definitions:

1. Exercising the Option. The act of buying or selling the underlying asset via the option contract is referred to as exercising the option.
2. Striking or Exercise Price. The fixed price in the option contract at which the holder can buy or sell the underlying asset is called the striking price or exercise price.
3. Expiration Date. The maturity date of the option is referred to as the expiration date. After this date, the option is dead.
4. American and European Options. An American option may be exercised anytime up to the expiration date. A European option differs from an American option in that it can be exercised only on the expiration date. (Ross et al, 2002)

In order to control these two types of risk, two options under betting condition is added to SPF contract. In addition, buyer (investor) purchases a put option for $ 140 (under betting condition) while he buys SPF contract. With these explanations on one hand, if the price of per barrel be lower than $140, at maturity date, holder will have the right of selling security (put option) to the National Iranian Oil Company for $ 140.

On the other hand, security buyer sells a call option to the National Iranian Oil Company and if the price of per barrel rises to more than $160, at the maturity date, National Iranian Oil Company will have the right of purchasing security (call

option) from security holder for $160. Thus, the swing range that buyer will be faced with is $140 to $160. In fact, if per barrel price is between $140 and $160, buyers can fulfill a cash settlements or physical agreement under conditions of the National Iranian Oil Company.

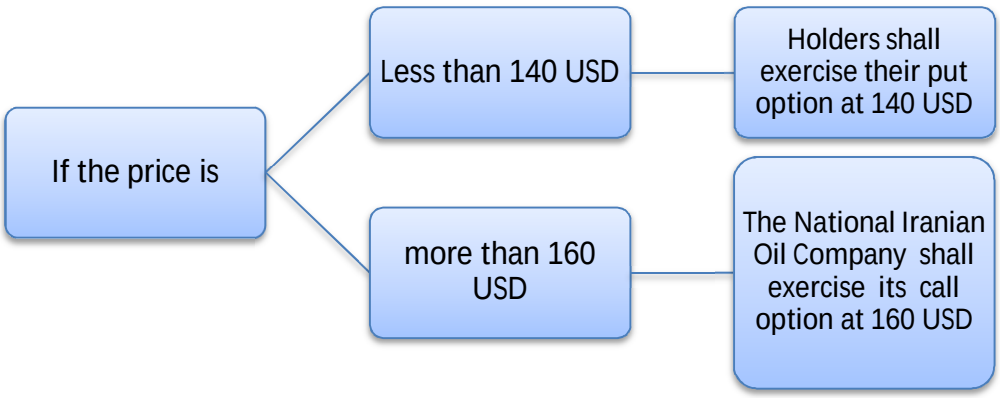

Figure1. Use of SPF contract; scenarios at maturity

Initially, three methods (in the form of three stock symbols) were proposed to the Ministry of Petroleum so that individuals could buy these securities with: Dollar, Rial based on Dollar and Rial. Therefore, the stock symbol should be opened for these items. Bondholders can choose physical delivery or cash settlement at maturity, under the price between $ 140 and $ 160. If they choose physical delivery option, buyer must accept the delivery terms of securities issued by the Ministry of Oil at the time of issuance. (Nikjou, 2012)

According to the latest available information, the minimum physical delivery value for shipments is one million barrels. In fact, buyers who own 100,000 contracts can request physical delivery. Furthermore, the conditions for physical extraction of crude oil in the form of oil SPF contract are so that bondholders shall announce their request to the National Iranian Oil Company three months before the maturity. All investors (domestic and foreign) have the opportunity to take part in this market and buy these securities, but in the case of physical delivery of crude oil, buyers should have special conditions of the National Iranian Oil Company.

A question raised is: How exactly do following prices get determined?

1. The exercise price of call option that byer sells to the Ministry of Oil
2. The exercise price of put option that byer purchases from the Ministry of Oil
3. The secondary price of oil forward contract in secondary market

This is a theoretical and exploratory research; therefore, we apply research hypotheses as a theoretical model to answer research questions. The purpose of this research is providing a model for proper pricing of oil SPF contract or in other words pricing the crude oil pre-sale units which is based on efficient economic principles so that finances National Petroleum Company's projects.

Domestic research attitudes

Nikjou (2012) in a paper titled "Survey of Oil Parallel Forward contract and Providing Three Offers" classified securities into two categories: (a) Financing (b): Speculating. He claims that Rial speculationary securities can be useful for

financial market and applying of Dollar speculationary securities[1] should be avoided. The reason is increase in Dollar speculative demand leads to Dollarization intensification. Research results showed that Oil Parallel Forward contract issuance could be useful to circulate people in-hand Dollars purchased in order to speculation. In setting prices and determination of interest rates, we should attend to the opportunity cost of foreign currency and keeping the securities. Two important problems addressed about the Dollar oil forward contract and it resulted that this instrument will be changed to a Dollar speculative security due to the volatility of oil price and exercising of call and put options. Finally, three important recommendations were raised for correct issuance of these securities:

1. Bank interest rates on dollar deposits must be ordained between the minimum interest rate and maximum of these securities. Otherwise, the National Oil Company will bear additional costs for financing.
2. Type of secondary transactions settlement for these securities must be made in Rial and based on the market exchange rate.
3. It is recommended that the parallel forward contract be issued along with exchange participation papers issuance. It causes both risk-taker and risk-averse investors be interested in these securities and increases the liquidity of them.

For the first time Farahani Fard (2010) in a research titled "Salam sukuk, an appropriate instrument for financing and hedging" using the experience of Bahrain tried to introduce this instrument to Iran capital market. The research shows that there is no problem with initial public offering for forward contract but according to Islamic economic rules, there are some problems in the secondary market.

Moosavian (2011) in a research titled "Salam sukuk, an instrument for financing the upstream projects of oil industry" showed that combining Standard Parallel Forward and drafts, we can make a legal and controlled risk instrument (so called forward contract). It might have many applications such as financing upstream projects. The different aspects of research are:

- It provides a better solution to address the problem of secondary market of forward contract
- Using call and put option contracts it controls fluctuations in prices at maturity and manages the risk of forward contract
- Given the current economic situation in Iran, it suggests suitable methods for pricing of forward contract.

Methodology

The holder of a forward contract is obliged to trade at maturity. Unless the position is closed before maturity the holder must take possession of the asset, regardless of whether the underlying asset has risen or fallen in price. Wouldn't it be nice if we only had to take possession of the asset if it had risen? To address this wish derivatives known as options are traded. The two most famous ones are call options and put options as follow:

- A call option gives the investor the right (not the obligation) to buy an underlying asset at an agreed-upon-price (the strike price) at a date in the future (the expiration date T)
- A Put Option gives the holder the right (but not the obligation) to sell an underlying asset at an agreed-upon-price (the strike price) at a date in the future (the expiration date T).

As already mentioned, oil parallel forward securities have two options for dealing at maturity. Since the buyer or seller does not pay for these put and call options, we have:

[1] . It means that settlement should be fulfilled with Dollar.

$$C_c = X_{max} - X_e \quad (1)$$

$$C_p = X_e - X_{min} \quad (2)$$

X_{max}: The maximum agreed crude oil price at maturity
X_e: The expected price of crude oil at maturity
C_c: Call option price
X_{min}: The minimum agreed crude oil price at maturity
C_p: Put option price

The oil SPF security should be profitable as a kind of financial security. Therefore, the expected price of crude oil at maturity should be determined so that provides profitability for holders of these securities. But the important point to keep in mind is that since these securities have an asset risk because of the volatility in their base assets (crude oil); the expected return of investor should be adjusted to its risk degree. One of the most significant models for determining the expected return on risk assets is Capital Asset Pricing Model (CAPM). For the first time, CAPM was developed by Sharp (1964),)Lintener (1965), Treynor (1961) in the 1960s. In their proposed model, they tried to create an implicit equilibrium between risk and return on securities. In this way, the return on a capital asset can be attributed to the return on the stock market by following equations (Perord, 2004):

$$R = R_f + \beta(R_m - R_f) \quad (3)$$

$$\beta = \frac{cov(R_i, R_m)}{var(R_m)} \quad (4)$$

R_f: Interest rate on bank dollar deposits (risk-free rate)
R: Expected rate of risk asset (crude oil)
R_m: The average of dollar return on other assets (market rate)
β: Systematic investment risk criterion
In addition, in this research X_e is calculated by the following formula:

$$X_e = R * P_{oil} \quad (5)$$

P_{oil}: Crude oil price at the beginning of period

In this paper, a template is presented based on the pricing of a dollar-based oil SPF security. In order to calculate X_{min} and X_{max} in oil SPF, the call and put option price of these securities should be determined; accordingly the Black-Scholes pricing model is implied for this purpose.

The Black-Scholes formula (also called Black-Scholes-Merton) was the first widely used model for option pricing. It is used to calculate the theoretical value of European-style options using current stock prices, expected dividends, the option's strike price, expected interest rates, time to expiration and expected volatility. The formula, developed by three economists – Fischer Black, Myron Scholes and Robert Merton (1973) – is perhaps the world's most well-known options pricing model. (Folger, 2015) It takes into account that you have the option of investing in an asset earning the risk-free interest rate. It acknowledges that the option price is purely a function of the volatility of the stock's price (the higher the volatility the higher the premium on the option). Black-Scholes treats a call option as a forward contract to deliver stock at a contractual price, which is, of course, the strike price.

It was designed based on binominal option pricing[2]. The reason of using this model is that oil SPF has no dividing and earning. Also, since these options will be applied at maturity, and in this regard, it is a kind of European-style option; consequently Black-Scholes model is the best choice. (Black and Scholes, 1973) In the main pattern of this method, the underlying asset had no dividing and earning, which has been modified in subsequent patterns by Robert Merton (1970s). In this method, the return on the underlying asset (stock) is considered as a variable with normal probability distribution. Using this model, the underlying asset price (stock) itself will have a normal logarithmic distribution.

The Black-Scholes model assumptions

For extracting the Black-Scholes formula, the following assumptions are considered:

- The option is European and can only be exercised at expiration.
- No dividends are paid out during the life of the option.
- Markets are efficient (i.e., market movements cannot be predicted).
- There are no transaction costs in buying the option.
- The risk-free rate and volatility of the underlying are known and constant.
- The returns on the underlying are normally distributed.
- Lending and borrowing are not restricted at risk-free rate.
- There is a feasibility for short-selling
- Transactions are ongoing, over the time
- Stock price changes are continuous and there is no price jump; therefore, stock prices follow a normal logarithmic distribution

Black-Scholes pricing formula

Black-Scholes pricing formula has six parameters: Cash price of underlying asset (S), Contractual price at maturity (X) and (k), Maturity date (t), Volatility of underlying asset (δ), Risk-free rate (r), Expected earnings of underlying asset (y) The formula for pricing European call option contracts is as follows:

$$C = SN(d_1) - ke^{-rT}N(d_2) \quad (6)$$

Also the formula for pricing European put option contracts is as follows:

$$P = ke^{-rT}N(-d_2) - SN(-d_1) \quad (7)$$

Where:

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r + \frac{\delta^2}{2}\right)(T)}{\delta\sqrt{T}} \quad (8)$$

And;

2 . Binomial option pricing is a simple but powerful technique that can be used to solve many complex option-pricing problems. In contrast to the Black-Scholes and other complex option-pricing models that require solutions to stochastic differential equations, the binomial option-pricing model (two state option-pricing models) is mathematically simple. It is based on the assumption of no arbitrage.(Hsia, 1983)

$$d_2 = \frac{\ln\left(\frac{S}{X}\right) + \left(r - \frac{\delta^2}{2}\right)(T)}{\delta\sqrt{T}} = d_1 - \delta\sqrt{T} \quad (9)$$

Considering N(x) is equal to standard normal cumulative distribution function.

Crude oil pricing model

Now we present a model for pricing of SPF. As it has explained:

$c = X_{max} - X_e$

$P = X_e - X_{min}$

$X_e = R * P_{oil}$

From these equations, we can extract the following formulas:

$X_{max} = X_e + c$ (10)

$X_{min} = X_e - p$

According to the Black-Scholes formula:

$C = SN(d_1) - ke^{-rT}N(d_2)$

$P = ke^{-rT}N(-d_2) - SN(-d_1)$

Now, by inserting these formulas, we will present a model for the pricing the SPF:

$X_{min} = X_e - ke^{-rT}N(-d_2) + X_eN(-d_1)$

$X_{min} = X_e[1 + N(-d_1)] - ke^{-rT}N(-d_2)$ (11)

$X_{max} = X_eN(d_1) - ke^{-rT}N(d_2) + X_e$

$X_{max} = X_e[1 + N(d_1)] - ke^{-rT}N(d_2)$ (12)

Since, in the SPF, the agreed-price for put option (k) is X_{min} and the agreed-price for call option is X_{max}, , placing in equations (11) and (12), we find the final equations (13) and (14) which are the main equations for determining the up and down prices of oil standard forward bonds at maturity:

$$X_{min} = \frac{X_e[1+N(-d_1)]}{1 + ke^{-rT}N(-d_2)} \quad (13)$$

$$X_{max} = \frac{X_e[1 + N(d_1)]}{1 + ke^{-rT}N(d_2)} \quad (14)$$

Conclusions and recommendations

Economic growth and sustainable development of economy depends on macroeconomic, national, targeted, and precise investment in the country. The oil industry is one of the most important economic sectors in Iran that finances other sectors of economy. Considering energy as a pioneer of Iran's economy, it has a definite investment position and deeply needs to be equipped. The way we suggested in this regard to finance the projects of oil industry is oil SPF. Due to its different nature with the conventional financing instruments, it should be investigated. Actually the most important aspect of this security is the pricing which discussed in this research. Finally, using the well-known model of Black-Scholes option pricing, we tried to illustrate the appropriate mathematical model. We have some considerations in this regard

- The maturity of oil parallel forward contract is usually as short as can be considered as an alternative for a conventional T-bill.
- In most of the case forward contract has been issued as monitory policy instrument, oil SPF contracts also can be used for this target.
- Despite a wide acceptance of some forward contracts, they have a very little amount of global issuance. We suggest the promotion of oil SPF contracts by policy-makers.
- Lack of secondary market for forward contract results liquidity risk that using these model would address this problem.
- Because of counterparty risk, entities rarely enter into a contract if there is no third-party guarantee that using this model individuals can trust to the contracts.
- Financing with less expenses
- No limitations regarding funds for financing
- Providing adequate price hedging for both side of transaction

Finally, we suggest that empirical and statistical research be carried out on the basis of this model to estimate the marginal prices of these securities.

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