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Abstract

The article presents empirical study results of Lukoil company risk-assessment model development. The study is based on a cash flow at risk method (CFaR). The assessment of Lukoil company risks is made on the end of 2013. The research method includes assessment of market, credit and operational risks. The obtained results demonstrate that oil prices don't affect the company's CFaR too much but the most severe market risk is the one connected with gasoline prices. To reduce CFaR some hedging procedures may be applied, especially for market risks: for example, options and futures can be used to hedge against changes in oil and gasoline prices fluctuations.

Keywords: corporate risk management, options, risk assessment, hedging strategies

JEL: G30, G32

Introduction

It's common knowledge that all companies are affected by some risks. Most risks can be structured in three following groups: market risks (those connected with commodity prices or processes that take place on markets), credit risks (those connected with company's lenders and debtors) and operational risks (connected with processes within the company and resulted in damaging production operations). Risks' exposure varies among different companies. For some of them the most important risk is market one, for others - it is credit risk and so on. Risks are closely connected with the industry.

Many studies focus on identification of risks, which are most important for oil and gas industry. Brett Schroeder and Jan A. Jackson formed the risk rating structure based on databases of risk registers, and found out, that the most severe for oil and gas projects are technological, planning, organizational, market and scope definition risks categories, while for refinery turnarounds these are – technical support, contracting and labor, planning, scope definition, procurement and materials [Schroeder, Jackson, 2007]. Osabutey D., Obro- Adibo G., Agbodohu W. and Kumi P., based on data, gathered from top managers and employees through questionnaires, point out credit risk-default on the part of OMC's, operational (fire and break down of equipment) and huge debt owed Ghana commercial bank as the most critical risks. [Osabutey, Adibo and others, 2013]. Olusegun Omole, T.A. Borisade and Ahmad Muhammad came to conclusion that the technical risk elements: reservoir area, hydrocarbon thickness, porosity, recovery factor and production mechanism, are the most dominant uncertainty factors in oil and gas exploration and production in Nigeria. The major economic uncertainties are the etude oil price and joint venture cash call. Political and strategic risks, environmental and health risks are of much lower significance to investors in the oil and gas industry in Nigeria [Omole, Borisade, Muhammad, 2004]. G. David Haushalter studies determinants of risk management policy in oil and gas producing sector and identifies that the fraction of production hedged against price risk is positively related to leverage and is greater for firms with little financial flexibility (relative amount of debt outstanding and cash holdings) and at the same time the fraction of production hedged is related to the basis risk (fraction of production located in regions where prices are correlated with prices on which exchange-traded derivatives are based [Haushalter, 2000].

Managers always wanted to somehow handle risks and to reduce their impact on a company. Rikard Smistad and Igor Pustylnick study the financial reports of 12 Canadian oil and gas companies and find out, that all companies examined have documented risk management strategies, use derivatives to help manage their financial risks, employ common risk management strategies using derivatives. The most common derivatives used by the companies to hedge are oil and/or natural gas swaps, collars or forward contract , including futures contracts , and interest rate swaps [Smistad, Pustylnick, 2012].

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Risk-management policy depends on many factors: the sector in which the company operates, institutional development of the country, economic, political situation, life cycle stage.

Morton Pincus and Shivaram Rajgopal investigate using of discretionary accruals and hedging with derivatives as substitutes to manage earnings volatility in oil and gas sector and take two types of industry specific risks for oil and gas producing firms: market factors (oil prices) and operational (drilling success) into consideration. It was found out, that in the extent of hedging regression, the extent of smoothing with DACs is not significant for the extent of hedging, while the extent of hedging is negatively related to the extent of smoothing with DACs. The idea is the following: firms do not attempt to eliminate earnings volatility and "managers trade off the extent of smoothing with DACs against the extent of hedging, once they have decided on the latter" [Pincus, Rajgopal, 2000]. Osabutey D., Obro- Adibo G., Agbodohu W. and Kumi P. describe risk management practices in Ghana. In order to reduce risk of default, management places limits that OMC's cannot exceed in order to reduce huge unpaid debts, makes them to produce bank guarantors before credit is granted them. In order to reduce fire out break and break down of equipment, management implements safety measures so safety departments provide training to staff to help prevent fire outbreak and frequent breakdown of equipment. On foreign exchange exposure, such as depreciation of the cedi against the dollar and instability in the global oil prices, management constantly advises the National Petroleum Authority (NPA) and government to adjust the ex-refinery prices. At the same time derivatives, a widespread tool for risks hedging is still beyond the scope of Ghana management [Osabutey, Adibo and others, 2013].

The problem of hedging in Oil&Gas is interested not only scientists but also government bodies. The report of the U.S. department of energy describes mechanisms of hedging, the risks in the production and consumption of petroleum, natural gas, electricity and gives detailed information about derivatives, derivatives markets and energy markets in USA. So oil producers hedge low crude oil price risk by selling crude oil futures and buying put option, petroleum refiners face risks of high crude oil price, low petroleum price and thin profit margin and hedge these risks by buying oil futures or call options, selling product future or swap contract or buy put options and buy crack spread (buy crude oil future and simultaneously sell product future) respectively [US department of energy, 2002].

All these risks should be treated properly. There exist some techniques that help managers to evaluate risks and to propose policy against them. Sunil K. Mohanty and Mohan Nandha estimate oil price risk exposures at the firm and at the industry levels based on the Fama-French-Carhart's four-factor asset pricing model and prove, that oil price risk exposures are positive and significant for American oil and gas companies. It was also found, that oil price risk exposures associated with the oil and gas producers and the oil equipment and services firms are higher than those that are associated with integrated oil and gas services firms or pipelines [Mohanty, Nandha, 2011]. Varoujan K. Minassian and Dr. George F. Jergeas describe different analytical techniques for risk analysis, such as tornado diagrams for the results of sensitivity analysis, Monte Carlo simulation, decision trees, influence diagrams [Varoujan, Minassian, Jergeas, 2003]. Angelo Pinheiro, Ben D. Cranor and David O. Anderson proposes a risk management approach using a modified risk matrix for planning, discusses the analysis, use and application of a modified risk matrix for prejob planning (preliminary hazards analysis) [Pinheiro, Cranor, Anderson, 2011].

This paper aims to make an analysis of Lukoil's company risks form the investor's point of view. Also the risk-management policy that the company implements will be analyzed. The company's performance is definitely affected by market, credit and operational risks and most important ones will be assessed in this paper. Moreover, some hedging strategies will be proposed and tested and several suggestions on the company's risk-management system will be lighted. These hedging strategies also aim to increase the company's value through decreasing risk effects.

The paper is organized as follows: first, we define market risks for the company and build a simple model which will help to assess risks. Some hedging strategies will be demonstrated to minimize negative effects of these risks. Second, we define credit and operational risks, make some assess-

ment and hedging procedures. Third, we build a hit-map and make some suggestions concerning risk-management in Lukoil company.

Market risks

Founded in 1991, Lukoil is the largest privately owned oil & gas company by proved oil reserves. It is also the 6-th largest by hydrocarbon production.

Lukoil currently operates in 38 countries. Main activities include exploration and production, petroleum refinery, power generation and products distribution. From 2007 credit rating has remained steady at BBB/ BBB-/Baa3 as ranked by S&P, Moody's and Fitch. Lukoil shares is not only traded in Russian stock market but also at London stock exchange, Germany and US OTC market. The company is responsible for corporate income tax at 20%, property tax, mineral extraction tax, VAT and export duties. The most powerful market risks factor for the company are inflation, interest rate and exchange rate fluctuations, oil price, Russian government policy, competition, changes in regulations, market share maintenance, acquisitions or divestitures, technological changes. So all market risk factors can be distinguished into 5 major types of market risks: equity, interest rate, foreign exchange, commodity and derivative risks.

- Interest rate risks. The long-term debt is exposed with bonds nominated in the US dollars. The short-term rate is quite volatile, posing a risk for high interest expenses. The way out how to mitigate this risk for the company is to improve debt structure and control the need for additional financing and debt refinancing.
- Foreign exchange risks. The company is subject to foreign exchange risk because it conducts business in many countries. The exchange rate of the Russian ruble to the US dollar has the most impact on transaction results, since the company's export proceeds are denominated in US dollars, while the major costs are incurred in Russia and in this case are denominated in rubles.
- Commodity risks. Rapid hydrocarbon price fluctuations in both directions may complicate the company's operations to a certain extent. The key techniques to mitigate short-term price risks include management of materials/value balance (including the redirection of the marketed volumes of oil and petroleum products from less efficient to most efficient segments), use of effective price formulas and abandonment of fixed prices in the contracts.
- Derivative price risk. Companies often use derivatives in order to hedge some of its risks. However, huge share of derivatives in the company's portfolio may pose some additional threats to financial stability of the company due to a derivative price fluctuation.
- Equity risk. This particular risk may affect the company performance through the prices of stocks in company's portfolio. This risk is considered to be the least important for production companies.

Tougher competition and worsening market environment may result in the following: lower sales and underutilization of capacity, lower refining margin, lower retail margin. The above mentioned facts may result in lost profit and higher expenses for the company, which in the long run will affect cash flow and enterprise value in this business segment. To mitigate the influence of these factors on the company it is necessary to take timely measures, including prompt retargeting of goods flows at market segments ensuring the largest profit, constant upgrade of refineries aimed at increased output with high added value, as well as other measures aimed at raising the efficiency of capital utilization in the refinery and petrochemical sectors. As soon as Lukoil not only uses its own oil in production but also buys it from suppliers, it will be assumed that changes in oil price can affect profits in both revenues and costs. For each market risk was found income statement position that depends on it (International Financial Reporting Standards). As already mentioned, oil prices affect both revenue and costs. Interest rate risks will have an impact on net interest expenses. Foreign exchange risks for company with a large export have a negative impact on cash flows and net profit.

Table 1

Market risks and their influence on income statement

Market risks	IS position
Commodity price risks	Revenue, Costs of oil and gas acquired
Interest rate risks	Net interest expenses
Foreign exchange risks	Revenue, Costs, Operating expenses

So in our model the following exposures is proposed:

$$\text{Rev} = \frac{P_0^{Ur}}{e_0} * V_0 + \frac{P_1^{Ur}}{e_1} * V_1 + \frac{P_2^{Ur}}{e_2} * V_2 + \frac{P_3^{Ur}}{e_3} * V_3; \quad (1)$$

$$\text{Exp} = \frac{P_0^{Br}}{e_0} * V_0' + \frac{P_1^{Br}}{e_1} * V_1' + \frac{P_2^{Br}}{e_2} * V_2' + \frac{P_3^{Br}}{e_3} * V_3'; \quad (2)$$

$$\text{Int}_{short} = D_0 * (\text{LIBOR}_0 + 4) + D_1 * (\text{LIBOR}_1 + 4) + D_2 * (\text{LIBOR}_2 + 4) + D_3 * (\text{LIBOR}_3 + 4), \quad (3)$$

Where P_t^{Ur} is price of Urals at time t;e_t is exchange rate at time t; V_t is a volume of oil sold; P_0^{Br} is a price of Brent at time t; V_t' is a volume of oil acquired; D_t is company's short-term debt.

In the model it is assumed that revenue is affected by both exchange rate and price of oil Lukoil sells (Urals). Moreover, it is a well known fact that the company sells not only oil, but also some petroleum products like gasoline, diesel and so on. So the exposure could be easily enhanced with these products in the way it is made with oil. Expenses, connected with the oil the company buys (assumed that it is Brent), similarly depend on the price and exchange rate. Taxes and export fees also depend on the oil price. Interest expenses are affected by short-term interest rate (3-month weighted-average rate). For its loans Lukoil uses floating debt. The average short-term rate for it is LIBOR+4%.

For simulating Brent price, exchange rate (USD-RUB) and interest rate (LIBOR 3 months, monthly) was used a Monte-Carlo simulation to identify potential scenarios for the market factors. The main statistics obtained from this simulation are presented in table 2:

Table 2

Mean and standard deviation of returns in logarithms

Statistics	Brent price	Urals price	Exchange rate	Interest rate
μ	0,000527	0,000213	0,004629	0,47383
σ	0,1735	0,2282	0,074914	0,09352

The following formula (4) was used to make a prediction for 1000 scenarios:

$$P_t = P_{t-1} + P_{t-1}\left(\mu\Delta t + \sigma\varepsilon_t\sqrt{\Delta t}\right) \quad (4)$$

Where ε is a random variable (0;1). The values for the 1st, 2nd, 3rd, 4th quarters were used to get final prediction for market risk factors. Also a random variable (0;1) was added to the previous value for 1000 days or 18 months as in case of interest rate.

Market risk assessment

To assess market risks Cash Flow at Risk technique was used. It helps to define effects of each particular risk and different hedging programs. While calculating cash flow a standard formula (5) was applied:

$$CF = (EBITDA - DA) * (1 - t) + DA - CapEx - \Delta NWC \quad (5)$$

Where EBITDA is earnings before interest, taxes, depreciation and amortization of Lukoil company, t is a tax rate, CapEx is capital expenditures, ΔNWC is delta net working capital. To make risk assessment more precisely the company's revenue and cost structure was taken into account.

According to Lukoil's income statement revenue is divided into export revenue, revenue from gasoline trade (both export and domestic) and other revenue. To calculate export revenue we simulate prices of Urals oil and expected export volumes. Based on the data from reports was assumed the volume of gasoline the company can sell next year. To be more precise, the number of gas stations the company owns was multiplied by the average daily volume of gasoline sold at 1 station. Prices of gasoline are also simulated using Monte Carlo. So one more risk factor was introduced- gasoline prices. Other revenues were calculated as an average from historical data.

The next step is analyzing cost structure which we tried to make as diverse and true to life as possible. First of all, costs connected with oil, gas and other resources acquired should be taken into account in the model. So we simulate oil prices and forecast necessary volumes of oil based on historical data. Another part of these costs (connected with resources acquired) we forecast as an average from historical data. Also taxes and export fees are taken into account as they have a significant weigh in company's costs. Export fees (in dollars per ton) change from month to month and are tied to Urals oil price. These fees are simulated as a ratio to oil prices simulated previously. Tax rate for resources (in rubles per ton) is also tied to the oil price and exchange rate. The legal rate of 470 rub per ton is adjusted by three coefficients. Two of them reflect the technical aspects of oil extraction (assumed these coefficients to be 0.7-0.8 based on historical data) and the third one reflects the oil prices (formula 6):

$$k_3 = (\text{price} - 15)\frac{\left(\frac{\text{dollar}}{\text{ruble}}\ \text{exchange rate}\right)}{261} \qquad (6)$$

In this paper we are able to simulate this coefficient and, hence, the tax rate. Also both export fees and taxes are adjusted for some constants (based on historical data) to account for other fees. Other costs, namely operational, transportation and commercial, as well as depreciation and amortization and CapEx are computed using historical data and applying historical trends. After analyzing net working capital based on historical data we concluded that its value is very small compared to company's cash flow and that is why it isn't taken into account. The effective tax rate is 20%, annual floating debt (tied to LIBOR, average rate LIBOR+4%) is assumed $6 000 million. As the result we come up with 1000 end-of-year Cash Flow possible values. Then we sort them in decreasing order, find average (benchmark) and compare it with average values of 950-th and 951-st (threshold) percentiles and come up with CFaR. Calculating expected shortfall (ES) is almost the same procedure the only difference is in comparison of the benchmark with average of 50 least values. Applying all these assumptions and calculations, we come up with the following CFaR and ES (Table 3).

Table 3

Calculation of Cash Flow-at-Risk for market risks (in million dollars)

Benchmark	2 774, 91		
Threshold	1 943, 32		
CFaR	831, 6	ES	1 088, 4

On the next step risk factors are fixed and calculated CFaR once again to determine the importance of each factor.

Table 4

Defining the impact of each risk-factor (in million dollars)

Interest rate fixed constant	CFaR	847, 97	ES	1 083, 95
Exchange rate fixed constant	CFaR	845, 80	ES	1 084, 85
Oil prices fixed constant	CFaR	813, 10	ES	1 041, 70
Gasoline price fixed constant	CFaR	225, 34	ES	290, 40

From the Table 4 it can be seen that for Lukoil company interest rate risk and exchange rate risk don't play an important role. As was assumed previously, oil prices affect CFaR, though not very

dramatically. It can be explained with the fact that these prices also affect taxes and fees the company pays. So revenues and costs balance the negative and positive changes in oil prices. What is more surprising - company's cash flow is very sensitive to changes in gasoline price. The reason for it is that gasoline price enters only revenue side of cash flow, so even minor changes in price can potentially reduce cash flow significantly and, as the result, CFaR.

Based on these results some hedging strategies can be proposed, for example hedging oil price risk and gasoline price risk using futures and options. Expiration prices are assumed for 4 quarters of the following year to be 109, 107,5, 106, 105 $ per barrel respectively, and 3, 2,9, 2,8, 2,6$ per gallon of gasoline. Our aim here is to find the optimal hedging strategy. It means that costs connected with hedge and advantages that Lukoil get from it we should be balanced. Trying to minimize CFaR different volumes of exports were hedged. The main results achieved from this simulation are if we too much export are hedged, Lukoil faces additional risks connected with derivative price. Moreover, options are too costly, so from some breaking point benefits will stop outweigh costs of hedging.

Table 5

Hedging suggestions (in million dollars)

Hedge with oil and gasoline futures		
	CFaR	ES
No hedge	831, 60	1 088, 39
20%	715, 25	902, 10
25%	687, 33	860, 40
30%	648, 83	820, 83
Hedge with oil and gasoline options		
	CFaR	ES
No hedge	831, 60	1 088, 39
20%	820, 80	1 055, 79
30%	812, 38	1 039, 64
35%	810, 22	1 031, 60
40%	808, 05	1 023, 56

From these tables can be seen that futures reduce CFaR more than the options do. But they also reduce the company's FCF and from point of 40% hedge with oil and gasoline options the possibility of negative cash flow arises. It reflects the situation when market prices are higher than the expiration ones. In this case options are more flexible. As was assumed earlier low expiration prices, CFaR managed to cut by 23 mln. dollars using options. The optimal volume of hedging is about 30-40% of export and gasoline volume on this level benefits and costs from this hedging program are balanced. The results connected with calculations EaR are rather realistic.

Table 6

Calculation of Earnings-at-Risk (in million dollars)

Benchmark	9 448,68		
Threshold	8 597,29		
EaR	851,39	ES	1 088,52

So we managed to come up with some realistic figures and to develop some hedging strategies. We also show that the company should take market risks into account as they pose a certain threat to its performance.

Defining credit and operational risks

Oil and gas companies are almost always huge and vertically integrated. It means that they have a lot of stakeholders which raises the number of different risks. Lukoil is not exception and it has all risks that typical for oil and gas industry. First of those risks is access to reserves. Nowadays most of oil reserves are explored and all new deposits belong to governments. It means that companies have

buy opportunities to use them from state authorities. This risk is very important for Lukoil because it has to state-owned competitors in Russian market. Also Lukoil has mining businesses in foreign countries and has to follow their terms of access to reserves. There are some other political risks. For example the event in Gulf of Mexico forced governments of many countries to increase regulation in this industry. Also oil company has to pay a lot of taxes and risk of changes in fiscal policy is an important one. Most of undeveloped deposits are more difficult and expensive to use than old. Oil companies have to invest a lot into new technologies and researches. This factor demands high oil prices to make developing profitable.

Previous problem is the reason of the human capital deficit. Companies need qualified staff to operate difficult equipment and make modern researches. Another side of this problem is terms of labor in oil companies. Demand of safety is very actual because a lot of deposits are far from comfortable places of living. Some oil producing countries have a threat of gun conflict. Also oil companies have a great pressure from society in reason of ecological issues. Expenditures to solving these problems plays greater share in all expenditures. Global warming allows to use new deposit and to solve some transportation issues. It changes terms of competition in the industry. Opportunity to explore deposit in the North Ice Ocean and to use The North Sea Way can change a lot Russian oil producing market.

The next step of this research is to define credit and operational risks that can threaten Lukoil company. It is a well-known fact that the main sources of credit risks for non-financial companies are accounts receivable, derivatives and company's bonds and loans. Moreover, the company can be a subject of a possible rating downgrade. The Lukoil's accounts receivable are about 6 000 million dollars for the 31-st of December, 2013. This number is netted from the allowance for bad debts (about 250 million dollars) and has been decreasing for the past three years. It is assumed assume that most debt will be paid because the volume of allowance for bad debts is not very big. Another point that makes us conclude that accounts receivable don't play an important role in Lukoil's credit risks is that accounts receivable are quite small relative to company's revenue. The recent year revenue is totaled to 140 000 million dollars. So even defaults of some counterparties won't affect the company's performance much.

In reports it is stated that the company uses forwards, futures and options (OTC) to hedge some of market risks. In theory these derivatives can pose some threats concerning credit risks. Most derivatives relate to commodities. Net obligation for these derivatives is 116 million dollars. This figure is also unlikely to affect dramatically company's net income or free cash flow. The company assures that most derivatives are provided by reliable investment banks and the risks are minimal. These risks are also minimized by some internal mechanisms like credit limits and cash-calls.

The company's obligations are quite moderate - about 30 000 million dollars, it is approximately 30% of total assets. Interest payments are equal to 5% of EBIT. These ratios and previous analysis of interest rate risk show that these risks don't pose much threat to Lukoil. Lukoil works with Sberbank, Petrocommerce Bank, Uralsib, Guta-Bank and possibly with other big banks. Some of them are main Lukoil shareholders (moreover, Sberbank, Petrocommerce Bank is presented on the BoD) so the estimation process of possible credit risk losses becomes rather difficult. The company received BBB rating with stable outlook from S&P about a year ago. There are still no signs that this rating is going to be reconsidered: the production remains stable, the debt doesn't grow rapidly, oil prices remain relatively high.

In this paper these risks also will be assessed, but our hypothesis is that the impact of this factor won't be very important. To measure risks concerning accounts receivable, we'll assume different probabilities of default and different percent of counterparties that go default. We will also assess how the company's CF is affected by the changes in credit rating, interest rates and other consequences following rating downgrade.

Operational risks addresses the risk of loss from insufficiency or failure in the process of operation, including those steered by personnel, systems or other external causes. It is usually perceived as a subset of other risks. Oil and gas industry seems to be focusing mostly on personal safety in opera-

tion and catastrophic events. However, it also includes wide range of operational processes, from non-compliances, cost overrun for complex projects to cyber security. For Lukoil we have looked into: the process risk, people risk, system risk, event risk, business risk and liquidity risk.

For process risk, Lukoil faces uncertainties in four major areas: ineffective and inefficient processes, technological complexity and legal and regulatory provisions compliances. Firstly, ineffective processes involve the risk of not achieving operational goals. Lukoil faces this risk mostly in the exploration process. After the seismic evaluation process, the company has to start drilling exploratory wells. In this process it must take the risk of getting dry hole (not finding any expected petroleum). In 2013, the exploration expense increased by $238 million, or by 65.4%. The total cost of dry hole alone amounted to $314 million in 2013 and $127 million in 2012.

The second process risk is inefficient processes, the risk of excessive cost. For Lukoil process risks lies in many areas of operation. One of them is transportation of crude oil and refined products in Russia. This is specific to the company as production regions are remote from the main crude oil and refined products markets. The transportation is performed mostly through the trunk oil pipeline system of the state-owned company, OAO AK Transneft, or by railway transport. This means dependency on the transportation, especially for gas, which is sold at the wellhead and then transported through the Unified Gas Supply System ("UGSS").

Another inefficient processes concern operational expenses (OPEX). This includes extraction expenses such as repairs of extraction equipment, labor costs, expenses on artificial stimulation of reservoirs, fuel and electricity costs, cost of extraction of natural gas liquids, property insurance of extraction equipment and other similar costs. In 2013 the company faced an increase of $474 million – 12.3% from 2012 which, has increased by $90 million from 2011. Another OPEX risk is the Refining expenses, which increased by $501 million, or by 30.0%, compared to 2012, 92% of the increase is caused by obtaining control over ISAB in September 2012 which contained a cost of overhaul to comply with Euro-5 standards.

The Company also faces Legal and regulatory provisions compliance risk. For Lukoil the challenges lie in the international and domestic platforms. The company major obligation is for the government in the country of operation. The second rank obligation would be for international organization, which overlooks some of the legal concerns in Oil and Gas. One of the case is the conflicts between complying with the Kyoto protocol and with the Russian Government. As the Russian Federation made a decision not to join the obligations in the second Kyoto period, the incentives for the environmental activities are lost. Lukoil has invested in 'emission reduction units –ERUs', which it aimed to introduce in the market. The change in the government decision affected the project at the price of $26 million, as the Russian Ministry of Economic Development prevented it to sell the technology.

Another operational risk is people risk. Lukoil employs more than 150,000 people throughout its operation. The turnover is not particularly problematic. The problematic part is more of the shortage of experts, lack of qualified personnel, and risk for employees on site. In 2012, 30 accidents were registered (19 in 2011), in which 36 employees were injured (25 in 2011), including 51 deaths (no deaths in 2011). In order to address this problem, Lukoil provides Safety and Environment management system to improve labour conditions at work place. Currently the company claims that 91.2% (and increasing) of the workplaces are approved in terms of labor conditions and there are no workplaces with extreme danger conditions in the company. The company also continuously initiate project for personnel development. The projects are such as joint MBA between Lukoil overseas holding Ltd. and Skolkovo Moscow School of management and young specialist of the year contests.

Lukoil is also a subject to system risk such as model risk, technological system and cyber security. The data for the company's model risk and technological system is difficult to find. However, it is possible to assume the risk of wrong inputs due to the uncertainty nature of data. The micro unit of the data also leads to wrong inputs and calibration errors. More interesting is the cyber security. The company in the oil & gas industry are adopting a "digital oilfield" or "integrated operations" to

enhance reservoir recoverability, optimize production, and reduce economic, environment, health, and safety risks. The system is being attacked by stuxnet virus which capable of invading process control systems and control systems on drilling rigs and in the refinery.

The forth operational risk addressed here is event risk. Lukoil is facing two kind of event risks: systemic and disasters. Systemic risk is the risk of collapse of financial system, only have indirect effect for Lukoil. During recent financial crisis oil prices fell dramatically, and company's performance was damaged. So, such a risk can affect the company only through oil prices (market risk). The major event risk is the disaster risk. Oil & gas industry operate in highly sophisticated and uncertain environment. Even though safety measures are put in place, accidents still occur. These events affect the company in two ways: it affects the cost of recovery and the cost of suspension. As an oil and gas company Lukoil is subject to some accidents involving technical failures. The advantage of the company is that Lukoil can claim that it is one of the few Russian companies that has a record of more than ten years of accident-free offshore operations.

The fifth operating risk is business risk, dealing more with strategic management of operation. The company faces two kinds of business risk. The first is project portfolio. The trend of the industry right now is to drill multiple smaller wells to compensate with the lack of big easy oil field. Lukoil therefore needs to make strategic decisions about projects prioritization. It also has to deal with diversification of energy resources. The company actually is addressing this risk quite well. It launched many projects for renewables such as solar project in Serbia and Krasnaya polyana settlement and wind power (farm) at Kaliningrad oblast. It also aims to increase hydrocarbon products by 44% in 2021. Another risk is the change in competitive environment. There is a rise of national oil & gas companies in the countries where there were none before. This makes it increasingly difficult to deal with getting licenses in many countries. Also, with increasing technological advancements, the world is moving toward alternative power generation and the electrification of energy delivery. The potential next major energy resource is the nuclear power. Its development can lead to change in government policies and market attention.

Last and also extremely important for the company is liquidity risk. Liquidity risk deals mostly with the ability of the company to manage its liquidity, either by seeking for funding or by any other means. As for Lukoil, the company requires a lot of funding for its numerous projects. The company's cash flow is affected by risk factors such as: sharp price changes of energy resources, energy demand, taxes, credit ratings and increase of costs. Liquidity management is centralized and operates effectively. It's automated system of concentration and redistribution of CF, corporate drilling and other crucial functions. According to Lukoil businesses, vital issues is taxes on mining operations and export duties because they fluctuate every month and depend on average Urals price on the international market. Both taxes are significant taxation loads on an oil company. Therefore, we can link this risk to our previous assignment with simulation techniques for estimation. As we show earlier, the company's CF is rather sensitive to oil and gasoline prices. In our model CF becomes negative with the 100$ oil price and 2.9$ gasoline price (though the probability of negative CF is about 0,5%).

The operational risks are harder to assess. Systemic and People risks can be assessed, using scenario analysis. For instance, it can be assumed different market conditions after financial crises, or different number of accidents with people injured. As for the legal system risk, can be assumed different number of licenses issued per year, because it is an important problem for the company nowadays. Liquidity risk was mostly assessed during previous part of the assignment. Other operational risks also should be considered to make our model more appropriate.

Assessing credit and operational risks

To make risk-management model of Lukoil company in this paper more realistic, credit and operational risks have to be taken into account. There are two main challenges in assessing these risks. First, they all are connected with some events that may occur, that is why an important assumption of this model is the probability of occurrence of such event. Second, they may enter the measures of current performance indirectly (for instance, default of the counterparty). So the right assessment of

loses and probability of such situations could make risk-management able to come up with relevant risk measures such as CFaR and ES

Assessing credit risks connected with evaluation risks that are interconnected with accounts receivable and rating downgrade. The following technique is proposed to assess this risk. Exist 1000 scenarios of possible company performance for the following year. If the event occurs the random variable will be 1, in other case it is equal to 0, the frequency of events depends on the probability assumed. Next step is the recalculation of the company's cash flows in different scenarios and, hence, CFaR and ES. If the company is able to estimate default probabilities, it can successfully use such a technique. For instance, let's use the following assumptions: with 10% probability 10% of our debtors go default. In this case according to trend based on historical data the company's accounts receivable will be 5 378 million dollars next period. Implementing this technique in model we'll get the following results. In this paper dollar ruble exchange rate is taken at the level of 33 rub/dollar to calculate all CF.

Table 7

Calculation of CFaR for credit risks (in million dollars)

Benchmark	2 723,77		
Threshold	1 850,17		
CFaR	873,60	ES	1 115,81
CFaR (with no credit risk)	831, 6	ES	1 088, 4

As it follows form table 7, the risk connected with accounts receivable affects the company's CF and CFaR increases by 42 million dollars (5%). If the probability of defaults or the fraction of debtors go default will be increased, CFaR will also increase. It means that that the risk also increases in this case.

Also credit risk can be combined with the risk of rating downgrade. The company has current rating BBB from S&P. The probability of downgrade from this level is 5,72%. So we might expect that in this case the cost of debt will increase by 1% (default spread by Damodaran).

Table 8

Calculation of CFaR for the risk of credit rating downgrade (in million dollars)

Benchmark	2 720,97		
Threshold	1 833,99		
CFaR	886,99	ES	1 127,75

It can be seen that this risk is less important than the previous one. However, it might have some other effects on the company, like decrease in the market capitalization. These risks are very unlikely to be hedged. As for the accounts receivable, Lukoil can call for some additional criteria for its counterparties, as a result it will decrease the probability of default (or the fraction of problematic companies) and decrease CFaR. For example, if the company manages to reduce the probability of defaults by 5%, CFaR and ES will be on the level (Table 9).

Table 9

Calculation of CFaR for the credit risk hedge (in million dollars)

CFaR	*862,51*	*ES*	*1 106,94*

The model of assessing operational risks will account three types of operational risks: risks connected with reserves and two types of event risk: disasters risk and systemic risk. Risks connected with some disasters can enter model by using the above mentioned technique. The probability of a disaster and the amount of money the company needs to overcome the consequences of these disasters can be assumed. But these risks are easily secured by the insurance and all losses can be paid back. So in this paper these risks will not be evaluated because they can be hedged easily. As

it was mentioned early systematic risk affects the company through market mechanisms. During last crises commodity prices dropped and interest rates and exchange rates increased dramatically. So using historical data can be defined how extreme circumstances affect the company's CF. We can assume some situation on the market like that which took place in 2008 and was characterized by the following parameters:

Table 10

Possible market conditions under crises circumstances

	1q	2q	3q	4q
Brent price (USD)	56,75	62,34	68,9	71,2
Urals price (USD)	55,89	61,95	68,05	70,76
LIBOR (%)	3,25	3,12	2,96	2,43
Gasoline price (USD)	1,93	2,15	2,34	2,54

With all other things being equal for example CapEx, OpEx, etc, can be seen that the average CF is about -3181 million dollars. It means that such changes affect the company very much. However, if the company adjusts its investments during the crises period, it'll manage to maintain positive cash flows. Such kind of risk can be hedged with the derivatives (though, partially). So these two risks are not of main importance for Lukoil. Our hypothesis is that the most important operational risk is connected with oil reserves. Hydrocarbon resources can also be categorized by reserves. Petroleum reserves can be broken down to 3 major categories: proved reserves (probability of recovery = P90), probable reserves (P50), and possible reserves (P10). It is often the case that the higher the probability, the smaller the reserve. The other terminology used in oil and gas is 1P, 2P and 3P: 1P=Proved, 2P = Proved plus Probable and 3P = Proved+ Probable + Possible.

Proved reserved generally, means that the amount of oil found should be at least 90% recoverable. Probable means that there's 50% chance of retrieving the oil, and possible mean the chance is 10%. Therefore, in calculating the amount of oil reserve, the volume should be adjusted by the probability. The adjusted volume is shown in the following table:

Table 11

Oil and Gas Reserves of LUKOIL Group (Jan 1st, 2013)

Reserves Category	Oil (in mln. barrels)	Gas (in bln. cubic foots)
Proved reserves	13381.0	23487.0
Probable	5933.0	10738.0
Possible	3680.0	3552.0
Total	22994.0	37777.0
Total * Probability	15377.4	26862.5

This risk is important because it can't be hedged and reserves reduction can affect the company's performance. Oil reserve risk can affect Likoil company in several directions.

First, it affects the company's market capitalization. If the company now stops all geological and exploration works, it can still extract oil 20 years (meaning it has reserves for 20 years). But investors expect that the company proceeds exploring and its reserves will be more or less stable. If evaluate company under ongoing concern assumption using DCF model we can come up with 44 400 million dollar value of the company. The actual market capitalization of Lukoil is about 46 000 million dollar. If it is assumed that the reserves start to decline and introduce an extreme condition (the company stops exploration at all), the company can still operate for 20 years, but the value will be about 36000 mln. dollars (almost 25% less). This simple calculations prove our hypothesis that drop in reserves will affect the capitalization negatively.

Second, if the company faces drop in reserves, it may boost investments in exploration, what actually happened after 2004. This additional investments will affect the company CF, so calculating CFaR, assuming some probabilities and investments that the company needs receive following results.

Table 12

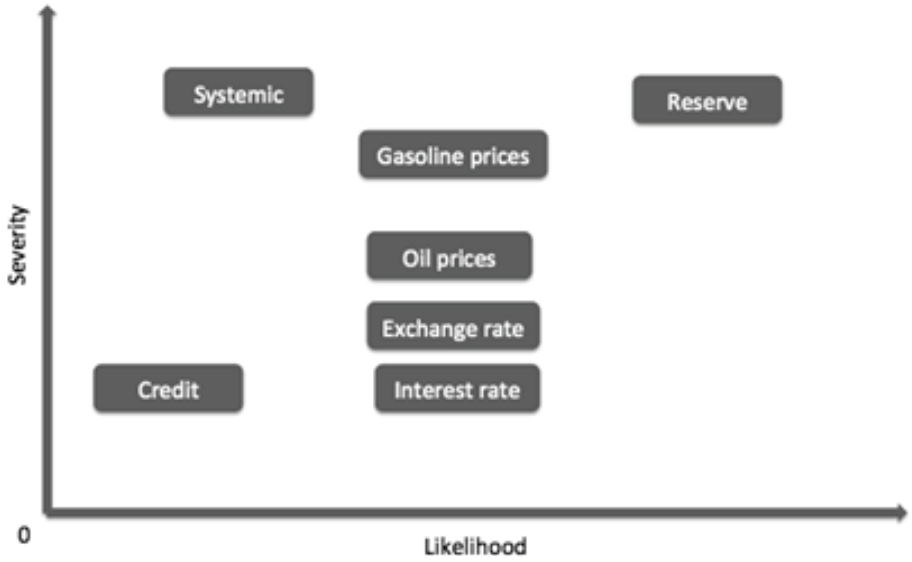
CFaR including risk of reserves (in million dollars)

Benchmark	2 626,69		
Threshold	1 251,34		
CFaR	1 375,34	ES	1 789,82

If assumed that reserves drop below some critical level for example when the company faces the need of additional investments, with 10% probability and additional investments are 1 500 million dollar CFaR will increase dramatically (Table 12). It can be explained with the fact that CapEx enters directly in CF and the sum of investment is relatively high (even for Lukoil cash flows).

Third, it might affect the company's balance sheet. Lukoil capitalizes its expenses on acquiring production field, drilling, geological works and so on. If the company gets dry hole these expenses are attributed to the costs. So the idea is that if the reserves drop because of lack of new fields or dry holes then all the expenses are attributed to costs. So company's tangibles reduce as well. It also reduces retained earnings as the company's income drops with time. As we can see, the most important operational risk is reserve risk. It might affect not only the company's CF, but also capitalization and value of total assets. So Lukoil should definitely account for such risk in its models.

Taking all our previous research into consideration we can finally build a risk-ap.



Picture 1. The risk map

We can see that the most likely and the most severe one is reserve risk. Also all market risks need a lot of attention from the company, though they are slightly less likely.

Conclusion and final suggestions

In this paper we considered the most important risks for Lukoil. Cash flow at risk methodology was used because it shows the amount of money the company could lose because of some risks and it also reflects uncertainty and accounts for unexpected loses.

We defined the following types of risks for the company: oil prices, gasoline prices, interest rates, exchange rates, taxes and fees (affected by oil prices), risks connected with receivables; credit rating downgrade risk; risk of reserves; systemic risk. If we implement all of them in the model we will get the following CFaR and ES (million dollars).

Table 13

CFaR for all defined risks (in million dollars)

CFaR	1 375,34	ES	1 789,82

We have also seen that oil prices don't affect the company's CFaR too much. It takes place because prices affect both revenues and costs (through taxes, fees and oil acquired). The most severe one is gasoline prices risk. We also calculated EaR and EPSaR, but results are quite the same.

To reduce CFaR we applied some hedging procedures mainly for market risk. We used options and futures to hedge against changes in oil and gasoline prices. We managed to reduce CFaR and ES. We defined optimal strategies as 30% of trading volume for futures and 40% for options.

The company can also hedge against risk connected with accounts receivable if it puts some additional requirements for its debtors and, hence, reduce the probability of non-payments. But this kind of risk is not very important for the company so the hedging is not very necessary. As for reserves risk, it can't be hedged because of its nature. Taking into account the company's size and specialization, its risk management strategy contains a range of measures against the key risks. Possible solutions for risk management are suggested by the audit committee, which is empowered, to the extent of its functions, to assess the company's risk management and to issue the relevant recommendations to the company's board. Also, it proposes the improvements of the risk management system. One of the Lukoil's RM tools is ERM-system (the enterprise-wide risk management system), which is benchmarked by the global best practices. There are some advantages of this system:

- it integrates risks evaluation with strategic and current processes, and therefore makes management more cautious;
- establishing of more effective analytical tools and techniques, which allow to warn threats at early stages;
- better measurement and monitoring of risks;
- can prevent negative events;
- cost decreasing of funding, which has positive influence on market capitalization.

Moreover, in line with the Lukoil risk management policy, regulatory risk management documents were approved in 2012 outlining the uniform risk management procedure:

- procedure for risk identification, assessment, selection of ways of risk response and risk monitoring;
- methodology for risk identification, description and assessment of Lukoil group companies.

These steps are strong base for establishing effective RM process at any company level. The company has established the risk committee that is a collegial body for risk management under the president of Lukoil. The managers of the company's key business segments manage the risks in accordance with the existing corporate requirements. All of this steps towards better RM assist the company's general line in this field to achieve its goal in more effective way.

We are absolutely sure that well established risk-management system in Lukoil might increase the company's value. It will help to reduce the consequences of some risks being realized. Moreover, it reduces the uncertainty over the company's cash flows and, hence, makes the company more appealing to investors.

After our analysis we can see that company's performance is really affected by some risks. We are sure that the company should account for that. Of course there is a risk department in the company but it has to be more efficient. For instance, there should be an assessment system for those who are in charge of risk-managements. Moreover, there might be some board or committee which would be responsible for risk treatment. The company uses options to hedge against prices risks. It's very reasonable, as these risks are very important. Lukoil definitely should implement CFaR and ES technique. It's very flexible and allows assessing risk treatment procedures. The company should also account for all possible risks to decide whether to hedge them or not. We managed to assess the most important ones.

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