Energy security, oil, gas, European Union, Russia

Risks, strengths and weaknesses of Russian oil and gas

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Abstract

The energy relations between the European Union and Russia are characterized by the EU's dependence on Russia's oil and gas supplies, Russia's dependence on oil and gas export revenues and the increasing diversification of the EU's energy imports and Russia's energy exports. The purposes of this study are to develop a benchmarking model for assessing oil and gas suppliers and present an objective picture of Russia's and the EU's alternative suppliers' position in the global oil and gas markets.

This study first identifies the market, macroeconomic, geological, political, regulatory and environmental risks affecting Russian oil and gas and their deliveries to Europe. The analysis of these risks results in a set of critical factors. A benchmarking model using value tree analysis is constructed based on the critical and other relevant factors.

Russia's oil and gas sectors are benchmarked against other important oil and gas regions using nine criteria. The other important oil and gas regions are the Caspian Region, Middle East, Africa and America. Russia's final ratings as an oil supplier and gas supplier are 30% lower and 70% higher, respectively, than the average ratings of the other important oil and gas regions. In the oil sector, Russia's strengths are moderate export potential, production growth and resources. Russia's weaknesses are small proved oil reserves and reserves growth. In the gas sector, Russia's strengths are large export potential and resources and moderate proved reserves. Russia's weaknesses are low growth of gas reserves and production.

The most important Russian oil and gas companies are benchmarked against the leading western oil and gas companies using seven criteria. The average final rating of the Russian companies is 9% higher than the average final rating of the western companies. The strengths of the Russian companies are high reserves-to-production ratios, low production costs and moderate production and reserves growth. The weaknesses are moderate debt intensity, modest profitability and low company value.

This value tree model provides an opportunity to objectively monitor and assess oil and gas suppliers in the changing oil and gas markets. This study also clearly shows that it is misleading to benchmark Russia's or some other actor's performance only against their own past performance or a single benchmark using only one or a few criteria.

Key words: Energy security, oil, gas, value tree analysis, benchmarking, reserves, resources, production, scenarios, European Union, Russia.

Preface

This study uses decision analysis to benchmark energy suppliers and is an updated and improved version of my licentiate thesis, which I prepared at Helsinki University of Technology in 2009. This new version takes into account the latest data and trends in the global oil and gas markets. I systematically assess the reserves, resources, production, recent and future export potential and political stability of an important oil and gas supplier, Russia, compared to other important global oil and gas suppliers. I also systematically assess the operational and financial performance of the leading Russian oil and gas companies compared to the leading western oil and gas companies using several different criteria.

I originally planned to publish this study as a printed version. In August 2013, I had the pleasure of introducing my ideas and this study to the leading Finnish experts in a meeting organized by the National Emergency Supply Agency of Finland. As a result of certain useful discussions, I decided to publish this study as a non-commercial eBook to guarantee up-to-date data and analysis and quick distribution to the relevant parties. After all, my aim is to generate comments, opinions and criticism on the core themes of this study because I plan to further develop the methods for assessing energy suppliers based on further research and the feedback which, hopefully, this study will generate.

I think a critical reader should especially pay attention to the core themes of this study, i.e., the risks of Russia’s energy supplies for Europe, choice of the criteria used for assessing oil and gas supplying regions, countries and companies, importance of different criteria and treatment of the uncertainties of source data and analysis results. I would be grateful for any questions, comments, proposals and criticism which help me to develop better methods for assessing energy suppliers. All feedback can be addressed to my email address: hannu.arkonsuo@arewcon.fi. It is also possible that I will carry out a structured survey based on the collected feedback and other information.

In Tallinn, November 2013

Hannu Arkonsuo

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Units and conversion factors

Unit or fuel	Explanation or conversion
bbl	barrel, 1 bbl = 158.984 liter
boe	barrel of oil equivalent
cf	cubic foot
m^3	cubic meter, 1 m^3 = 35.315 cf
production year	365 days
t	ton
toe	ton of oil equivalent, 1 toe = 7.33 boe
Btu	British thermal unit
MMBtu	million British thermal units
therm	10^5 British thermal units
TJ	Terajoule
million	10^6
billion	10^9
trillion	10^{12}
crude oil	1 toe = 7.33 boe = 1101 m^3 natural gas = 38882 cf natural gas
	= 0.0418 TJ
natural gas	1000 m^3 natural gas = 35315 cf natural gas = 35700 MMBtu natural gas
	= 0.9082 toe = 6.657 boe = 0.038 TJ, 1 boe = 5305 cf natural gas
	= 10.55 MWh
LNG	1 t LNG = 1380 m^3 natural gas = 1.253 toe = 9.187 boe
oil production	1 bbl per day = 49.8 t per year
gas production	1 cf per day = 10.34 m^3 per year = 0.0688 boe per year

Source data: BGR 2012, BP 2013a

Fossil energy sources are natural products and therefore there are variations in their energy content depending on the sort or blend of product in question and physical conditions, like temperature. E.g., the energy content of oil and natural gas can vary considerably. Most of the companies included in this analysis use the conversion 1 boe natural gas = 6000 cf natural gas. The above conversion factors are used if specific values are not available.

1 Introduction

The EU is an important trading partner for Russia and Russia is an important trading partner for some EU countries. Russia's energy supplies are important for many EU countries. Energy exports are the major source of Russia's export and tax revenues.

It is important to recognize the great imbalances in the trade between the EU and Russia. Russia's imports and exports are only 5.4% and 9% of the EU 27's exports and imports, respectively. Russia's shares of the EU 27's imports and exports are only 4.7% and 2.7%, respectively. Some 76% of the EU 27's imports from Russia are mineral fuels. Mineral fuels include different coals, oils, oil products, gases and electricity, i.e., the most important energy products. By contrast, the EU 27's shares of Russia's imports and exports are significant, 42% and 53%, respectively. In other words, the EU is a much more important trading partner for Russia than Russia is for the EU (table 1.1).

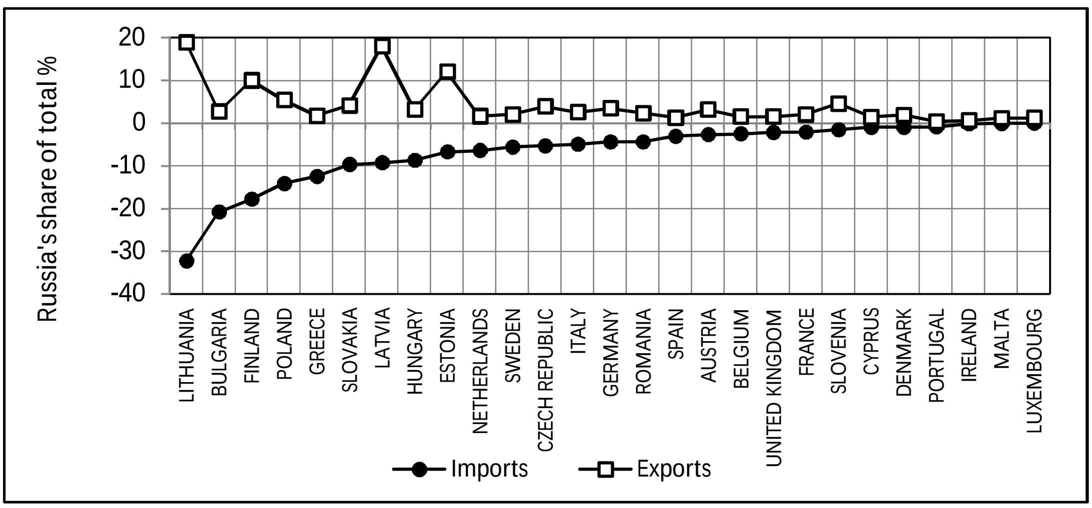
Table 1.1 EU's and Russia's trade in 2012, billion USD

	EU 27 imports	EU 27 exports	Russia imports	Russia exports
Total	5828	5796	313	525
Total with Russia	274	158		
Total with EU 27			132	278
Mineral fuels with Russia	209	2		
Mineral fuels with EU 27			2	209
Total with other than Russia	5554	5637		
Total with other than EU 27			180	247

The values total with Russia and total with EU 27 are different because the data sources are different. Source data: CustomsRu 2013, Eurostat 2013, Rosstat 2013.

However, the above average percentages tell only part of the truth of the imbalances in the EU-Russia trade. The EU 27 countries' dependence on exports to Russia and imports from Russia varies significantly (figure 1.1). For example, Lithuania exported 18.9% of its total exports to Russia and imported 32.2% of its total imports from Russia in 2012. Luxembourg is on the other extremity, the respective percentages being 1.2% in exports and 0.2% in imports.

Figure 1.1 Russia's share of EU countries' imports and exports in 2012



Negative percentages refer to imports. Source data: Eurostat 2013.

Russia's strength in the trade with the EU is energy because the EU imports over 60% of its gas and over 80% of its oil and the EU faces growing competition for fossil fuel resources from, *inter alia,* emerging countries and energy producers themselves (EU 2011a). In 2011, Russia's share of the EU27's total imports was 32% of crude oil, 13% of oil products and 24% of natural gas (Eurostat 2013).

A European observer can look at Russia's oil and gas sectors from three economic perspectives. First, they are important drivers of Russia's economy. Second, Russia is an important but controversial source of energy supplies for Europe. Third, Europe has certain alternatives to Russia in energy imports and Russia has certain alternatives to Europe in energy exports. The purpose of this study is to develop methods for assessing oil and gas suppliers and present an objective, up to date picture of Russia's position in the global oil and gas markets.

This study consists of five main tasks: 1) Identifying the risks of Russian oil and gas; 2) analyzing the availability and quality of oil and gas data and analyzing the recent developments in oil and gas trade; 3) constructing a model for assessing oil and gas suppliers; 4) assessing Russia and other important oil and gas regions and 5) assessing Russian and other oil and gas companies. When addressing these five tasks five questions must be considered: First, what are the risks to which Russia's oil and gas sectors and their supplies for Europe are exposed? Second, how can these risks be measured and how can their significance be assessed? Third, which data sources are used? Fourth, how does Russia perform as an oil and gas supplier? Fifth, how do Russian companies perform as oil and gas suppliers?

The following chapter 2 presents the executive summary of this study.

Chapter 3 first indentifies the risks to which Russia's oil and gas sectors and their deliveries to Europe are exposed. This identification is based on the analysis of both western and Russian reports. The most significant risks, critical factors, are the starting point for the problem formulation and further analysis. The chapter ends with the problem formulation and definition of the objectives of this study.

Chapter 4 gives information about oil and gas. The first part of the chapter reviews different types of oil and gas resources. Then examples of the quality and uncertainties of oil and gas data are presented. The latter part of the chapter discusses the recent trends of the price formation and trade of oil and gas.

Chapter 5 first presents the principles and theory of value tree analysis. Then a benchmarking model based on value tree analysis and suitable for assessing oil and gas companies and regions is presented.

Chapter 6 first introduces the principles and criteria used in assessing oil and gas countries and regions. Then Russia's oil and gas sectors are benchmarked against other strategic oil and gas regions of the world. These other strategic regions are: the Caspian Region, Middle East, Africa, America, EU 27+ and Rest of World. EU 27+ means EU 27 plus Norway. Besides scenarios extending to the future, the assessment uses data from the years 2003-2012.

Chapter 7 first introduces the principles and criteria which can be used in assessing oil and gas companies. After that Russian and western oil and gas companies are benchmarked against each other. The Russian companies included in this analysis are Gazprom, Gazprom Neft, Lukoil, Rosneft, and Tatneft. The western companies are Chevron, ExxonMobil, Shell and Total. The assessment uses data from the years 2007-2012.

Chapter 8 first evaluates the significance of the risks faced by Russia's oil and gas sectors. Then the choices and problems related to the assessment model are discussed. Finally, the risks, strengths and weaknesses of Russian oil and gas are evaluated based on the results of the regional and company analyses.

This study presents up-to-date information about the latest trends in oil and gas production, trade and pricing. The risk analysis of Russian oil and gas, analysis of the strengths and weaknesses of Russia's oil and gas sectors and the strengths and weaknesses of Russian oil and gas companies are the core of this study. This study is certainly relevant to analysts, observers, researches, policy makers, and companies dealing with Russia and Russian energy. The principles and methods used in this study are general and not tied only to Russia or oil and gas. They are applicable also for the monitoring and assessment of other actors in the energy industry.

2 Executive summary of this study

2.1 Risks and problem formulation

A European observer can look at Russia's oil and gas sectors from three economic perspectives. First, they are important sources of energy supplies for Europe. Second, they are important drivers of Russia's economy. Third, Europe has certain alternatives to Russia in energy imports and Russia has certain alternatives to Europe in energy exports. The purpose of this study is to develop methods for assessing oil and gas suppliers, and present an objective picture of Russia's position in the global oil and gas markets.

The energy relations between the European Union (EU) and Russia are characterized by the EU's dependence on Russia's oil and gas supplies and Russia's dependence on oil and gas export revenues. This study first identifies the risks to which Russia's oil and gas sectors and their supplies to Europe are exposed based on the analysis of both western and Russian reports. The risks are classified into seven categories.

Market risks include changes in oil and gas prices and demand, competition in the European and other gas markets due to increasing unconventional gas production and liquefied natural gas (LNG) trade. Macroeconomic risks include ruble inflation and exchange rate movements and the high dependence of Russia's economy on oil and gas export revenues. Geological and geographic risks originate from the fact that Russia's low-cost oil and gas fields are in the decline phase and the new resources are in more challenging and costly regions. The main regulatory risks are the high taxation of oil export revenues, low regulated domestic gas prices and restrictions on private and foreign investments which cut companies' cash flows. Environmental and technical risks are primarily related to the outdated infrastructure and low energy efficiency, which increase oil and gas consumption, emissions and the probability of accidents.

Political risks stem from the Russian state's tightened grip on oil and gas sectors, Europe's high dependence on Russia's oil and gas deliveries, Russia's goals to diversify energy exports to other regions, conflicts with transit countries and the fears that Russia may use energy supplies and supply disruptions as an energy weapon to advance its political and strategic interests. It is often argued that especially Russia's gas pipeline projects are motivated by strategic advantage rather than financial viability.

The above risks result in companies' decreased ability to make investments. As a result, there are a number of industry-specific risks, which in this study are called critical factors. The critical factors are the following: insufficient renewal of oil and gas resources; stagnating or decreasing oil and gas production and exports; economic and political distress; companies' poor operational and financial condition including growth, efficiency, profitability, value and indebtedness.

The critical factors are the starting point for the problem formulation and further analysis. In order to enhance objectivity, the assessment should use benchmarking and multidimensional, quantitative and transparent approaches. Furthermore, the model shall be updatable. Also, it is decided to make the assessment at both the regional and company level. The objectives of this study are defined as follows:

1. The first objective is to construct a benchmarking model for assessing oil and gas suppliers that takes into account the critical factors, results of relevant research, industry practices and the availability of relevant data.
2. The second objective is to benchmark Russia's oil and gas sectors against the other strategic oil and gas regions of the world.
3. The third objective is to benchmark leading Russian oil and gas companies against leading oil and gas companies from other countries.

2.2 Special characteristics of oil and gas

Oil and gas industries have special characteristics that affect the choices of assessment methods and interpretation of assessment results. Such special characteristics are: several different types and qualities of oil and gas resources; different resources classification rules; great uncertainties of oil and gas data; complicated price formation and poor predictability of prices.

Oil and gas resources are often classified into conventional and unconventional resources. Unconventional resources are often distributed over a larger area than conventional resources and usually require specialized production methods to be economically producible. Currently, the most important unconventional oil resources are Canada's oil sands, Venezuela's extra heavy oil and the USA's tight oil. Unconventional gases include tight gas, shale gas and coal bed methane (CBM).

The amount of oil and gas resources on the earth is finite, but they cannot be measured, only estimated. There are several different resources classification systems. In this study, the PRMS (the Petroleum Resources Management System) and the SEC (the US Securities and Exchange Commission) systems are used. The PRMS classifies resources taking into account the level of certainty of recoverable volumes and the chance that they can be exploited commercially. Proved reserves are the quantities recoverable from known deposits under existing economic and operating conditions with reasonable certainty or at least 90% probability. Other reserves classes are probable and possible reserves.

Resources are discovered or undiscovered but geologically possible quantities that currently cannot be recovered but might be recoverable in the future. In brief, the difference between reserves and resources is that there may be a significant risk that resources will not achieve commercial production. The SEC rules only allow the reporting of proved, probable and possible reserves. The reporting of resources is not allowed. According to company reports, the same proved reserves are greater under the PRMS rules than under the SEC rules. Most regional and country-specific reports use PRMS or similar systems. Most companies use the SEC system.

Several information and research agencies and companies such as the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), Oil & Gas Journal and BP publish updated worldwide country specific oil and gas proved reserves, production and consumption information every year. Besides possible differences in source data, the quantities and their regional distribution vary between agencies because they include slightly different types of oil and gas in their reports.

Compared to proved reserves, resources quantities are much more uncertain. The estimates of conventional and especially unconventional oil and gas resources vary considerably between data sources because the data from many countries and regions is imprecise and insufficient. If reserves and resources are ranked in accordance with their estimated production costs and certainty of existence, proved reserves are the most valuable, followed by conventional resources and then by unconventional resources.

Some information agencies such as the International Energy Agency (IEA) and the Energy Information Administration (EIA) publish supply and demand scenarios extending 20-30 years into the future. Scenarios are based on assumptions about the development of such key factors that are thought to affect energy supply and demand. These assumptions are analyzed by energy models producing quantitative demand, supply and other data. Although energy models and scenarios are widely used tools for foresight and for aiding decision making, the future projections are only as good as the underlying assumptions and data. Scenarios will never be able and are not intended to predict the future perfectly because resources data and future circumstances are inherently full of uncertainties. Therefore, scenarios shall be used together with other relevant information.

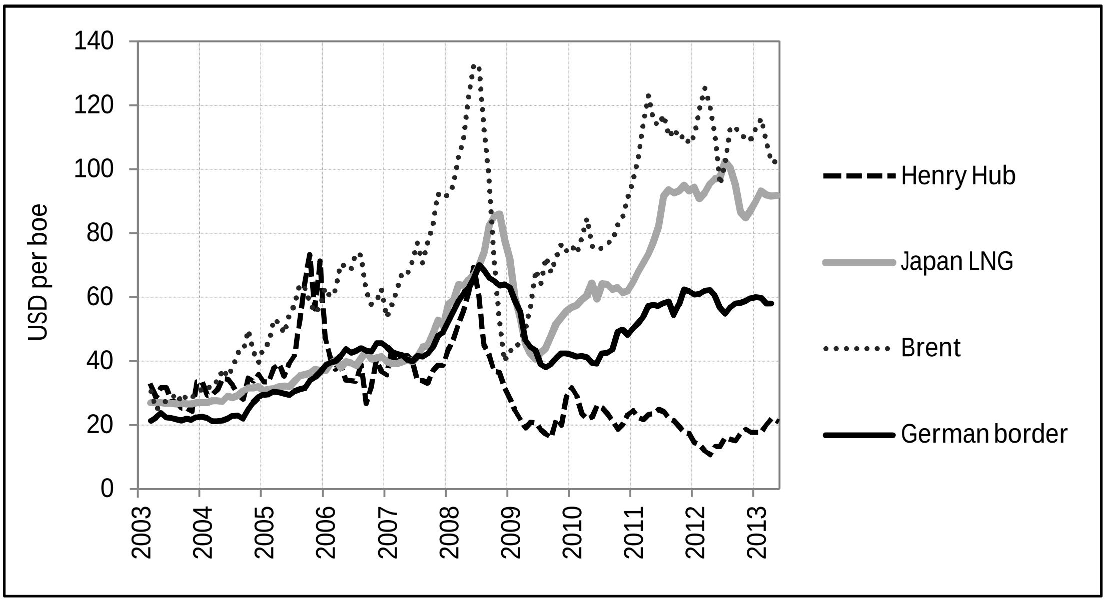
Besides the geological uncertainty, the uncertainties of reserves estimates and future production volumes originate from the uncertainties of future oil and gas prices, future production costs, technological development and changes in regulation. Indeed, the total recoverable resources of an oil and gas field will not be known for certain until after the field has been abandoned. Oil and gas prices ultimately determine which resources are economically producible.

Oil is a global commodity and the prices of different oils are linked to the prices of benchmark oils such as Dated Brent and West Texas Intermediate (WTI). Although there are differences between the prices of different types of oil, it can be said that there is a world oil price. Oil prices depend on oil demand, non-OPEC supply, OPEC supply, the level of inventories, availability of spare capacity, political situation and financial markets where expectations and news influence the attractiveness of oil as a financial asset in market players' hedging and speculating operations. In recent years, the price of oil has been highly volatile and poorly predictable.

The physical properties of gas require transportation along fixed pipelines or in the form of liquefied natural gas (LNG), which requires liquefying and regasification terminals and special vessels. Consequently, gas markets are regional and there is no world gas price. The most widespread gas pricing mechanisms are oil indexation where gas prices are tied to the prices of competing oil products, price regulation where prices are set by authorities and gas-to-gas competition where gas demand and supply determine prices.

Figure 2.1 presents the recent development of four important reference prices. The Brent crude oil price is used as an indicator of the world oil price; the Henry Hub price is the primary gas price in North America, where gas prices are based on free gas-to-gas competition; the German border price is the average price of pipeline gas from Russian, Dutch, Norwegian and other origins and it is used as an indicator of pipeline imports prices in continental Europe; the average Japan LNG import price is tied to the prices of crude oils imported to Japan and it is used as an indicator of the gas import prices in the Asia market. The prices in figure 2.1 are presented in an equivalent unit USD per barrel of oil equivalent (boe). Consequently, they are comparable with each other according to their energy contents.

Figure 2.1 World oil and gas prices



The prices are monthly averages.

Since the 2008 economic crisis, gas prices in North America have been low because of increasing domestic unconventional gas production and relatively low demand. In continental Europe and Asia prices have been driven, though not completely, by much higher oil prices. The goal of the liberalization of natural gas markets is to let gas-to-gas competition set prices. Although the international gas markets differ substantially from the competitive ideal, certain recent developments have raised expectations of the change in gas trading and pricing.

Shale gas production has considerably increased in the USA due to advances in horizontal drilling and hydraulic fracturing which enable the extraction of oil and gas in more difficult circumstances. This trend is expected to continue and the USA can become a LNG exporter in the near future. The USA's success has encouraged exploration of shale gas in Europe, China and elsewhere.

The world's LNG liquefaction and regasification capacities and LNG trade have significantly increased in recent years and are expected to increase further. Increasing unconventional gas production and LNG trade will increase trade between regional gas markets, moderate gas prices and diminish the share of Russian and Middle Eastern gas in Europe and Asia. Some big European gas importers have managed to negotiate discounts on existing oil price-linked gas supply contracts with Russia and other suppliers.

Although the development of shale gas and tight oil production in the USA has been convincing and gas prices low, the shale gas, LNG and tight oil revolution is not a certainty. Environmental problems, the uncertainty of economically recoverable quantities, and the uncertainty of the price level that could guarantee sustainable production may undermine the expectations of cheap and widely available fuels.

2.3 Benchmarking model

The benchmarking model used in this study is based on value tree analysis. Value tree analysis is typically used in analyzing several alternatives under different criteria. Alternatives are quantitatively rated under each criterion and between different criteria. The main stages of the value tree analysis process are: identifying the objectives and criteria, identifying the alternatives, constructing the value tree, preference modeling, rating the alternatives, and sensitivity analysis.

Objectives are the dimensions along which the analysis is done. *Criteria* measure the achievement levels of objectives. *Alternatives* are the subjects of assessment. The *value tree* presents the interconnections between dimensions, criteria and alternatives and is the basis for the further quantitative analysis.

Preference model contains criterion value functions which give the criterion score to each alternative under each criterion and aggregated value function which combines criterion scores into the final ratings of alternatives. In this study, the criterion value function is such that it linearly reflects the actual criterion values compared to the best alternative, which gets a score of 100. This means that, e.g., two times greater profitability or reserves are two times more valuable. The aggregated score is a weighted average of the criterion scores. The weighting is done with criterion weights which sum up to 1.

The analysis results are often examined using one-factor sensitivity analysis in which the values of criteria or criterion weights are varied one at a time to examine which criteria are critical if the values of alternatives or criterion weights change. In this study, one-factor sensitivity analysis is not done because of the great number of the criteria and alternatives. Instead, in the regional analysis, the following sets of criterion weights are used: equal weights and weights based on the reliability, importance and combined reliability and importance of different criteria. In the company analysis, several different criteria are used to measure the same dimensions in order to examine and demonstrate the effects of using different criteria.

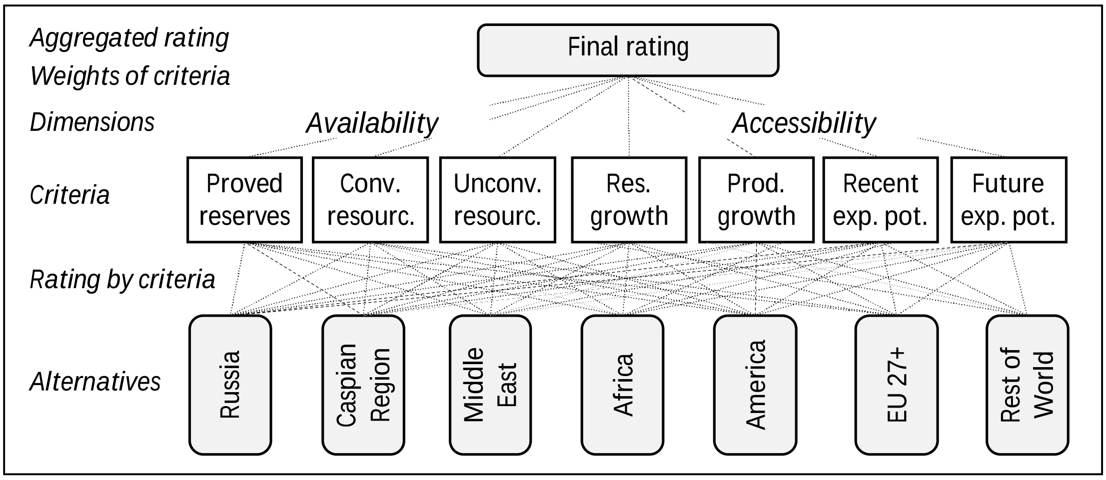
The quality of analysis results depends on the quality of the key elements of the model: alternatives, criteria, criterion value functions, criterion weights, and information sources. The regional primary data originates mostly from recognized information and research agencies such as the BGR (Bundesanstalt für Geowissenschaften und Rohstoffe), the EIA (the U.S. Energy Information Administration), Rosstat and Eurostat. Euromoney Country Risk (ECR) is used to describe the political and economic stability of the regions.

The data for company analysis is mostly from the financial and operational reports of the companies. Some companies use US GAAP (United States Generally Accepted Accounting Principles) financial reporting, while others use IFRS (International Financial Reporting Standards) financial reporting. Some companies report PRMS reserves and some companies report SEC or both SEC and PRMS reserves. It is impossible to precisely evaluate the effects of different financial or reserves reporting systems but a rule of thumb for the possible differences could be some 20%. If the purpose is to compare European, Russian and U.S. companies, these uncertainties must be accepted. It is pointed out, that country-specific reserves and other data between the above-mentioned recognized sources of regional data differ from each other in many cases more than 20%.

2.4 Regional analysis

In the regional analysis, the alternatives are Russia, the Caspian Region, Middle East, Africa, America, EU 27+ and Rest of World. EU 27+ means EU 27 plus Norway. The choice of these alternatives takes into account the EU 27 countries' current and potential future suppliers, global coverage of this analysis and the availability of necessary data. Figure 2.2 presents the value tree of the regional analysis.

Figure 2.2 Benchmarking oil and gas regions

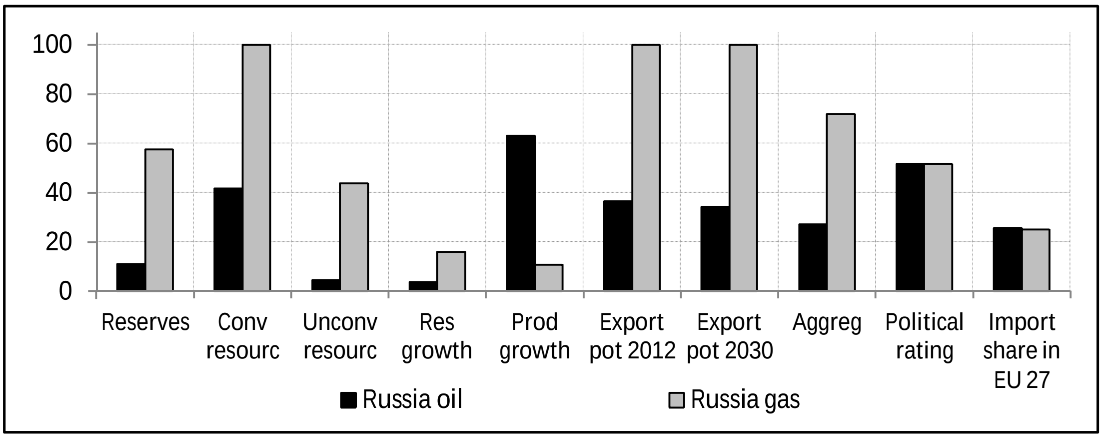


The regional criteria are the following: proved reserves, conventional resources, unconventional resources, reserves growth, production growth, recent export potential, future export potential, the region's political and economic stability and the region's market share in the EU 27. The criteria are based on the critical factors and the factors affecting energy security. These factors are the availability of resources, accessibility to resources, which depends on production, consumption, investments and political stability of a supplying region, and acceptability, which refers to the EU 27's import dependency on the region in question. The regions' political and economic stability and their market share in the EU 27 are assessed separately outside the value tree.

Proved reserves, conventional and unconventional resources are based on 2011 data, reserves and production growth on 2003-2012 data, recent export potential on 2012 data and future export potential on scenarios published in 2011 and 2012. An equivalent unit ton of oil equivalent (toe) is used to express oil and gas quantities. Consequently, the actual oil and gas quantities are comparable according to their energy contents. Oil and gas activities are assessed separately.

A performance profile comprises the criterion and aggregated scores of an alternative. Figure 2.3 presents Russia's oil and gas performance profiles together with Russia's country risk score and Russia's shares of the EU 27's oil and gas imports. Table 2.1 presents the oil and gas performance profiles of the major oil and gas suppliers in the four sensitivity cases.

Figure 2.3 Russia's performance profiles



Country risk is presented on a scale of 0-100 where greater is better. Import share in the EU 27 is the region's share of the EU 27 imports in percents. The greater the share, the worse the situation. Aggregated scores are according to the case "combined reliability and importance" because it is regarded as the most realistic.

Table 2.1 Oil and gas performance profiles

	Russia		Caspian Region		Middle East		Africa		America	
	Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas
Proved reserves	11	58	5	19	100	100	17	18	59	22
Conventional resources	42	100	15	22	62	43	50	33	100	60
Unconventional resources	5	44	4	0	0	7	0	38	100	100
Reserves growth	4	16	9	100	28	54	11	4	100	28
Production growth	63	11	28	12	100	100	35	24	83	66
Recent export potential 2012	37	100	12	38	100	78	34	53	-21	1
Future export potential 2030	34	100	18	37	100	53	37	47	3	21
Aggregated score base case	*28*	*61*	*13*	*33*	*70*	*62*	*26*	*31*	*61*	*43*
Aggregated score reliability	*29*	*53*	*14*	*39*	*79*	*75*	*26*	*27*	*56*	*33*
Aggregated score importance	*27*	*75*	*12*	*29*	*77*	*58*	*27*	*36*	*42*	*40*
Aggregated scores R+I	*27*	*72*	*12*	*36*	*86*	*73*	*27*	*34*	*34*	*26*
Region's risk score	*52*	*52*	*34*	*34*	*57*	*57*	*37*	*37*	*68*	*68*
Share of EU 27's imports	*26*	*25*	*7*	*0*	*13*	*9*	*12*	*16*	*6*	*1*

R+I means combined reliability and importance. EU 27+ and Rest of World are not presented because they have highly negative export potentials.

In the oil sector, Russia's greatest weaknesses are reserves quantity and reserves growth both compared to the other regions and other criteria. The small unconventional oil resources are not regarded as a serious weakness because it is presumed that new data will change perceptions of the situation outside America. Russia's greatest strengths are moderate conventional resources, production growth and recent and future export potential.

In the gas sector, Russia's greatest weaknesses are reserves and production growth both compared to the other regions and other criteria. Russia's greatest strengths are the largest conventional resources, recent and future export potential and the second largest gas reserves.

Compared to the other regions America is an exception. Its relatively high oil and gas aggregated scores stem mostly from Canada's and Venezuela's unconventional oil and the USA's unconventional gas. Although America's oil export potential is negative and gas export potential low, some American countries are potential oil and/or gas suppliers for Europe. In order to give the right picture of America's position in the global oil and gas markets, a country-specific analysis and a deeper evaluation of the costs of unconventional oil and gas production would be needed. However, such an approach is outside the scope of this study.

Compared to the Caspian Region, Middle East, Africa and America, Russia performs moderately in the aggregated oil scores. It is ranked third after the Middle East and America, approximately on the same level with Africa. As a gas supplier Russia performs well being ranked first on approximately the same level with the Middle East. Criterion weights may have a great influence to the final rating if an alternative has a very low or high score in some important criterion which has high weight as the differences between the different sensitivity cases in table 2.1 show. Russia has the third best (or third poorest) country risk score. Russia's shares of both the EU's oil and gas imports are the greatest.

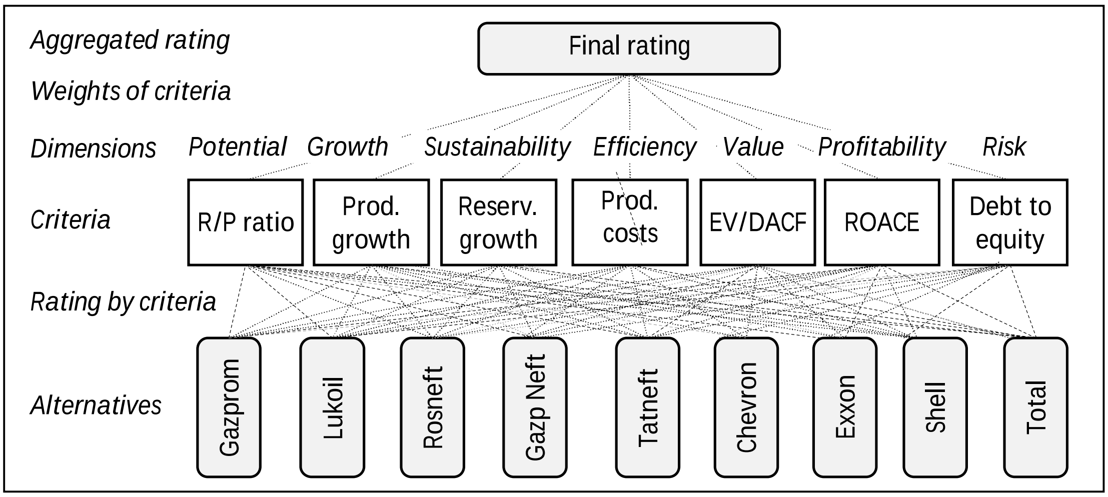
2.5 Company analysis

In the company analysis, the alternatives are the Russian companies Gazprom, Gazprom Neft, Lukoil, Rosneft and Tatneft and the western companies Chevron, ExxonMobil, Shell and Total. The western companies are from the USA and Europe but have worldwide oil and gas activities. In 2013, Rosneft acquired TNK-BP, a large private oil and gas company earlier owned by British BP and a group of Russian investors. In 2012, 42% of BP's oil came from TNK-BP. Because of the changed situation both BP and TNK-BP are excluded from this analysis. One significant Russian company Surgutneftegaz is excluded because it uses only the Russian reserves reporting system and until 2012 it used only the Russian accounting standards (RAS), both of which differ significantly from the western systems. The criterion and aggregated scores of OAO Novatek, Russia's second largest gas producer are not presented because the actual values of many criteria of OAO Novatek are many times greater than those of all other companies due to Novatek's very strong growth in the recent years.

It would be ideal to benchmark Russian companies also against companies from certain interesting regions such as the Middle East, Caspian Region and Africa. Unfortunately, most of the national oil and gas companies from these regions disclose only limited amounts of financial and operational information. Consequently, it is decided to benchmark Russian companies against well known western companies and western effectiveness and efficiency in worldwide operations.

In the base case, the companies are assessed using the following dimensions and criteria: potential is measured by the reserves-to-production ratio (R/P), growth is measured by production growth (PG), sustainability of growth is measured by reserves growth (RG), efficiency is measured by production costs (PC), the company's relative value is measured by enterprise value to debt-adjusted cash flow (EV/DACF), profitability is measured by the return on the average capital employed (ROACE) and risk is measured by debt to equity (D/E). Figure 2.4 presents the value tree of the company analysis.

Figure 2.4 Benchmarking oil and gas companies

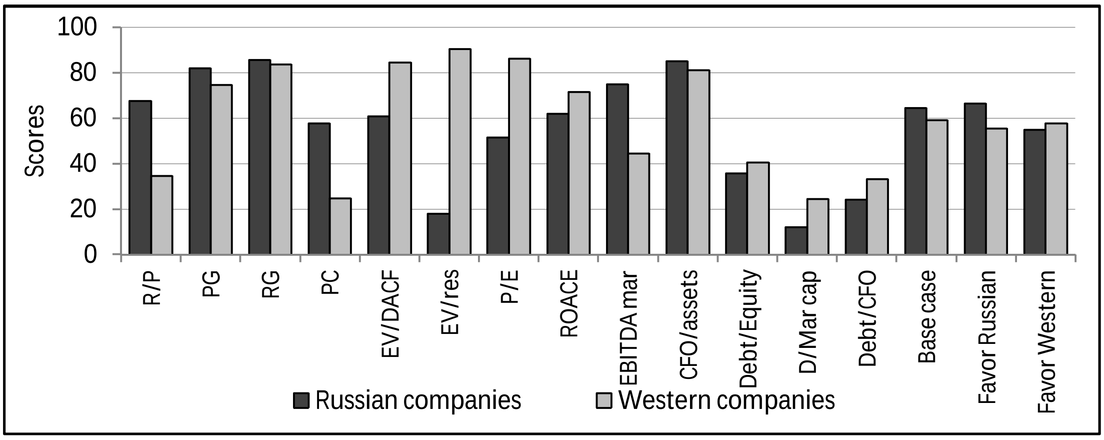


The company's relative value is also measured by the ratio of enterprise value to reserves (EV/reserves) and the price to earnings ratio (P/E), profitability by the EBITDA margin and cash flow to assets (CFO/assets) and risk by debt to market capitalization (D/Mar cap) and debt to cash flow (D/CFO). EBITDA is earnings before interest, taxes, depreciation and amortization and CFO is cash flow from operations. The alternative criteria are used to examine and demonstrate how the analysis results change when alternative criteria are used. The choice of the criteria is based on the critical factors, recommendations in research reports, criteria used in companies' reports and availability of relevant data. Production and reserves growth are based on 2007-2012 data and the values of other criteria on 2010-2012 data. Companies are assessed as a whole including oil, gas and other activities. An equivalent unit, ton of oil equivalent (toe), is used to express oil and gas quantities.

In the base case, the best performing company is Exxon with a score of 75, Rosneft has a score of 70, Gazprom, Gazprom Neft and Tatneft have scores of 66, Chevron 65, Lukoil 63, Shell 57 and Total 53. However, it is more interesting to analyze the average performance profiles of the Russian and western companies. Figure 2.5 presents the average performance profiles of the Russian and western companies including all the alternative criteria. Also, the aggregated scores of the base case and two other cases "favor Russian" and "favor Western" are presented in order to demonstrate the effects of using different criteria.

The greatest strengths of the Russian companies are their high reserves-to-production ratios and low production costs. The greatest weaknesses of the Russian companies are the low relative company value, which depends on a company's share price, and high debt intensity. Figure 2.5 shows that using different criteria to measure the same dimensions gives different values in criterion scores and aggregated scores. For example, the combination of EV/DACF, EBITDA margin and Debt to Equity favors Russian companies while the combination EV/reserves, ROACE and Debt-to-market capitalization favors western companies. Consequently, some interest groups can manipulate companies' observable performance by using suitable criteria.

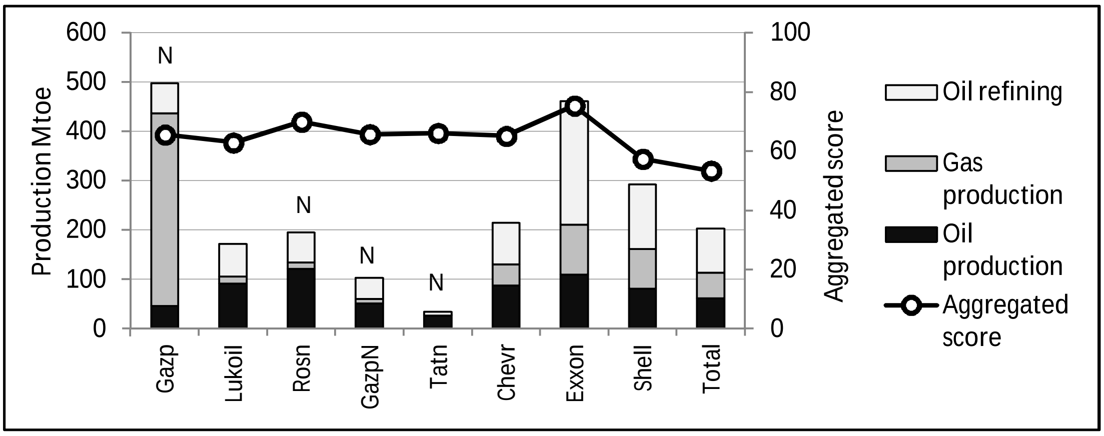
Figure 2.5 Average scores of Russian and western companies



R/P: reserves-to-production ratio; PG: production growth, RG: reserves growth; PC: production costs; relative company value is measured by EV/DACF or EV/reserves or P/E ratio; profitability is measured by ROACE or EBITDA margin or CFO to assets; debt intensity is measured by Debt to Equity or Debt to Market capitalization or Debt to Cash flow. The criterion scores of production costs and debt indicators are calculated from the inverses of the actual criterion values because in these cases smaller is better.

Figure 2.6 presents the companies' aggregated scores and also reminds us that the companies significantly differ from each other in size and production and ownership structure. One guideline in relative analysis is to choose similar companies for comparisons. In practice, the set of possible candidates for comparisons is rather small. Some research results suggest that a company's size and reputation affect a company's relative value. Some research results suggest that national oil and gas companies underperform private companies in profitability and efficiency. The analysis of these factors is outside the scope of this study.

Figure 2.6 Conclusion of company analysis

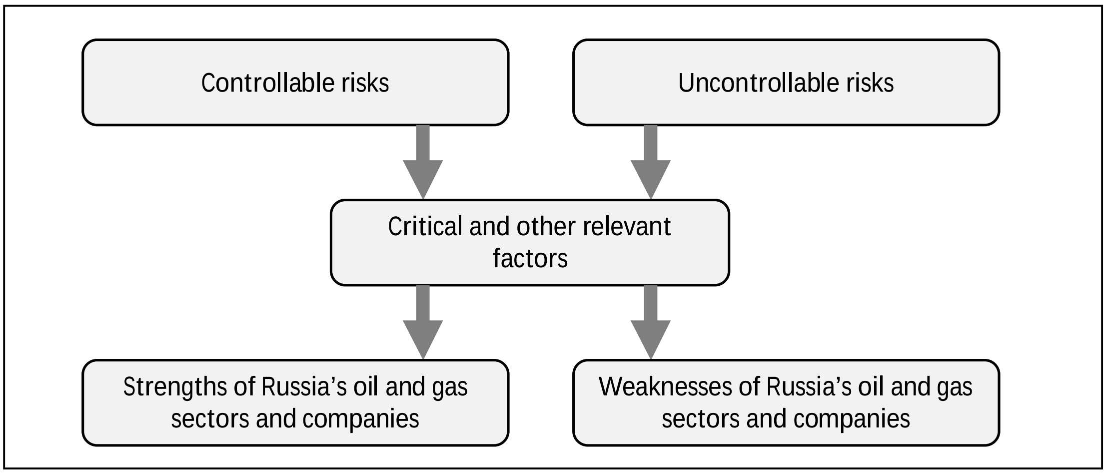


N means a partly national company.

2.6 Conclusion

Figure 2.7 presents the connections between the key results of this study. The risks are based on the criticism presented against Russian oil and gas both in western and Russian reports. The controllable risks depend mainly on decisions made in Russia while the uncontrollable risks are mostly outside the control of Russian oil and gas companies and authorities. Critical factors are the consequences of the risks. In this study, the choice of the criteria is based on the critical factors, recommendations in research and company reports and the availability of relevant data. The strengths and weaknesses are the results of benchmarking Russian oil and gas against the other important actors in the global oil and gas markets.

Figure 2.7 Grouping of key results



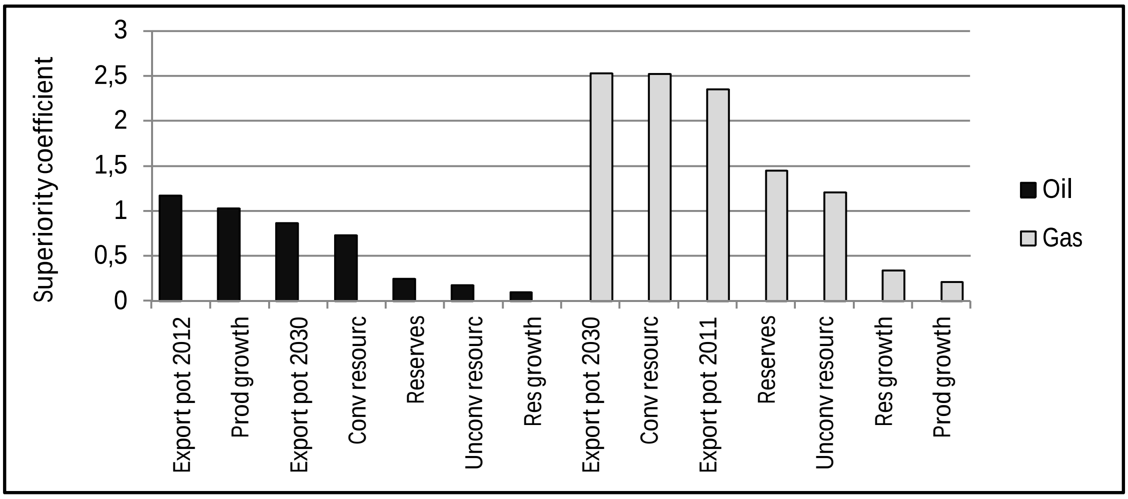
The uncontrollable risks (international oil and gas prices, growing capital intensity of new production, high inflation and exchange rate movements, and competition in the European and other gas markets because of increasing unconventional gas production and LNG trade) are faced also by most of the other major oil and gas suppliers. The uncontrollable risks are not specific only to Russia and in this respect the criticism against Russia is not objective and justified.

Certain controllable risks (oil sector taxation, domestic gas prices, risk of conflicts with transit countries, diversification of exports and energy efficiency) have developed slightly positively. On the other hand, the state ownership in Russia's oil and gas sectors has increased and the share of oil and gas exports in the GDP has remained high. Consequently, the criticism against Russia is partly justified.

The Russian and European views of certain risks can conflict with each other. Presumably, such risks are the following: oil and gas prices, Russia's market share in Europe because the EU's goal is to decrease its dependence on Russian oil and gas, diversification of Russia's exports and certain pipeline projects because they may diminish the oil and gas available for Europe and increase Russia's bargaining power.

The main focus of this study is on the strengths and weaknesses of Russia's oil and gas sectors and Russian oil and gas companies. In this section, the strengths and weaknesses of Russia's oil and gas sectors and Russian companies are presented using superiority coefficients. In the regional analysis, superiority coefficients are calculated by dividing Russia's criterion scores by the corresponding average criterion scores of the Caspian Region, Middle East, Africa and America. Figure 2.8 presents the superiority coefficients of the regional analysis.

Figure 2.8 Russia's strengths and weaknesses



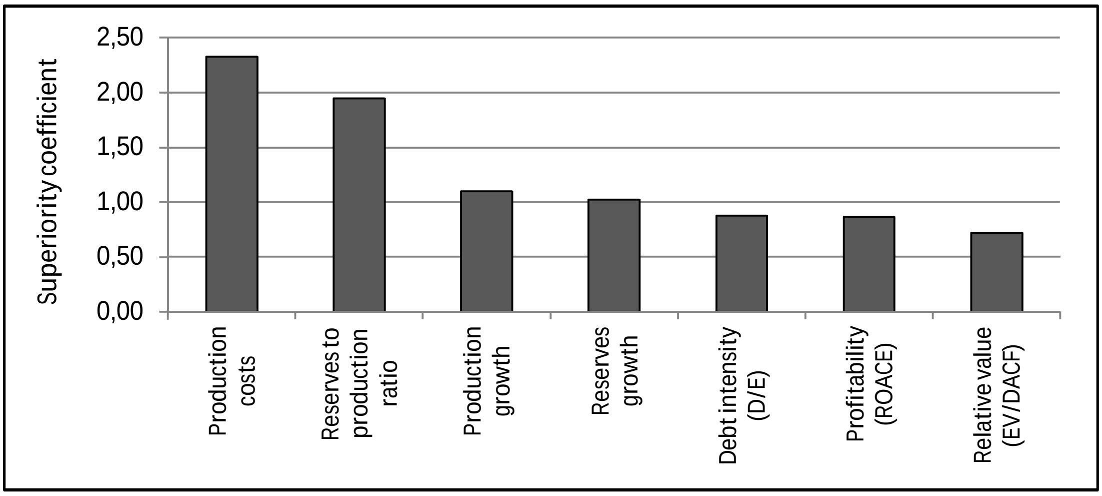
If the coefficient's value is greater than 1, Russia has superiority to the average of the Caspian Region, Middle East, Africa and America. The superiority coefficients of Russia's aggregated oil and gas scores are 0.7 and 1.7, respectively.

Although Russia's oil export potential and oil production growth are relatively high, Russia's small oil reserves and reserves growth gives a reason to doubt the sustainability of the growth. The company analysis and certain analyses from other sources, e.g. the IEA, support the view that, Russian oil is competitive compared to many other regions, except the Middle East. It is possible that Russia is capable of achieving only a relatively flat oil production. Consequently, the concerns about stagnating oil production and exports are justified. Russia's relatively small unconventional oil resources are not regarded as a weakness because, except for America, all the other regions also have small unconventional oil resources but the situation may change as additional information accrues.

Although Russia has large gas export potential, reserves and conventional and unconventional resources, Russia's gas production and reserves growth are small. The company analysis and evaluation of gas investment costs from other sources, e.g., the IEA, support the view that Russian gas will be competitive in the future compared to many other regions except for the Middle East. Consequently, the concerns of stagnating gas production and exports are justified but the reasons seem to be competition and the pricing of Russian gas.

Figure 2.9 presents the superiority coefficients of the company analysis. The coefficients are calculated by dividing the average scores of the Russian companies by the average scores of the western companies. The strengths of the Russian companies are low production costs and the high reserves-to-production ratio while the weaknesses include low relative value, high debt intensity and modest profitability.

Figure 2.9 Strengths and weaknesses of Russian companies



If the coefficient's value is greater than 1, Russian companies have superiority to the western companies. The superiority coefficient of the aggregated score is 1.15. ROACE is the return on average capital employed, D/E is the debt-to-equity ratio, and EV/DACF is the ratio of enterprise value to debt-adjusted cash flow.

It is reminded that the company analysis is not necessarily globally valid because many interesting companies such as National Iranian Oil Company, Saudi Aramco and Petróleos de Venezuela, which control practically all the oil and gas resources of oil- and gas-rich countries, are not included in the company analysis. A proper analysis of these and similar companies based on publicly available data is impossible.

The greatest uncertainties of the regional analysis stem from reserves and resources data and future projections. Also, production and consumption quantities vary between different data sources. The greatest uncertainties of company analysis stem from the possible differences in companies' financial reporting practices and the use of different financial and reserves reporting standards. Furthermore, the values of certain criteria such as reserves and production growth depend on the length of the assessment period.

When the results of this study are interpreted, it must be remembered that besides the above-mentioned uncertainties stemming from measurement, assessment and conversion errors and different standards, there are also other possible sets of criteria and alternatives and other possible value functions which can give different results. This value tree model is not bound to the criteria, value functions or alternatives used in this analysis. The limiting factors are an analyst's ability to choose proper key elements of the model and the availability of relevant information irrespective of whether the question is one of expert opinion or recorded data.

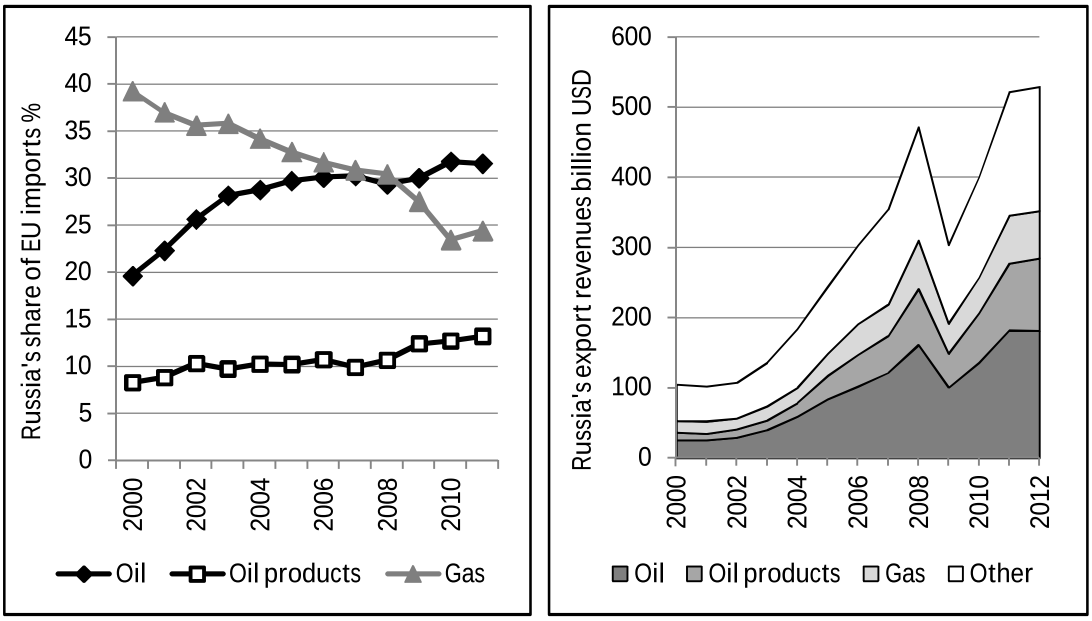
The value tree model suits well for the assessment of oil and gas regions, countries and companies. The assessment chain comprised of information sources, determining criterion values and scores and constructing performance profiles works well, provided that the key elements of the model are properly chosen. Performance profiles clearly and unambiguously present the strengths and weaknesses of an alternative compared to the other alternatives and criteria and are not dependent on the different units of measurement. The aggregated scoring forces the user of the model to consider the relative importance of different criteria. The analysis also fulfills the requirements of objectivity: benchmarking, quantitative, multidimensional, transparent and updatable.

This study clearly shows that it is misleading to evaluate Russia's or some other region's or company's performance based only on a qualitative assessment or to benchmark them only against their own past performance or a single benchmark like the Middle East using only one or a few criteria. This value tree model provides an opportunity to objectively monitor and assess oil and gas regions, countries and companies compared to the other important actors in the changing oil and gas markets.

3 Risk analysis and problem formulation

The energy relations between the European Union and Russia are characterized by the EU's dependence on oil and gas supplies, Russia's dependence on oil and gas export revenues (figure 3.1) and a dose of mutual mistrust (EU 2011b). The EU aims at security of supply by trying to secure an optimal quantity of Russia's supplies and diversifying its oil and gas supply sources and routes to reduce its reliance on Russia (EU 2011a). Russia aims at security of demand by trying to secure an optimal market position in Europe and diversifying oil and gas supplies to other regions, first of all to Asia (Strategy 2009). Security of supply and demand is further complicated by the great uncertainties of Russia's future supply potential and Europe's future demand. Also, European and Russian views about certain things such as access to energy resources and transport infrastructure, gas pricing, certain pipeline projects and access to European energy markets differ from each other.

Figure 3.1 EU 27's and Russia's dependence on energy supplies



The figure presents Russia's share of the EU 27's total oil, oil product and gas imports including imports from the other EU countries and the structure of Russia's export revenues. The EU 27's gas import volume has increased 45% and oil product imports 29% while crude oil imports have decreased 8% since 2000. The shares of crude oil, oil products, natural gas and other products were 34%, 20%, 13% and 33%, respectively, of Russia's total export revenues in 2012. Source data: Bank of Russia 2013, Eurostat 2013.

3.1 Critical factors

The problem formulation of this study begins with the question: what are the greatest risks regarding Russia's oil and gas from the European and Russian perspectives?

Risk can be understood as a chain including three components: source, scenario and consequence. A source of risk can generate a scenario which influences the system under evaluation; e.g., a volatile oil price is a source of risk. A scenario has negative or positive consequences in the system; e.g. the price of oil declines by 10 US dollars per barrel. A consequence is the loss or benefit in the system as a result of a scenario; e.g., an oil price decline by 10 US dollars cuts a company's revenues by one million US dollars. A system is a group of interrelated elements which is under evaluation, e.g., an oil company (modified from Ayyb 2003).

In this analysis risks are classified into seven categories (Table 3.1). This classification combines certain features of the IEA's (International Energy Agency) classification of energy investment risks (IEA 2003), risks mentioned in the Roadmap of EU-Russia Energy Cooperation until 2050 (EU 2013) and risk classifications used by western and Russian companies (e.g. Exxon 2013a, Gazprom 2013b). The major sources of risks described in table 3.1 are mostly as they can be seen from the Russian perspective. The risks may have negative or positive consequences for the oil and gas supplies to Europe.

Table 3.1 Classification of risks and examples of sources of risks

Type of risk	Major sources of risks
1. Market risks	*Uncertainty of and changes in oil and gas demand and prices, production and transportation costs. Competition with other suppliers and energy sources.*
2. Macroeconomic risks	*Exchange and interest rates, inflation, dependence on oil and gas export revenues and oil and gas supplies.*
3. Regulatory risks	*Changes in taxation, price regulation, investment and trade regulation.*
4. Geological and geographical risks	*Depletion of traditional resources and geologically, geographically and economically more complex new resources.*
5. Political risks	*Low predictability of energy policies, dependence on energy supplies, diversification of energy supplies, problems with transit countries, political control of business.*
6. Environmental and technical risks	*Poor condition of infrastructure, equipment and environmental control and low energy efficiency.*
7. Industry-specific risks	*Companies' unfavorable operational and financial environment and companies' reduced ability to make investments as consequences of different risks.*

Market risks stem from the changes in international and domestic commodity and financial markets. Russia's economy is highly dependent on oil and gas export revenues and world oil and gas prices and demand movements strongly affect Russian oil and gas companies' revenues, cash flows, market values, ability to make investments, service debts and pay taxes (IEA 2011b, Myers Jaffe et al. 2009). Russia's and Gazprom's gas exports and gas prices face indirect competition from the increasing unconventional gas production in the USA and direct competition from the increasing liquefied natural gas deliveries to Europe. Many observers expect that increasing shale gas production will further reduce Russia's market share in Europe and, consequently, Gazprom's export and Russia's tax revenues (Medlock et al. 2011).

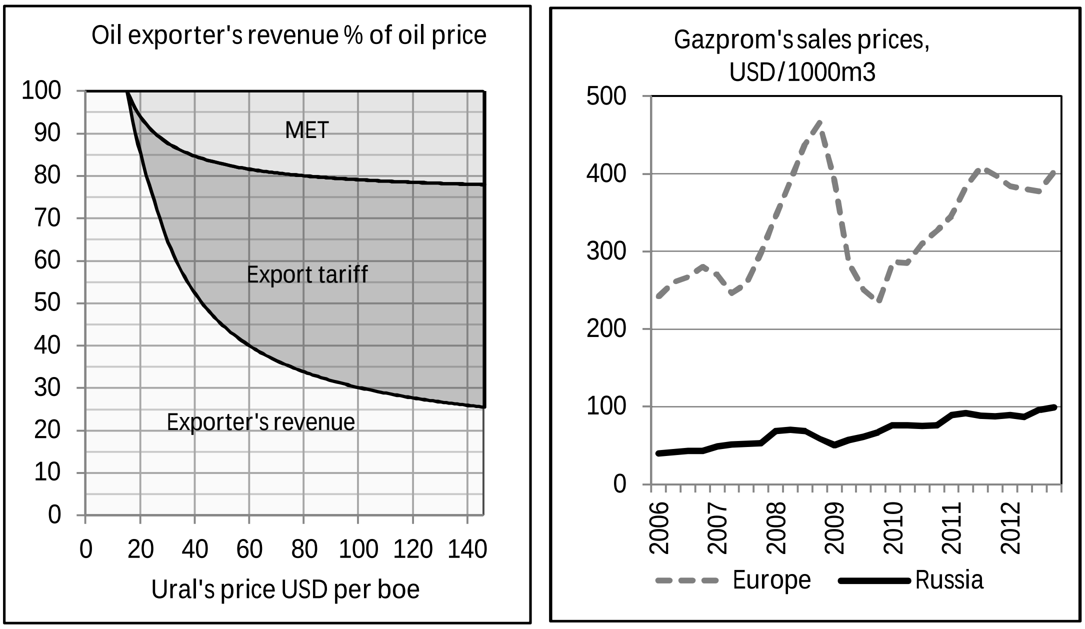
Macroeconomic risks have their origin in the economic relations between Russia and other countries and the problems afflicting Russia's economy. The ruble inflation and movements in the ruble/U.S. dollar exchange rate and in certain cases also the ruble/euro exchange rate affect companies' cash flows because companies' revenues are mostly in U.S. dollars and costs in rubles (Myers Jaffe et al. 2009). Because Russia's economy is highly dependent on oil and gas export revenues, economic slowdowns may delay economic and social reforms in Russia and increase economic and political distress.

Russia was one of the countries worst affected by the 2008 and 2009 economic crisis because of the fall in oil prices and decrease of global oil and gas demand (IEA 2011b, Myers Jaffe et al. 2009).

Geological and geographic risks stem from the fact that the low-cost oil and gas fields in Western Siberia accounting for the bulk of current production are entering or are in a phase of decline. Most of the new resources are far from markets and in geologically and geographically more challenging and costly areas in the Arctic, North-West and Eastern Siberia. The IEA estimates that oil production costs in the traditional regions are 4-6 USD/barrel but capital and production costs in new regions range between 11-25 USD/barrel. The corresponding figures for gas are 5 USD/1000 m^3 and 35-110 USD/1000 m^3, respectively (IEA 2011b). The higher cost level of new projects will cut companies' cash flows and ability to make investments.

Regulatory risks are related to the different regulatory measures set by Russian authorities. The high taxation of oil export revenues, low regulated domestic gas prices (figure 3.2) and restrictions on private and foreign investments cut companies' cash flows and diminish their ability to make investments to secure renewal of resources and sufficient production. Taxation has favored refining and increased domestic crude oil consumption while low regulated domestic gas prices have increased domestic gas consumption, thereby decreasing quantities available for export (IEA 2011b, Myers Jaffe et al. 2009). Moreover, tax legislation is the most flexible area of Russian law which is often modified, supplemented and updated (Gazprom 2013b).

Figure 3.2 Russia's oil export taxation and domestic gas prices



The progressive mineral extraction tax (MET) and export tariff, which are tied to the international price of Urals blend, effectively cut oil exporter's revenues. The mineral extraction tax and/or export tariff are reduced for crude oil produced at certain fields or exported to certain countries. Most gas export prices are tied to international prices of oil products but domestic prices are regulated. Russia's domestic gas prices in rubles have increased but the USD/ruble exchange rate changes are reflected in the above figure. Source data: Bank of Russia 2013, Gazprom 2013a, Rosneft 2013b.

Environmental and technical risks are primarily related to outdated infrastructure and equipment. Russia's energy intensity is among the highest in the world and the potential for efficiency gains is enormous. The gas transport pipelines owned by Gazprom are over-aged and generate energy losses and greenhouse gas emissions. Russia is the leading country of the world in gas flaring, i.e., burning the gas obtained as a byproduct in oil production and the fourth-largest emitter of CO_2 in the world. Besides emissions and increased oil and gas consumption, the over-aged infrastructure also increases the probability of technical failures and accidents (IEA 2009, IEA 2011b).

Political risks stem from Europe's dependency on Russia's oil and gas deliveries and from the fears that Russia may use oil and especially gas deliveries and delivery disruptions as an energy weapon to advance its political and strategic interests in transit countries and Europe. Russia has had several price and ownership disputes with transit countries, first and foremost, Ukraine and Belarus. For example, the gas price disputes with Ukraine in 2006 and 2009 and with Belarus in 2004 and 2010 and the oil price dispute with Belarus in 2007 resulted in delivery cuts to European client countries (Le Coq et al. 2012, Yafimava 2010).

In recent years, the Russian state has tightened its grip on Russia's oil and gas sectors. As a result, the majority state-owned Rosneft is Russia's largest oil company, state-owned Transneft has monopolies on trunk oil and oil product pipelines and the majority state-owned Gazprom produces about 72% of Russia's gas, owns trunk gas pipelines in Russia and has a monopoly on gas exports. Also, the privately owned large oil companies have strong ties with the government (IEA 2011b). In March 2013 Rosneft announced that it has completed the acquisition of a 100% stake in TNK-BP, a large private oil and gas company earlier owned by British BP and a group of Russian investors (Rosneft 2013c). Besides questionable political interests, researchers have time after time shown that state-owned oil and gas companies underperform private companies in efficiency and profitability (Victor 2007).

Russia has constructed and is constructing or planning new pipelines such as North Stream and South Stream gas pipelines through the Baltic Sea and Black Sea, respectively, and Baltic Pipeline System 2 oil pipeline (BPS-2), circumventing transit countries Ukraine, Belarus and Moldova. Gazprom has also been active in acquiring transit and distribution assets in transit and client countries. It is argued that especially Russia's gas pipeline projects are motivated by strategic advantage rather than financial viability. According to this reasoning, the aim is to increase Russia's control over transit countries and its European clients and avoid the flow of competitive gas from Central Asia to Europe via new routes such as Nabucco. It is also argued that one goal of Russia's new gas pipelines planned in the Far East is to demonstrate to Gazprom's European clients that Gazprom has alternative clients in the Far East if the terms of trade with Europe become unattractive (Henderson 2011).

The EU, in turn, seeks to establish energy partnerships with the Caspian and Central Asian regions and with many oil and gas producers in Africa and the Middle East. The EU also backs certain gas and oil pipeline projects circumventing Russia's territory such as the Nabucco and Trans Caspian gas pipelines and Euro-Asian Oil Transportation Corridor providing a direct access to Caspian oil and gas (EU 2011a). Regardless of whether diversification of exports is interpreted as a market or political risk or both, it can increase Russia's bargaining power in gas pricing and diminish the quantities of Russian oil and gas available for Europe. Political and economic distress in Russia and transit countries can constitute a threat to oil and gas deliveries.

The above risks have been compiled from western sources. The Energy Strategy of Russia for the period up to 2030 was approved in 2009. According to this strategy, the objective of Russia's energy policy is to maximize the effective use of energy resources and the potential of the energy sector to sustain economic growth, improve the quality of life of the population and promote strengthening of foreign economic positions of Russia. The strategy recognizes most of the above risks and sets guidelines and goals to overcome the problems as the following citations from the strategy show (Strategy 2009).

The main macroeconomic problem, Russia's dependency on the oil and gas export revenues, should be reduced by switching from selling raw materials and energy resources abroad to selling highly processed products. The share of the energy exports in the gross domestic product should be decreased by no less than 3 times.

The low investment capacity of oil companies as a result of high taxation and regulation should be improved by introducing predictable taxes and legal protection of investor's rights; private investments in geological exploration and subsoil use should be promoted. In the gas sector, the low regulated domestic gas prices should be eliminated with a transition to market principles in gas pricing so that prices take into account payback of production, transportation and investments.

According to the strategy, initial oil reserves of Russia have already been depleted by more than 50%. Gas reserves of major exploited deposits in Western Siberia have been depleted by 65–75%. Currently they are in a phase of declining production. Thus, there is a clear necessity to explore and develop resources on new more costly territories such as the Yamal Peninsula, the continental shelf of the Arctic and Far Eastern seas, Eastern Siberia, the Far East and the Caspian region. Besides improvements in pricing and taxation, state support of geological exploration is necessary as well as improvement of extraction technologies to increase recovery rates.

The main environmental and technical problems include the high energy intensity of the GDP, excessive dependence on natural gas, whose share represents around 53% of the domestic energy consumption, and the high prevalence of over-aged assets. Russia must reduce energy intensity to the level of countries with similar climatic conditions such as Canada and the Scandinavian countries, which means that the energy intensity of the GDP should be decreased by more than twice. The share of gas in the domestic consumption should be reduced to 46-47% and the share of renewable energy should be increased. The energy sector's impact on the environment and climate should be reduced. The amount of greenhouse gas emissions by 2030 should be limited to the level of 100–105% compared to the level of 1990 and at least 95% of associated gas should be used.

The main goals in Russia's foreign energy policy are the following: Russia's national interests should be considered in the world energy markets; oil and gas exports should be geographically diversified to the world's largest consumers. The proportion of Europe in Russian exports will decline due to export diversification to eastern markets including China, Japan, Korea, and other countries of the Asia-Pacific region. By 2030 the proportion of eastern markets in the exports of oil and oil products should grow to 22–25%, while the corresponding share of natural gas exports should rise to 19–20%; in exports, the share of products with high added value such as oil products and liquefied natural gas should be increased; Russia's dependency on transit through the adjacent countries should be reduced; the international positions of Russian energy companies should be strengthened.

According to Russian oil companies, the main market, macroeconomic and regulatory factors affecting their results are the following: changes in the world crude oil and refined products prices and demand; changes in the U.S. dollar-ruble exchange rate and inflation; domestic pipeline and railway tariffs; oil sector taxation and especially the progressive mineral extraction tax and export tariffs (e.g. Lukoil 2013b, Rosneft 2013b).

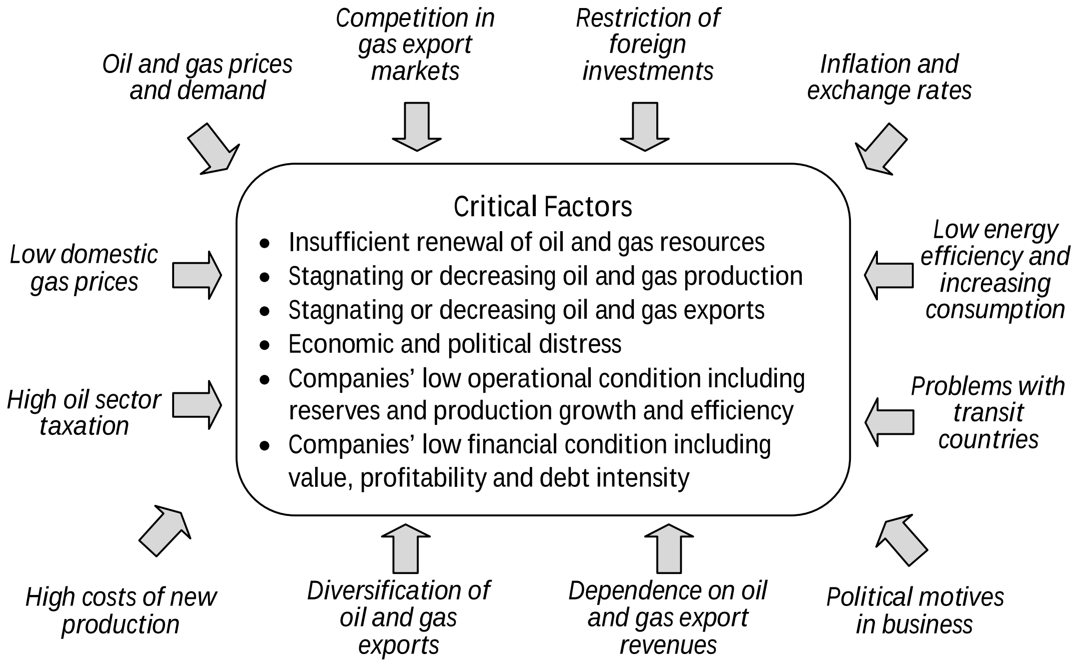
The world oil and oil products prices also affect Gazprom' export revenues because gas prices in export contracts are partly tied to the prices of oil products. Besides the U.S. dollar, part of Gazprom's sales revenues is denominated in euro; consequently, changes in the euro/ruble exchange rate also affect the company's results.

One of Gazprom's greatest problems is the low regulated domestic gas prices. The Russian government aims to achieve net back parity between domestic prices for industrial users and export prices during 2011-2014. Net back parity means that export and domestic prices are equal taking into account export tariffs and costs of transportation. However, certain industry sources expect that the FTS (Federal Tariff Service) will continue to approve price increases on an annual basis and prolong the timetable for market price liberalization (e.g. Novatek 2013b).

In the European gas market, there are risks related to price and demand changes due to increasing competition, liberalization of the European gas markets and the EU's efforts to diversify gas supplies. The increasing production of unconventional gas in North America is a risk because it diverts LNG deliveries to the European and Asian markets increasing competition. According to Gazprom, it rises to challenges by increasing efficiency and cost control. Moreover, Russia has large unconventional gas reserves and Gazprom develops technology for their exploitation (Gazprom 2013c).

Russia or the EU have only limited possibilities to control world oil prices, international gas prices or the cycles in the world economy, but because of the confiscatory oil sector taxation, low regulated domestic gas prices, high inflation, competition in gas export markets, domestic oil and gas consumption, political motives in business, inefficiency in energy production, transportation and use and increasingly costly new resources, there are a number of economically dangerous scenarios which can negatively affect the economic and business environment in Russia and Russian companies' ability to make sufficiently investments. As a result there are a number of possible negative consequences which in this study are named as critical factors. The critical factors were defined using an iterative process based on the above discussion and availability of relevant data. The dangerous scenarios and critical factors are presented in the following figure 3.3.

Figure 3.3 Dangerous scenarios and critical factors



3.2 *Objectives of this analysis*

It is worth noting that most of the criticism presented against Russia's oil and gas sectors can also be presented against most of the major oil and gas exporters. Compared to most of the OPEC countries in the Middle East and Africa and oil and gas exporting countries in the Caspian region, Russia is less dependent on oil and gas export revenues and its economy is more diversified (Bahgat 2010, OPEC 2012a). Gas prices in most Middle Eastern and North African countries are substantially below the economic cost of gas (Darbouche 2012) and fossil fuels consumption subsidies are lower in Russia than in most OPEC and Caspian region countries (IEA 2011d). Energy intensity in Russia is approximately two times higher than in Canada, Sweden or Finland but on the same level or lower than in many oil and gas producing countries in the Middle East, Africa and the Caspian region (World Bank 2012).

With the exception of Norway, all important oil and gas exporters, in Africa, Middle East and Central Asia pose political risks of one kind or another. The partially or wholly state-controlled Russian oil and gas companies are not unique. Most of the oil and gas production and export in the OPEC countries and Caspian region are in the hands of state-controlled companies (Bahgat 2010, IEA 2010).

Except for the OPEC Middle East countries, geological, geographical and environmental circumstances set challenges for oil and gas explorers and producers everywhere in the world. The era of cheap oil and gas is over (IEA 2008, IEA 2011b). If the focus is only on the problems of Russia or some other single strategic oil and gas region, there is a danger of making wrong conclusions and choices based on one-sided information. Consequently, the first important choice in this study is to use benchmarking in assessing strategic oil and gas regions.

When assessing oil and gas regions, company information, if available, is useful. After all, companies, state-controlled or private, make investments, explore and develop resources, produce and export oil and gas, collect payments and pay taxes. The second important choice in this study is to benchmark both Russia's oil and gas sectors and Russian oil and gas companies against other relevant regions and companies.

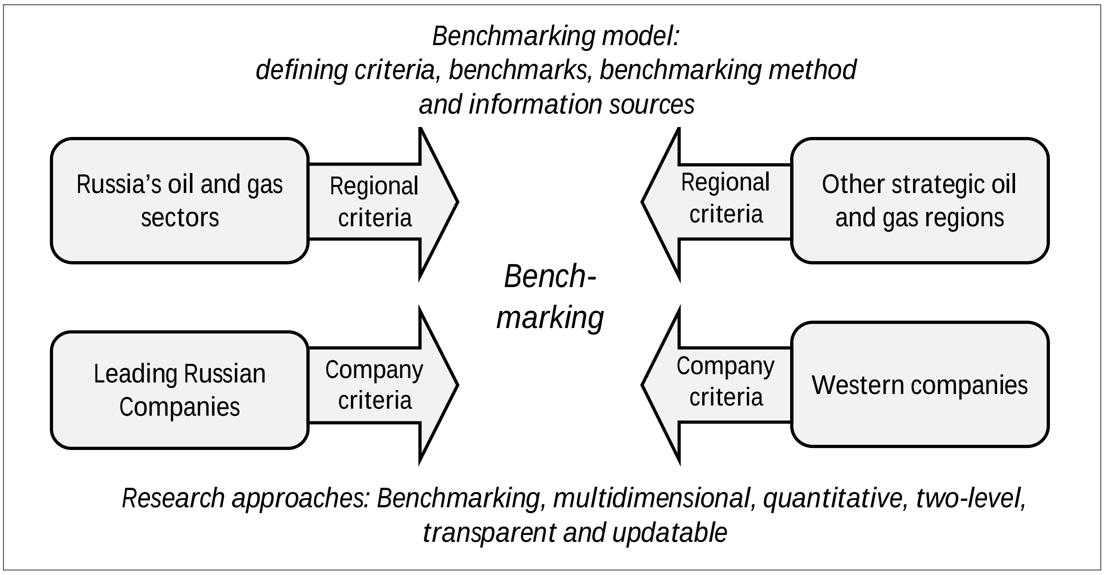
A preliminary analysis showed that the problem can be viewed and assessed from several different perspectives. The third important choice in this study is to use a multidimensional, quantitative and transparent approach in order to enhance objectivity. The fourth important consideration is the source data. The data sources shall be reliable enough, publicly available and such that they are updated at reasonable time intervals.

The fundamental question of this study is: How do Russia's oil and gas sectors and Russian oil and gas companies perform compared to other strategic actors in the global oil and gas arena? Based on the above discussion and the list of the critical factors the objectives of this study are formulated as follows:

1. The first objective of this study is to construct a benchmarking model for assessing oil and gas suppliers that takes into account the critical factors, results of relevant research, industry practices and the availability of relevant data.
2. The second objective of this study is to benchmark Russia's oil and gas sectors against the other strategic oil and gas regions of the world.
3. The third objective of this study is to benchmark leading Russian oil and gas companies against leading oil and gas companies from other countries.

Figure 3.4 presents the problem formulation, objectives and research approaches of this study and concludes this chapter.

Figure 3.4 Problem formulation



4 Resources, uncertainties, trade and prices

This chapter reviews different types of oil and gas resources, discusses the availability and quality of oil and gas data and the recent trends in the price formation and trade of oil and gas.

4.1 Different oils and gases

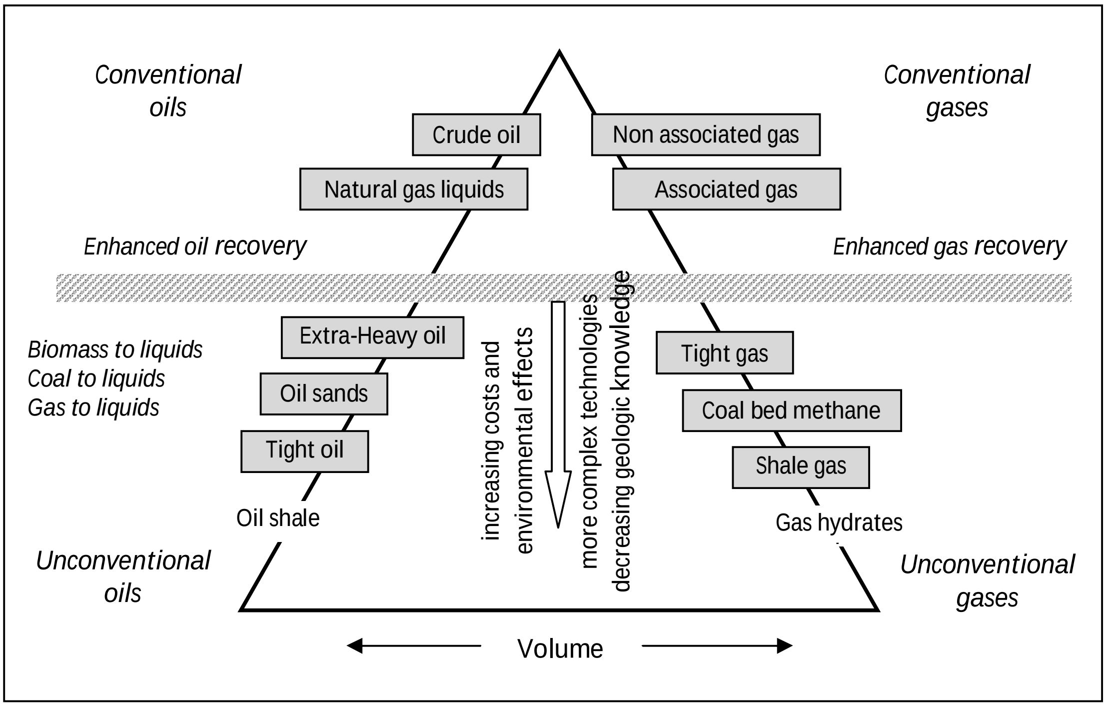
First, seven fundamental terms: hydrocarbons, petroleum, accumulation, reservoir, field, reserves and resources are shortly defined. Hydrocarbons consist wholly of hydrogen and carbon. The word petroleum is defined as a naturally occurring mixture of hydrocarbons in the gaseous, liquid or solid phase (SPE 2007). An accumulation is an individual occurrence of petroleum. A reservoir contains an individual and separate accumulation. A field is a geologically individual area containing a single or multiple reservoirs (Schlumberger 2013, SPE 2007). Reserves are estimates of those volumes of oil and gas that can be extracted economically from known accumulations and resources are those volumes that are estimated to become recoverable in the future from discovered or undiscovered accumulations.

Petroleum resources are often divided into *conventional* and *unconventional resources.* Conventional resources exist in discrete petroleum accumulations, reservoirs are under natural pressure and oil or gas flow readily into wellbores. Unconventional resources exist in accumulations where permeability (i.e., the ability for oil or gas to flow through the rock) is low. Unconventional accumulations are often distributed over a larger area than conventional accumulations. They usually require specialized methods like horizontal and multilateral drilling, hydraulic fracturing or injection with steam or solvents (Holditch et al. 2008) and in some cases mining activities in order to be economically productive. Moreover, the extracted unconventional petroleum may require significant processing prior to sale (IEA 2010, SPE 2007).

In *horizontal multilateral drilling*, long horizontal wells are drilled from a single surface location. Because a horizontal well typically penetrates a greater length of the reservoir, it can offer significant production improvement over a vertical well. *Hydraulic fracturing* is a stimulation treatment performed on oil and gas wells in low-permeability reservoirs. Specially engineered fluids are pumped at high pressure and rate into the reservoir causing fractures to open. Proppant, such as grains of sand, ceramic or other particulates, is mixed with the treatment fluid to keep fractures open resulting in greater flow of oil or gas from the reservoir (IEA 2009, Schlumberger 2013).

In this report, conventional oils include crude oil and natural gas liquids (NGLs) while conventional gases include non-associated and associated gas. Unconventional oils include extra-heavy oil, oil sands, tight oil and oil shales and gases tight gas, coal bed methane (CBM) and shale gas. Also, oil produced with coal to liquids (CTL) and gas to liquids (GTL) processes and biofuels are included in unconventional oils (figure 4.1).

Figure 4.1 Different oils and gases



Source: Modified from SPE 2010

Conventional crude oils flow naturally or can be pumped from the subsoil without further processing or dilution. Conventional oils are often distinguished from each other and also from unconventional oils according to their density, API gravity (the American Petroleum Institute gravity). API gravity is a measure of the relative density of petroleum liquids compared with water and is expressed in degrees. The higher the degree is, the lighter the oil is (BGR 2009, SPE 2007).

Conventional natural gas occurs in permeable reservoir rock, either in the gaseous phase, i.e., *non-associated gas*, or dissolved in crude oil, i.e., *associated gas*. The principal component of natural gas is methane. Besides methane, natural gas may also contain heavier hydrocarbons: propane, butanes, pentanes, natural gasoline and condensate (WEC 2010). These heavier components are often extracted from gas and marketed separately as natural gas liquids, NGLs. NGLs are used in oil refining and also in other industries. In 2010, NGLs' share of world oil production was approximately 10% (IEA 2011b) but this share is expected to increase with the increasing natural gas production.

Associated gas is an important byproduct of oil and is obtained when oil is brought from the high subsoil pressure to the low pressure at the surface. Dissolved gas comes out of oil and is very similar to natural gas. Some 22% of the world's conventional gas resources are contained in associated fields. Ideally, the associated gas can be utilized, like the non-associated gas, but in remote oil production areas it is often flared, i.e., burned due to a lack of infrastructure and markets (IEA 2009).

In primary recovery, in which the natural pressure of a reservoir and pumping are used, and in secondary recovery, in which gas or water injection are used to raise the reservoir pressure, recovery factors between 20-50% can be achieved. The recovery factor is defined as the percentage share of the recoverable petroleum of the total petroleum originally in the subsoil. In tertiary recovery or *enhanced oil recovery (EOR)* more complex materials such as carbon dioxide, chemicals and steam are injected into a reservoir to maintain the reservoir pressure and improve the fluid flow. Horizontal drilling and hydraulic fracturing are also often used technologies to improve oil recovery. The global average recovery factor was recently estimated at 35% and EOR currently accounts for only about 3-4% of the world's oil production but EOR is expected to contribute significantly to the recoverable quantities in the future (BGR 2009, IEA 2008).

However, the above refers only to oil. Recovery factors are significantly higher for conventional gas fields. They range from 30% to close to 100%, averaging around 61%. The average rate is likely to increase with technological improvements but *enhanced gas recovery* (*EGR*) is still in its infancy compared with EOR (IEA 2008).

Oil sands are a mixture of bitumen, water, sand and clay. Bitumen is high viscosity oil that does not flow under natural conditions. Oil sands which are close to the surface are mined and treated with hot water and/or solvents to separate out the bitumen. The deeper oil sand deposits are recovered in place (*in situ*) using advanced drilling techniques that inject steam or hydrocarbon solvents into the reservoir and warm the bitumen so that it can be pumped up to the surface through recovery wells. Extracted bitumen is diluted or upgraded to get synthetic crude oil. *Extra heavy oil's* density is the same as bitumen's but its viscosity is lower and its mobility in reservoirs better. When the oil's viscosity is low enough it can be extracted through long horizontal and multilateral wells. Also, the injection of steam to vertical or horizontal wells is used. Extracted extra heavy oil is diluted or upgraded to get synthetic crude oil. The greatest and most well known oil sand deposits in commercial use are in Alberta, Canada and extra heavy oil deposits in the Orinoco Belt in Venezuela (BGR 2009, IEA 2010 and CAPP 2011).

Tight oil refers to crude oil in shale or claystones, and oil in other low permeability rocks. Oil produced from shale formations is called shale oil. Oil produced from other low permeability formations such as sandstones and carbonates is called tight oil or light tight oil (BGR 2012). Although the terms shale oil and tight oil are often used interchangeably, the oil and gas industry in the USA typically uses the term tight oil to refer to oil both in shale and other tight formations. Consequently, shale oil is a subclass of tight oil. The key technologies to extract tight oil are horizontal drilling and hydraulic fracturing (EIA 2013e).

Oil shale contains neither oil nor shale but it is a rock that contains solid organic material called kerogen. Oil shale deposits near the surface can be mined and the crushed kerogen-rich shale is used as a fuel for energy production like coal or is heated in retorts and transformed into gas and shale oil, a synthetic crude oil. Also, *in situ* retorting technologies have been tested. The upgraded shale oil can be used as a feedstock in oil refineries. According to current knowledge the greatest oil shale deposits are in the USA. Because the commercial production of oil from oil shales is still in its infancy, many important parameters for the assessment of their crude oil potential are missing and global data of extractable amounts is very uncertain (BGR 2009).

Gas to liquids (GTL) and *coal to liquids (CTL)* are processes to product synthetic oil products from natural gas and coal (IEA 2008). *Biomass to liquids (BTL)* and other processes for deriving oil from biomass are in this study included in unconventional oils.

Tight gas reservoirs have so low permeability that gas cannot be extracted with conventional vertical wells, due to low flow rates. The key technologies to increase gas flow rates are hydraulic fracturing and horizontal drilling (IEA 2009, SPE 2010).

Coalbed methane (CBM) is a gas contained in coal. It is adsorbed to the surface of the coal and is held in place by the pressure of formation water. CBM is produced in many countries using conventional technologies but hydraulic fracturing and sometimes also horizontal wells are also used to enhance the productivity of reservoirs. For safety and electricity generation reasons, gas is also recovered from active coal mines (BGR 2009, IEA 2009).

Shale gas occurs in a sedimentary rock called shale. Shale reservoirs have low permeability and the key technologies to extract shale gas are horizontal drilling and hydraulic fracturing (IEA 2009). Shale gas occurrences can also include liquids, NGLs, which can be extracted from the wet natural gas (IEA 2012a).

Gas hydrates are formed from water and gas under high pressure in low temperatures. The gas resources contained in hydrates are estimated to be larger than all other gas resources together and hydrates are thought to represent an important future source of natural gas. However, the technology to support their commercial production has yet to be developed (IEA 2009, SPE 2007).

The energy density of gas is only about one thousandth compared to oil at atmospheric pressure. The physical properties of gas require transportation along fixed pipelines or in the form of *liquefied natural gas (LNG)*. LNG is produced in liquefaction plants by cooling natural gas down to below minus 160 degrees Celsius at atmospheric pressure. LNG is transported by special vessels and then converted back to gaseous form in re-gasification plants. A ton of LNG contains about 1400 m^3 of natural gas and 1 m^3 of LNG weights about 0.42 tons. Consequently, LNG's volume is about one six-hundredth of natural gas's (BGR 2009).

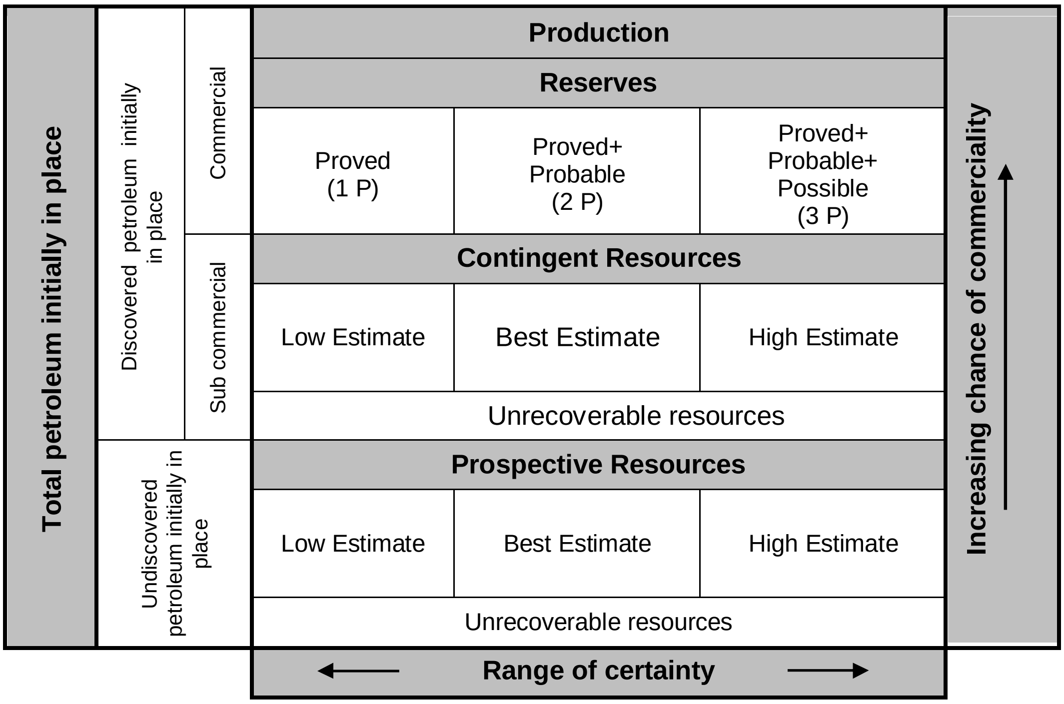
4.2 Reserves and resources

The amount of petroleum resources on the earth is finite, but they cannot be measured, only estimated. In estimates the appraiser's judgment is combined with information from three dimensions: economic, including current costs and prices and their predictions, technological, including available methods and technology today and in the future and geological estimates of petroleum quantities (Mitchell 2004).

There are a number of reserves and resources classification rules which differ from each other. For an analyst interested in Russian petroleum, the following three classification systems are important: The PRMS (the Petroleum Resources Management System) system, the SEC (the US Securities and Exchange Commission) rules and the Russian system. The PRMS system is widely used by Russian companies and Western research and information agencies. The SEC rules are also widely used by Russian and Western companies because companies listed in the USA must report their reserves according to the requirements of the SEC. Russian authorities and a few Russian companies disclose reserves and resources only according to the Russian system.

The PRMS classifies resources and reserves taking into account the level of certainty of recoverable volumes and the chance that they can be exploited commercially (Figure 4.2). The classification applies to both conventional and unconventional resources.

Figure 4.2 Classification of petroleum resources according to PRMS



The Society of Petroleum Engineers (SPE), the World Petroleum Council (WPC), the American Association of Petroleum Geologists (AAPG) and the Society of Petroleum Evaluation Engineers (SPEE) published jointly in 2007 guidelines on resources definition and classification, the Petroleum Resources Management System (PRMS). Source: SPE 2007

Reserves are those quantities of petroleum that are estimated to be commercially recoverable from known reservoirs under current economic, regulatory and technological conditions. This implies that the amount of reserves depends on petroleum prices as well as on the technological progress. Reserves are further divided in accordance with the certainty of the existence of the reported quantities. *Proved reserves (1 P)* are those quantities which are recoverable with reasonable certainty or at least at 90% probability. *Proved plus probable reserves (2 P)* include additional volumes that are less likely to be recoverable than proved reserves or the 2P reserves are recoverable at least at 50% probability. *Proved plus probable plus possible reserves (3 P)* include additional volumes that are less likely to be recoverable than probable reserves or the 3P reserves are recoverable at least at 10% probability (SPE 2007).

Contingent resources are those quantities that are anticipated to be recoverable in the future from known accumulations, but are not yet mature for development, i.e., there is a chance of commercial development and *prospective resources* are those quantities that are anticipated to be recoverable from undiscovered accumulations based on geological indication, i.e., there is a chance of discovery. Contingent and prospective resources are also classified in accordance with the certainty of the existence of the reported quantities. If probabilities are used, “low estimate” corresponds to at least 90% probability, “best estimate” to at least 50% probability and “high estimate” to at least 10% probability that the quantities actually recovered will equal or exceed the reported quantities. Because most of the information sources do not make a distinction between the quantities of contingent and prospective resources, the following resources definition is used in this study: *resources are discovered and undiscovered but geologically possible quantities that currently cannot be recovered but might be recoverable in the future*. The resources estimates referred in this study are mostly the best estimates. In brief, the difference between reserves and resources is that there may be a significant risk that the resources will not achieve commercial production (SPE 2007)

Not all petroleum in the subsoil is recoverable. *Unrecoverable resources* are those portions of petroleum which are estimated not to be recoverable. *Total petroleum initially in place* includes all estimated quantities of petroleum in the subsoil, as well as those quantities already produced. *Estimated ultimate recovery (EUR)* includes all quantities which are estimated to be potentially recoverable plus quantities already produced. *Remaining potential* is the entire amount of petroleum which can still be recovered, i.e., the sum of reserves and resources. A portion of unrecoverable resources may become recoverable in the future and the estimated ultimate recovery, remaining potential, reserves and resources may increase as commercial circumstances change, technology develops, or additional geological data is acquired (BGR 2009, SPE 2007).

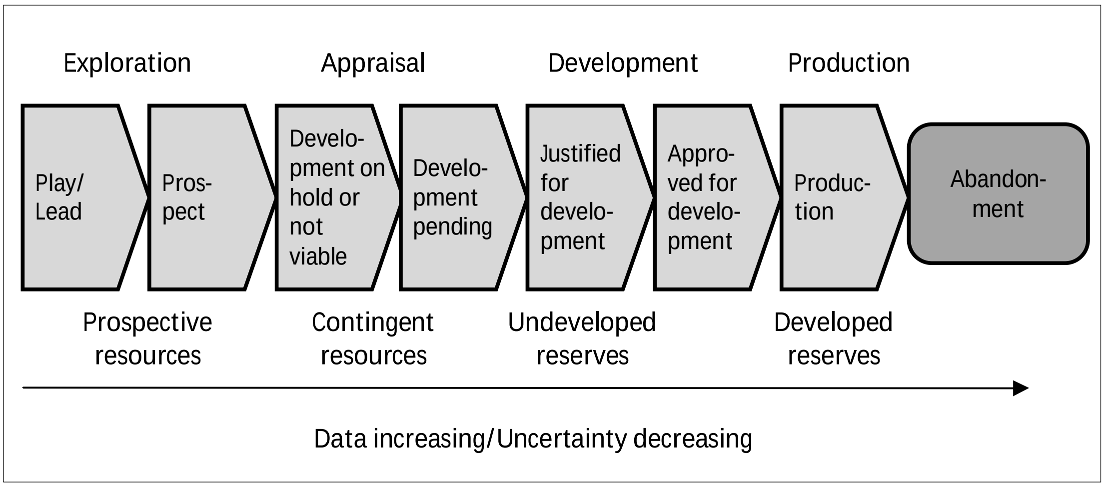
The old SEC 1978 rules addressed proved reserves only and prohibited the disclosure of probable and possible reserves as well as contingent and prospective resources. While SPE and SEC proved reserves definitions were quite similar, SEC regulations were considered to be more restrictive. Consequently, the reserves quantities were smaller than under the PRMS definitions (IEA 2008). The new SEC rules are effective for fiscal years ending on or after 31 December 2009. Changes to the rules included, *inter alia*, the following: the disclosure of probable and possible reserves is permitted but the disclosure of contingent or prospective resources is not allowed. Reserves are based on the average petroleum price of the prior 12-month period instead of year-end prices. Previously excluded unconventional resources are allowed to be classified as oil and gas reserves. Although the SEC 2009 rules are closer to the PRMS than the old SEC 1978 rules, the reports of such companies which disclose both the PRMS and SEC reserves show that the same proved reserves are greater under the PRMS system than under the SEC 2009 rules (cf., e.g., Novatek 2013b and Rosneft 2013d).

Unlike the SPE and SEC systems, the Russian standard is solely based on geological resources and all classes of reserves and resources are commercially equal. Reserves categories A, B and C1 consist of explored reserves and category C2 consists of preliminary estimated reserves. Resources categories D1, D2 and D3 are based on geologic surveys and considerations. The Russian reserves classes A, B, and C1 together roughly correspond to PRMS proved reserves. Category C2 encompasses PRMS probable and possible reserves (IEA 2011b). However, according to several sources, the A+B+C1 reserves quantities are approximately one third larger than the same PRMS proved reserves (e.g. Stern 2005).

Figure 4.3 presents the different phases of a petroleum project and their connections to the different classes of resources. However, before any actual activities can take place, permission, e.g., a license from the resource owner must be granted. In general, the resource owner is the government in the actual country (Robelius 2007).

In figure 4.3, *exploration* means prospecting for undiscovered petroleum using seismic surveys and drilling exploration wells. *Play* is an area in which petroleum accumulations or prospects are expected to occur. *Lead* is a potential accumulation which requires more data acquisition and evaluation.

Figure 4.3 Petroleum project, phases and resources



Source: Modified from SPE 2007

Prospect is an area in which petroleum is predicted to exist in economic quantities and which represents a viable drilling target. *Appraisal* follows successful exploratory drilling. During appraisal, wells might be drilled to determine the size of the field and how to develop it most efficiently. Disappointing appraisal results can lead to the classification of the project's status as being *on hold* or *not viable*. During d*evelopment pending* project activities are ongoing to justify commercial development in the foreseeable future. *Development* means drilling, construction and other activities which are necessary to begin production and transportation of petroleum. *Undeveloped reserves* are quantities expected to be recovered through future investments and *developed reserves* are quantities expected to be recovered from existing wells and facilities. A project is *justified for development* when there are reasonable commercial conditions and reasonable expectations that all necessary approvals for the project will be obtained. A project is *approved for development* when all necessary approvals have been obtained, capital funds have been committed, and implementation of the development project is underway. After the *production* phase the field is abandoned. *Abandonment* typically includes the plugging of wells, removal of well equipment, production tanks and associated installations and surface remediation (adapted from Schlumberger 2013 and SPE 2007).

Besides discoveries, reserves are also added by acquisitions, revisions, extensions, and enhanced oil or gas recovery, EOR and EGR respectively. Revisions refer to revising earlier estimates either downward or upward due to better understanding of reservoirs or changes in economic, regulatory and political conditions. Extensions are new discoveries within an existing field (Robelius 2007).

4.3 Oil and gas data and its uncertainties

This section discusses the uncertainties of regional and country-specific oil and gas data. Company-specific problems related to accounting and operational data are discussed in chapter 7.

Several information agencies publish updated worldwide country-specific oil and gas reserves information every year. Most of the agencies report only proved reserves. Besides possible differences in source data, the reserves quantities and their regional distribution vary between agencies because they report different quantities of unconventional oils and gases. In practice, the greatest differences stem from the different assessments of Canada’s oil sands, Venezuela’s extra heavy oil and Turkmenistan’s gas (table 4.1).

Table 4.1 World proved reserves reported in 2012

	Oil, billion tons				Gas, trillion m^3			
	BGR	BP	OPEC	OGJ	BGR	BP	OPEC	OGJ
Europe	2,1	1,7	1,9	1,6	4,3	3,8	4,9	4,1
CIS	17,4	17,5	17,2	16,2	*62,3*	*74,9*	*62,7*	*61,7*
Africa	18,0	18,1	17,5	17,4	14,6	14,5	14,7	14,6
Middle East	108,5	108,5	108,7	109,1	79,7	80,0	79,6	80,0
Asia Pacific	5,6	5,6	6,8	6,4	16,8	16,8	16,4	14,3
North America	*33,5*	*29,7*	*5,4*	*27,8*	9,8	10,8	10,2	10,1
South America	*30,9*	*44,4*	*44,6*	*44,3*	7,6	7,6	7,6	7,6
World	216,1	225,5	202,1	222,8	195,1	208,4	196,2	192,4

BGR: Bundesanstalt für Geowissenschaften und Rohstoffe, BP: British Petroleum, OPEC: Organization of the Petroleum Exporting Countries, OGJ: Oil & Gas Journal. Source data: BGR 2012, BP 2012, OGJ 2012, OPEC 2012a.

Compared to reserves, resources quantities are much more uncertain and are reported irregularly. The U.S. Geological Survey made a regional worldwide conventional oil and gas resources assessment in 2000. Since the 2000 assessment, the USGS has reassessed some regions and also assessed some other regions for the first time. In 2012, the USGS published a complete reassessment of undiscovered conventional oil and gas resources of the world. It is emphasized that these assessments are for conventional resources only and not all oil and gas provinces of the world were assessed (USGS 2000, 2012).

The USGS assessments have been criticized. On the one hand, it is argued that the methods used in the assessment overestimate the resources and, on the other hand, it is argued that the assessments underestimate the resources because it does not cover all the possible regions of the world (Aguilera et al. 2009). As far as is known, only the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) issues an updated worldwide country-specific resources assessment every year based on the USGS assessments and other sources.

The estimates of conventional and especially unconventional oil and gas resources vary considerably because the data from many countries and regions is imprecise and insufficient. Table 4.2 presents oil and gas reserves and resources quantities reported by the BGR and the IEA in November, 2012. The proved reserves quantities differ only slightly but both conventional and unconventional resources quantities differ significantly between these data sources.

Table 4.2 Reserves, conventional and unconventional resources

	Oil billion tons			Gas trillion m^3		
	Proved reserves	Conventional resources	Unconventional resources	Proved reserves	Conventional resources	Unconventional resources
BGR 2012	216	159	210	195	307	270
WEO 2012	225	191	389	208	254	328

The unconventional oil resources include oil sands, extra heavy oil and tight oil and unconventional gas resources include coal bed methane, tight gas and shale gas. WEO (World Energy Outlook) 2012 oil quantities are approximated from appropriate figures because numerical data is not available. WEO 2012's gas resources are based on the assumption that practically all proved reserves are conventional because the specifications in WEO 2012 do not enable precise comparisons between reserves, conventional resources and unconventional resources. Source data: BGR 2012, IEA 2012a.

The development of shale gas and tight oil production in the USA has drawn worldwide attention to these resources. Table 4.3 presents the top 10 countries in shale gas and oil resources according to the latest publicly available shale gas and oil assessment published by the EIA in 2013. The results of two earlier assessments reported by the BGR in 2012 and the EIA in 2011 are also presented.

Table 4.3 TOP 10 countries in shale gas and oil resources

	Shale gas trillion cubic meters			Shale oil billion tons		
	EIA 2013	BGR 2012	EIA 2011		EIA 2013	BGR 2012
China	32	9	36	Russia	10	2
Argentina	23	22	22	USA	8	3
Algeria	20	7	7	China	4	41
USA	19	16	24	Argentina	4	2
Canada	16	4	11	Libya	4	0
Mexico	15	6	19	Australia	2	2
Australia	12	11	11	Venezuela	2	34
South Africa	11	14	14	Mexico	2	0
Russia	8	10	0	Pakistan	1	0
Brazil	7	6	6	Canada	1	1
Others	43	53	37	Others	9	1
World total	207	157	188	World total	47	87

Source data: BGR 2012, EIA 2011a, EIA 2013e.

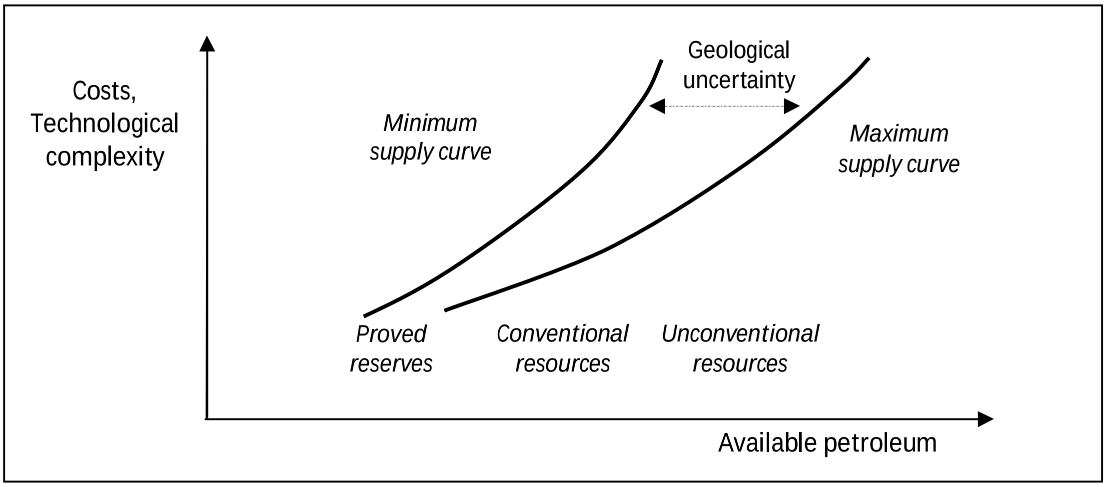
The aim of table 4.3 is to emphasize five important things, namely terminology, definitions, time, methodology and distribution, which affect the assessment results and explain at least part of the differences between different assessments. Terminology is often used confusingly, e.g., the term shale oil used by BGR 2012 refers to tight oil and that of EIA 2013 to shale oil which is a subclass of tight oil. The resources definitions are often different. According to the EIA's reports, the resources are technically recoverable resources which are defined as the volumes that could be produced with current technology, regardless of oil and gas prices and production costs. The resources reported by

BGR 2012 are defined as the proven amounts which cannot currently be exploited for technical and/or economic reasons, as well as unproven but geologically possible amounts which may be exploitable in future. Estimated resources volumes change with time. The EIA 2011 and 2013 shale gas assessments show that the new data and knowledge accrued with time causes downward and upward revisions in resources quantities.

There are differences in the methods and input parameters used in different assessments which complicate comparisons between assessments (EIA 2013e). Although shale gas and tight oil resources are distributed around the world, many important and interesting regions such as the Caspian Region and many Russian and Middle Eastern regions have not been assessed so far, at least publicly. Commercial production of shale gas and tight oil currently takes place only in North America. Therefore the volume estimates in other parts of the world are much more uncertain than in North America and upward and downward revisions in resource quantities can be expected also in future.

The purpose of the above discussion is to emphasize that different resources are of different value. If resources are ranked in accordance with their estimated production costs and certainty of existence, it can be thought that proved reserves are the most valuable, followed by conventional resources and then by unconventional resources (figure 4.4).

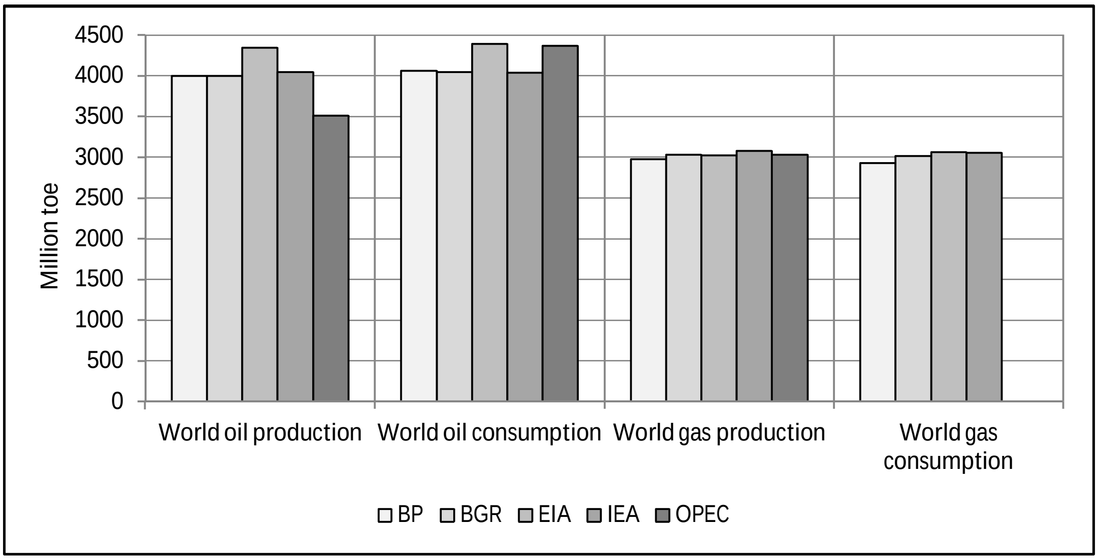
Figure 4.4 Availability, economic viability and uncertainty



Modified from IEA 2008, IEA 2009, MIT 2011

Besides reserves and resources quantities, also the production and consumption quantities reported by different information agencies differ from each other. Besides possible differences in source data and conversion factors, e.g., barrels to tons or *vice versa*, agencies also include slightly different items in their oil and gas quantities. Figure 4.5 presents the oil and gas production and consumption quantities in 2011 reported by five well-known organizations.

Figure 4.5 Oil and gas production and consumption in 2011



OPEC does not report gas consumption. Sources: BP 2012, BGR 2012, EIA 2013a, IEA 2013a, OPEC 2012a

The oil production quantities reported in the Statistical Review of the British Petroleum (BP) include conventional and unconventional crude oils and NGLs but exclude GTLs, CTLs and biofuels. The EIA's and IEA's production numbers include also GTLs, CTLs and biofuels. The BGR defines oil production as including the production of liquid hydrocarbons. Presumably, the OPEC's oil production quantities do not include NGLs and other liquids. The oil consumption quantities of the BP, EIA and IEA include all inland demand (e.g. also GTLs, CTLs and biofuels) and international bunkers, i.e., the quantities used by international marine and aircraft. The OPEC's consumption quantities include inland demand including refinery fuels and NGLs. The BGR does not define oil demand or consumption in precise terms.

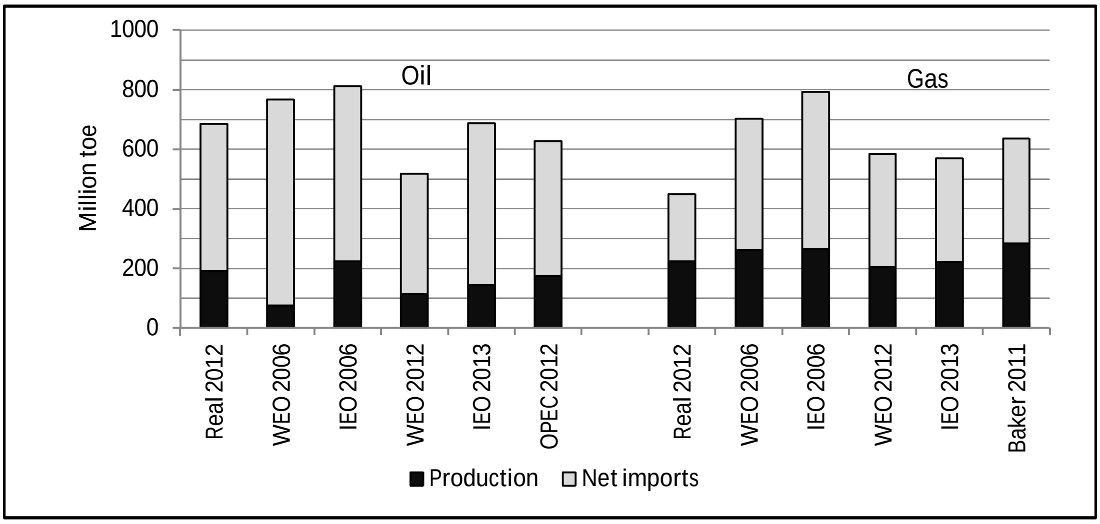
The gas production quantities refer to marketable production, i.e., the quantities flared or reinjected to oil fields or used for liquids production are not included in quantities. Gas consumption quantities are the deliveries of marketable gas, including consumption stemming from gas extraction, pipeline systems and gas processing.

Some information agencies such as the IEA (International Energy Agency), the EIA (Energy Information Administration) and the OPEC (Organization of the Petroleum Exporting Countries) develop and publish supply and demand scenarios extending 20-30 years into the future. Thus, to a certain extent and with many reservations, the assessment of future oil and gas production, consumption and export potential is possible.

In scenario analysis, alternative future projections are created by making assumptions about the development of key factors that are thought to affect energy supply and demand. These assumed circumstances are then analyzed quantitatively using energy models which produce quantitative demand, supply and other, e.g., environmental information (Siddiqui et al. 2006). Key factors include, but are not limited to, population growth, economic growth, future energy prices, assumptions about government energy policies and technological developments affecting energy supply and consumption. Oil and gas demand is a consequence of the development of the key factors and supply depends on demand and supply potential. Supply potential is based on recoverable resources, production profiles and decline rates of petroleum fields, fuel prices and finding, development and production costs (IEA 2011c). Usually, agencies prepare reference, i.e., business as usual scenarios and alternative scenarios based on different assumptions of key factors. These alternative scenarios help to analyze the consequences of the changes in the values of key factors.

Figure 4.6 presents OECD Europe's oil and gas demand and production projections in 2030 according to six different scenarios. Also, the actual demand and production in 2012 is presented. Except the WEO 2012 scenario, all the scenarios are reference scenarios. WEO 2012 is the new policies scenario which takes into account certain energy-related policies and plans announced by countries. In other words, none of the scenarios is based on extreme assumptions about the values of key factors.

Figure 4.6 Europe's oil and gas demand and production in 2030



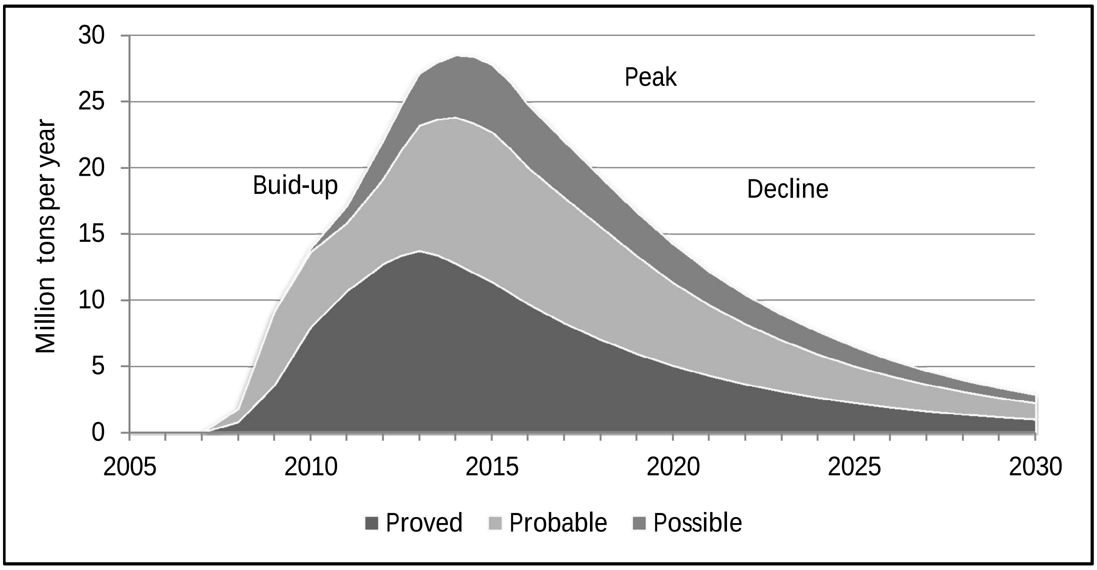
Demand = Production + Net imports. WEO 2006 and 2012 by the International Energy Agency in 2006 and 2012, IEO 2006 and 2013 by the U.S. Energy Information Administration in 2006 and 2013, OPEC 2012 by the Organization of the Petroleum Exporting Countries in 2012, Baker 2011 by the James A. Baker III Institute for Public Policy Rice University in 2011. Source data: BP 2013a, EIA 2006, EIA 2013a, EIA 2013g, IEA 2006, IEA 2012a, OPEC 2012b, Medlock et al. 2011.

From figure 4.6 it can be deduced that in the 2012 WEO and 2013 IEO scenarios, the oil and gas demand of the OECD Europe is revised downwards compared to the year 2006. Also, it can be seen that scenarios from different origins differ from each other. Which scenario is right is not the point because only time will tell which one was the best estimate. The main question is: What information is useful today for policy and investment decisions having long lasting effects in the future?

Although energy models and scenarios are important tools for foresight and for aiding decision making, they and future projections are only as good as the underlying assumptions and data. Scenarios will never be able to predict the future perfectly. There is a long list of reasons for that. Suffice to mention that the resources data and the future are inherently full of uncertainties and no model can capture all the factors of the underlying complex reality and human behavior. Therefore scenario analysis must be supplemented with judgment and other off-model information (Karbuz et al. 2009) or as the EIA advises: scenarios should serve as a supplement to, not a substitute for, a complete and focused analysis of public policy initiatives (EIA 2011b).

Two examples emphasizing the importance and uncertainties of a field's production profile conclude this section. According to the audit results as of December 31, 2005, the Vankor oil and condensate field owned by Russian oil major Rosneft contained the following PRMS oil reserves: Proved 135, probable 133 and possible 55 million tons, totaling 324 million tons. Three different production profiles based on the proved, probable and possible reserves were estimated for the years 2006-2030 using the appraisal and audit information (figure 4.7) (Rosneft 2006).

Figure 4.7 Three production projections of an oil field



Source data: Rosneft 2006

This example sheds light on three important things related to petroleum resources, production and the value of petroleum resources. The first important thing is that a petroleum field theoretically goes through a build-up phase, during which production rises as new wells are brought into production, a peak production phase, and a decline phase, during which production gradually falls with reservoir pressure. Peak production is the highest level of production recorded over a single year and the often used term "plateau production" means the phase when annual production is more than 85% of peak production (IEA 2008). Looking only at reserves quantities tells only the half of the truth. Equally important is the phase of a field's, company's or country's resources utilization. Is production increasing, plateau or declining?

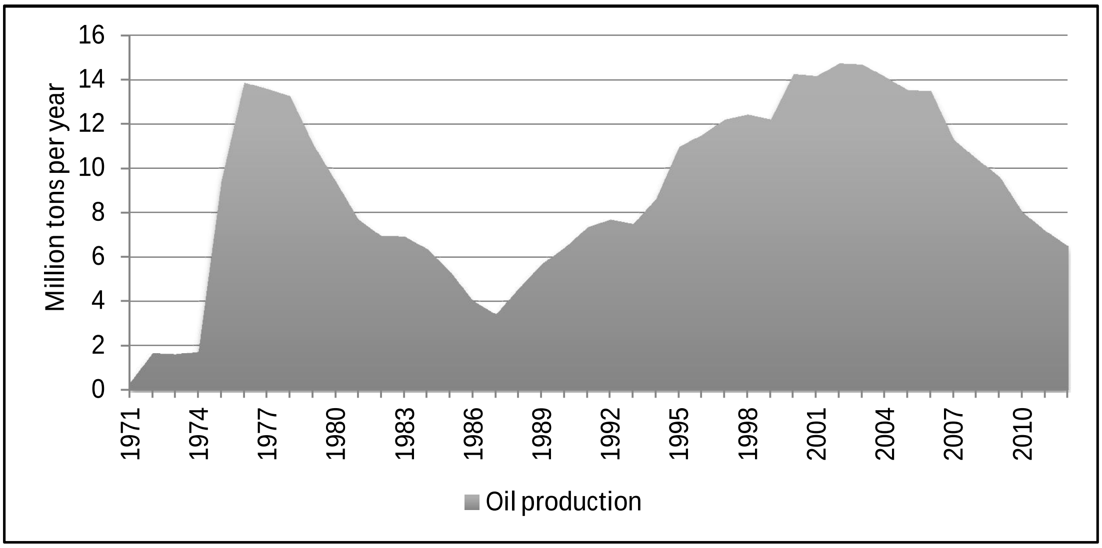
Second, this example gives a reason to write a few words about the Peak Oil theory. Colin Campbell defines the term "peak oil" as follows: "*The term Peak Oil refers the maximum rate of the production of oil in any area under consideration, recognizing that it is a finite natural resource, subject to depletion.*" The maximum rate of production in a certain area is reached when production from new fields is not enough to offset declining production from old fields. If this occurs on a global scale, global oil production starts to decrease and global peak oil has been reached. The idea of peak oil originates from the work of M. King Hubbert, a geologist employed by Shell, who predicted in 1956 the peak of USA's oil production in 1970. His method and the bell-shaped production profile (like that in figure 4.7) are referred to as the Hubbert model and the Hubbert curve (Robelius 2007). The peak oil theory has been criticized using both economic and technological arguments. Price mechanisms, supply-demand equilibrium, advancing technology and accrued new data shift the peak forward (Götz 2007). For example, the oil production in the USA is currently increasing (BP 2013a). Thus, the discussion and research concerning peak oil is focused on the following problem: Is the global or regional petroleum production ascending, plateau or descending, and when was the peak reached or is expected to be reached?

Third, the production projections and relevant price and cost data can be used to calculate the net present value of a petroleum project or a company's petroleum reserves. Most companies present in their financial statements a calculation "The standardized measure of discounted future net cash flows". Estimated future cash inflows from production are computed based on the production projection of proved reserves and the price of oil during the accounting period and cash outflows are based on company's knowledge and estimates of costs and taxes. Future net cash flows are calculated using a 10% discount factor. However, companies disclaim the applicability of these calculations for investment decisions. Indeed, a better estimate of the present value of reserves should also take into account, *inter alia,* the recovery of reserves not presently classified as proved, anticipated future changes in prices and costs and a discount factor more representative of the time value of money, and the risks inherent in reserves estimates (e.g. Lukoil 2013a, Rosneft 2013a). According to the audit results as of December 31, 2010 the total PRMS oil reserves (proved, probable and possible) of the Vankor field were 480 million tons, i.e., 48 % more than five years earlier (Rosneft 2011).

In practice, fields rarely follow a smooth, predictable production path. Commercial and policy considerations and the type of oil and/or gas affect how a field is developed and reservoirs behave in different ways at different stages of depletion for geological and technical reasons (IEA 2008). E.g. the production profiles of unconventional oil and gas fields differ significantly from the Hubbert curve (EIA 2012a). Figure 4.8 presents the oil production history of the Ekofisk field located in the southern part of the North Sea.

Ekofisk is a conventional oil field and was originally developed by pressure depletion and had an expected recovery factor of 17 per cent. Since then, limited gas injection and comprehensive water injection have contributed to a substantial increase in oil recovery. Large-scale water injection started in 1987, and in subsequent years the water injection area has been extended in several phases. Experience has proven that water displacement of the oil is more effective than expected, and the expected recovery factor for Ekofisk is now approximately 50 per cent (NPD 2013).

Figure 4.8 Oil production history of Ekofisk field



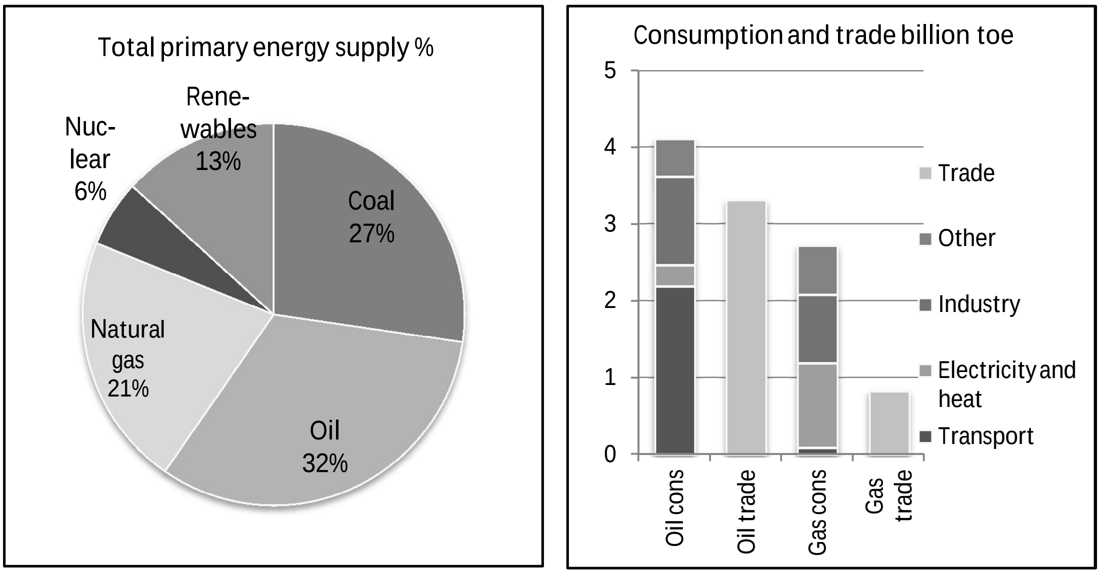
Source data: NPD (Norwegian Petroleum Directorate) 2013

Besides the geological uncertainty, the uncertainties of resources and reserves estimates and future production volumes originate from the uncertainties of future petroleum prices, future exploration, development and production costs, technological development and changes in regulation. Different reserves and resources assessments are often based on different definitions and source data and are open to interpretation. Indeed, total recoverable resources in an oil and gas field will not be known for certain until after the field has been abandoned and even then, it is often not known how much of the resources remain in the subsoil.

4.4 Market forces and price formation

Figure 4.9 below presents some facts about the world's oil and gas markets. In 2010, the share of oil was 32% and the share of gas was 21% of the world's total primary energy supply. It is expected that the share of gas will increase and the share of oil will decrease a few percent in the future (IEA 2012a). In 2010, about 53% of the world's oil was consumed in transportation, while 7% was used for electricity and heat generation, 28% in industry as a feedstock and for steam and heat generation and 12% for other purposes. The corresponding figures for natural gas are: 3% in transportation, 40% for electricity and heat generation, 33% in industry and 24% for other purposes (IEA 2012b). Measured in equivalent units, natural gas consumption was 66% of oil consumption and international natural gas trade was 25% of international oil trade in 2010.

Figure 4.9 World TPES, consumption and trade of oil and gas in 2010



TPES is total primary energy supply. Oil and gas consumption and trade are presented in equivalent units, ton of oil equivalent, i.e., according to energy content. Trade is measured with total imports. Source data: IEA 2012b.

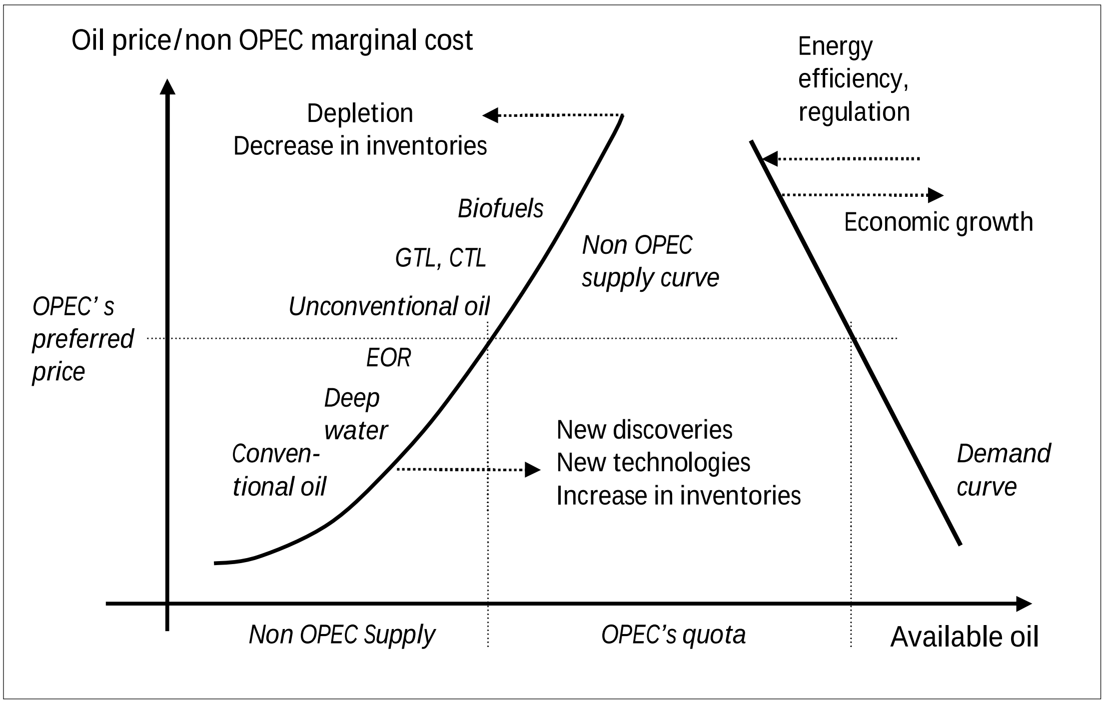
4.4.1 Oil markets

Oil is a global commodity whose trade and price formation take place on physical and financial markets. Physical deliveries of oil are organized either on the spot market or using long-term contracts. Prices of different oils in spot deliveries and long-term contracts are usually linked with a discount or premium to the spot prices of benchmark oils like West Texas Intermediate (WTI), Dated Brent and Dubai-Oman. Financial markets include forward, swap, futures, and options markets. Spot and some financial contracts, e.g., forwards, swaps and options, are traded bilaterally in the over the counter (OTC) markets while futures and some options are traded on regulated exchanges such as ICE and CME Group.

The benchmark oils are an important part of the oil pricing system and are used by oil companies and traders to price cargoes under long-term or spot contracts, by exchanges for the settlement of financial contracts and by governments for taxation purposes. Assessments of benchmark oil prices are made by oil price reporting agencies (PRAs) such as Platts and Argus (Fattouh 2011).

Physical demand for oil is a function of a wide range of factors, including economic growth, population growth, demand-side technology, relative prices of competing energies, taxation policies, and of course, the price of oil itself. Besides demand, the fundamental drivers of oil supply and prices are OPEC’s behavior, inventory levels, spare capacity and technological and geological progress. Figure 4.10 presents the main factors influencing oil demand, supply and price.

Figure 4.10 Drivers of oil demand and supply



The notional demand curve depicts total demand while the supply curve depicts non-OPEC supply. Dashed arrows depict different possible movements of demand and supply curves for different reasons. Growing possibilities to use alternative fuels diminish the slope of the demand curve. Modified from Fattouh 2007 and IEA 2008.

Economic growth influences through the increasing demand of refined products and shifts the demand curve outwards. Tightening regulation, e.g., via taxation, and technologies increasing energy efficiency shift the demand curve inwards. Increasing possibilities to use alternative fuels make the demand curve more elastic, i.e., its slope diminishes (Energy Charter 2007, Fattouh 2007).

On the supply side it is useful to distinguish between OPEC and non-OPEC supply because of the different behavior and resources of these suppliers. OPEC countries controlled 69% of the world's oil and 48% of the world's gas proved reserves and produced 43% and 18% of the world's oil and gas in 2011, respectively (BGR 2012). In addition, the OPEC Middle East countries' oil and gas exploration and production costs are low compared to other regions in the world (IEA 2011b, MIT 2011).

New discoveries and more effective production technologies which enable mobilizing of more complex resources like arctic, deep water and unconventional resources shift the non-OPEC supply curve outwards. However, all these are commercially viable only at high enough oil prices. The depletion of resources works in the opposite direction shifting non-OPEC supply curve inwards.

The oil price level is related to the OPEC's behavior. By altering production quotas the OPEC is bound to have an influence on oil prices. The OPEC's long-term strategy (LTS) states: "*The LTS sets objectives in relation to the long-term petroleum revenues of OPEC Member Countries; fair and stable prices; the role of oil in meeting future energy demand; OPEC's share of world oil supply; the stability of the world oil market; the secu-*

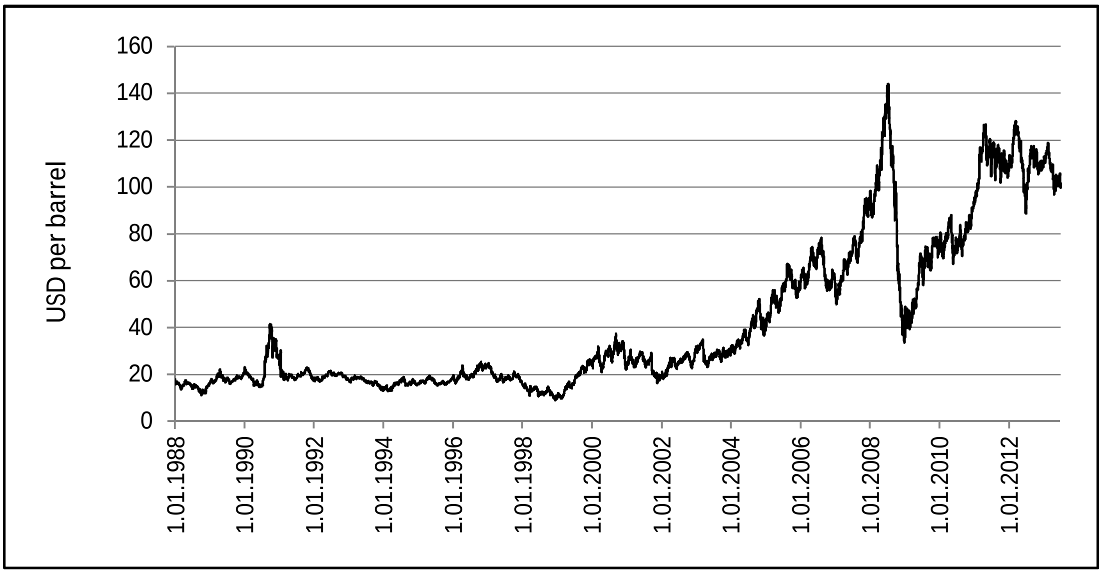
rity of a regular supply to consumers; the security of world oil demand for producers; and in seeking to secure and enhance the collective interests of Member Countries in global negotiations and future multilateral agreements“ (OPEC 2010).

The above is interpreted as follows: OPEC tries to set the production quotas so that the long-term oil price, on the one hand, encourages economic growth and consequent oil demand but does not encourage excessive development of alternative fuels and technologies and, on the other hand, guarantees sufficient long-term incomes for the OPEC nations’ welfare. According to this concept OPEC sets production quotas based on the markets’ call on OPEC’s supply and OPEC’s preferred oil price and the oil price is determined by the marginal cost of the last produced non-OPEC barrel in each demand – supply position.

However, OPEC has on many occasions failed to defend the oil price due to OPEC’s internal friction, imperfect information and uncertainty about the future demand. Also, oil prices have, at least until recently, behaved cyclically. The rise in oil price stimulates investments in exploration and production and also slows the growth of oil demand. New capacity forces oil prices down, which in turn stimulates demand and increases the price of oil (Fattouh 2007).

The above model does not explain the recent sharp swings in oil prices (figure 4.11). In explaining the rises in oil prices since 2002, analysts have pointed to a wide list of factors including strong demand in China and India, lack of spare capacity, distributional bottlenecks, OPEC’s supply restrictions, cost inflation, political instability in many producing regions, and the increasing role of speculators and traders in price formation (e.g. BGR 2009, Energy Charter 2011).

Figure 4.11 Brent spot prices since 01.01.1988



The 2008 economic crisis is clearly seen in the figure. Source data: EIA 2013b.

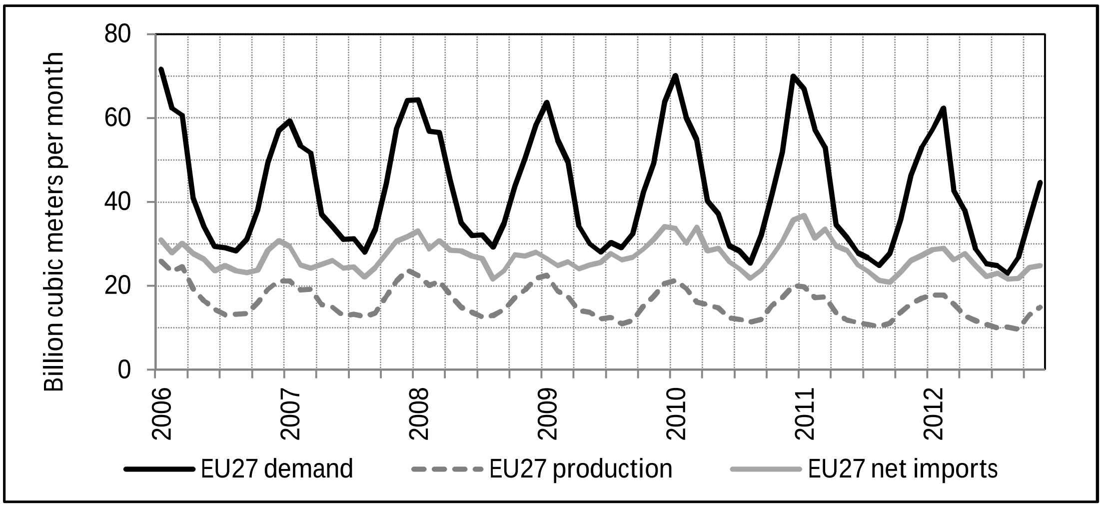
The recent high and volatile oil prices are also explained by the dual nature of oil as a physical commodity and as a financial asset. As a physical commodity, the price of oil is influenced by current market fundamentals, such as the supply-demand balance, the level of inventories and the availability of spare capacity. As a financial asset, the price of oil is influenced by expectations of oil market fundamentals and macroeconomic news that influence the attractiveness of oil as an investment object in market players' hedging and speculating operations (Fattouh 2010).

According to OPEC, the development of a spot market for crude oil and oil products historically led to increased volatility. This, in turn, increased the need for financial instruments to hedge against the resulting price risk. Combined with financial deregulation and the emergence of oil as a financial asset, the sharp increase in investment flows into the commodity derivatives markets further exacerbated oil price volatility (OPEC 2012b).

4.4.2 Natural gas markets

Natural gas demand depends on economic growth, the competitiveness of gas compared to other fuels, environmental policies and technological developments favoring gas or other fuels, the proximity of gas resources and transport infrastructure, weather conditions, political and geopolitical environments and of course the price of gas itself (IEA 2011a). Demand for natural gas is highly cyclical depending on the time of year and is highest during the coldest months of winter and lowest during the warmest months of summer. Peak loads in production and imports can be reduced by using gas storage facilities as figure 4.12 demonstrates.

Figure 4.12 EU 27 monthly gas demand, production and imports

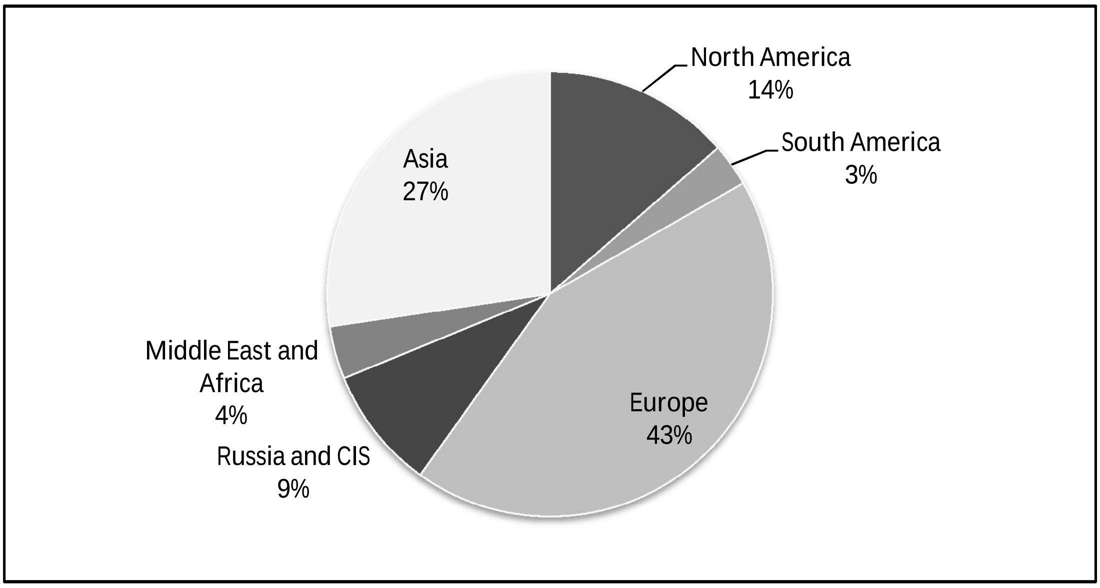


Source data: Eurostat 2013

The physical properties of gas require transportation along fixed pipelines or installing gas liquefying and regasification terminals and use of special vessels in transportation, which has contributed to the development of regional gas markets where different gas pricing patterns are used. Consequently, there is no world gas price.

In this study, the world's gas markets are the following: North America, South America, Europe, Russia and CIS, Middle East and Africa, and Asia. If the volume of international gas trade is measured by the total imports of the countries of each gas market, the Europe gas market is the largest, followed by Asia, North America and Russia and CIS (figure 4.13).

Figure 4.13 Distribution of world's gas imports in 2012

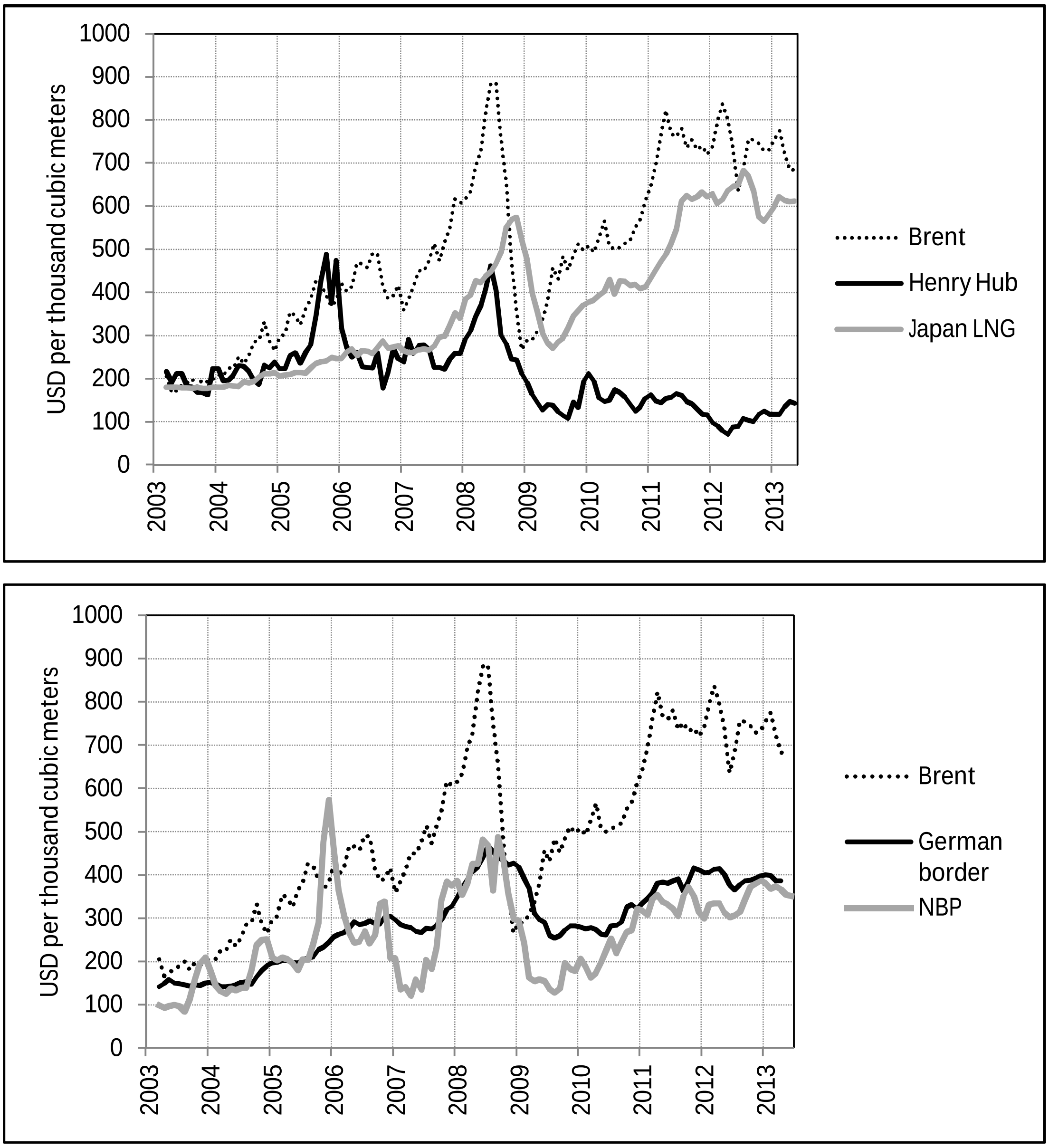


Main exporters to the countries of the main markets are the following: USA, Canada and Trinidad & Tobago to *North America*, Russia, Norway, Netherlands, Algeria, Qatar and Nigeria to *Europe*, Indonesia, Malaysia, Qatar and Australia to *Asia*, Russia, Turkmenistan, Uzbekistan and Kazakhstan to *Russia and CIS*. Source data: BP 2013a.

Gas pricing is based on regulation, bilateral arrangements, oil indexation or gas to gas competition. Gas is traded using negotiated physical bilateral contracts, physical and financial spot, forward, swap and option contracts in the OTC markets and financial futures and option contracts in the exchanges (Heather 2010). In gas-to-gas competition, pricing and trading take place in real or virtual locations called market hubs. According to the International Gas Union, 58% of the world's gas imports were based on oil indexed prices, 37% on gas-to-gas competition and 5% on different bilateral arrangements in 2012 (IGU 2013).

Because pipeline and LNG investments are capital intensive and have long lead times, bilateral long-term contracts and oil linked pricing have been dominating in international trade in many import dependent regions like Europe and Asia. Such markets where gas supply costs and gas demand determine prices have developed only in North America and the United Kingdom based on domestic gas production. The following four indicator prices show the price development in the largest gas markets: the Henry Hub in North America, Japan's average LNG import price in Asia, the German border price and the National Balancing Point (NBP) in Europe (Figure 4.14).

Figure 4.14 Gas prices in North America, Asia and Europe



Prices are monthly averages except the NBP price, which is the monthly closing price of the ICE NBPI index. The Japan LNG price is the average import price (CIF) from all origins. Brent oil price is in equivalent unit USD per thousand cubic meters. Source data: EIA 2013b, c, Japan Ministry of Finance 2013, BAFA 2013, ICE 2013.

In the *North America market*, the Henry Hub is a major pipeline junction in South Louisiana and it is the centerpiece of the North American gas pricing system. Spot and futures prices set at the Henry Hub are generally seen as the primary prices in the North America market (Energy Charter 2009). Gas prices are based on free gas-to-gas competition and import and wholesale prices fluctuate in response to short-term shifts in supply and demand. Gas-to-gas competition does not mean that competing fuel prices, like oil or coal, play no role in price determination. Both consumers and suppliers react to price differentials by increasing or decreasing gas consumption or supply, which affect gas prices.

In the *European market*, the German border price is the average price of pipeline gas from Russian, Dutch, Norwegian, and other origins (BAFA 2013) and is used as an indicator of pipeline import prices in continental Europe. In continental Europe, approximately 50% of the gas is bought under long-term oil indexed take or pay contracts (Market Observatory 2013a). Pricing in the United Kingdom is based on gas-to gas-competition and a virtual pricing point, the National Balancing Point (NBP). It, like the Henry Hub, is the reference point for gas commodity and financial trading (Energy Charter 2009). Gas prices in other European hubs have approximately followed NBP prices (Market Observatory 2013b).

The idea behind long-term take or pay contracts is to justify and secure the high investments of gas transportation and guarantee the competitiveness of gas against other fuels. The duration of these contracts is often 20 – 25 years (Energy Charter 2007). The supplier has a long-term obligation to provide defined volumes and the buyer an obligation to pay specified minimum volumes irrespective of whether the buyer uses the gas or not. The gas price at the consumer end is linked to the prices and price movements of competing fuels like different oil products. The price at the border of the buyer's country is calculated by deducting the costs of transportation, storing, distribution and marketing in the buyer's country. Gas prices are adjusted periodically, using average prices of competing fuels over a period of six to nine months to reduce price volatility (IEA 2009).

The following example (Gas contract Timoshenko-Putin, Ukrainskaya Pravda 2009) illustrates the price formula and concept:

(4.1) $P_m = P_0 \times (0.5 \times G/G_0 + 0.5 \times M/M_0)$

The gas price in the recalculation month (m) P_m is a function of the negotiated base price P_0, base prices of competing fuels, in this case light fuel oil (G_0) and heavy fuel oil (M_0) and current prices of light fuel oil (G) and heavy fuel oil (M). The base price P_0 is a result of negotiations and is based on the replacement value of competing fuels, transport and distribution costs and different marketing factors. Base prices of competing fuels (G_0 and M_0) are average prices over the last nine months before concluding the contract and current prices (G and M) are average prices over the last nine months before the recalculation month. Gas price Pm is calculated quarterly. Because the prices of competing fuels are based on the last nine months' price history, the price of gas is less volatile than oil prices and lag oil price movements.

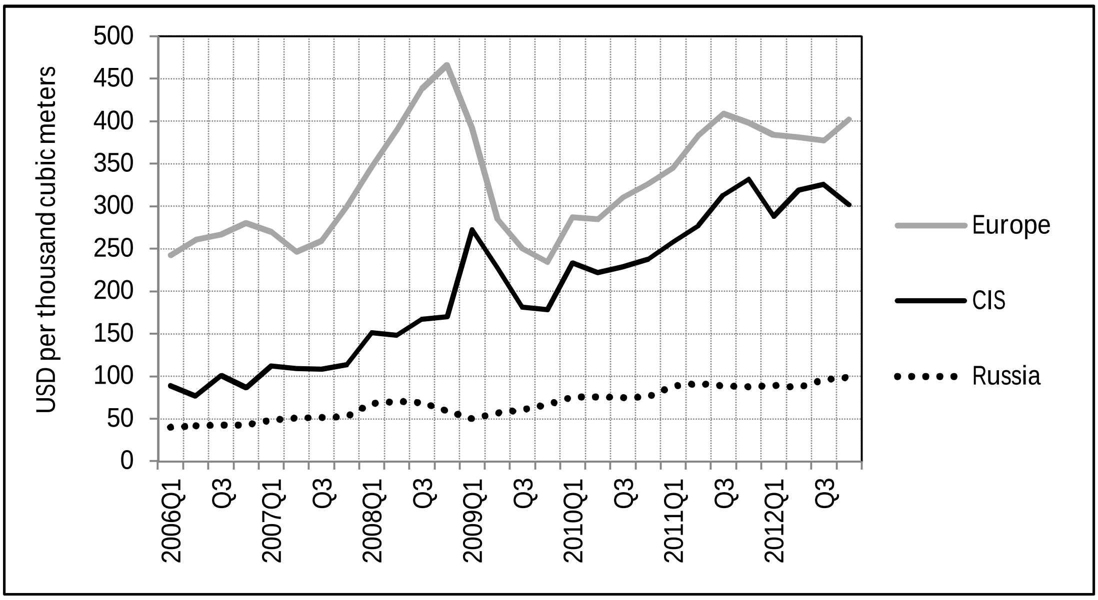
The structure of pricing formula varies between different contracts. For example, in the import contracts of the EU countries, oil and oil products dominate in the basket of competing fuels, but also inflation, coal prices, reference gas prices, electricity prices, and other fuel prices are used in some contracts (EU 2007).

In the *Asian market* the Japanese LNG import contract prices are indexed to the prices of crude oils imported to Japan. The average Japanese LNG import price is used as a proxy of the import prices in *the Asian market* because Japan is the biggest gas importer of the region and the pricing principles of Japan have been adopted by many other important gas importers of the region like South Korea and Taiwan. In North East Asia, domestic wholesale prices are either oil-linked or regulated (Miyamoto *et al.* 2009). Gas prices in China are under the control of the government and are low compared to the prices of imported gas (Henderson 2011).

As the previous figure 4.14 shows, the price behavior is different in North America, Asia, United Kingdom and continental Europe. These regions differ with respect to sources of gas supply, their reliance on contracts and the extent to which they have liberalized their gas markets. Since the 2008 economic crisis, prices in North America have been low because of increasing domestic unconventional gas production and relatively low demand. In continental Europe and Asia prices have been driven, though not completely, by much higher oil prices. The U.K. prices fluctuate depending on the price differential and gas flows between continental Europe and the United Kingdom.

In the Russian and CIS market, the gas delivery contracts between Russia and other CIS countries were earlier based on different barter and transit arrangements and the price of gas was significantly lower than the export price to Europe. With certain exceptions, Gazprom has since 2005 pursued a policy involving transition to similar pricing with the CIS countries as is used with the European countries. Also, in Russia's import contracts from the Caspian Region, the gas price is determined based on the prices in the European market (Gazprom 2013b). Most of the gas wholesale and consumer prices are regulated in Russia and other CIS countries (IEA 2009). Figure 4.15 presents Gazprom's sales prices to Europe, the CIS countries and regulated Russian market.

Figure 4.15 Gazprom's sales prices to different markets



Prices are quarterly averages. Russia's domestic prices are defined in Russian rubles. The USD Russian domestic prices are calculated using the average quarterly USD/Ruble exchange rate. European and CIS prices include custom duties. Russia prices are net of VAT. Source data: Gazprom 2013a, Bank of Russia 2013.

Many countries of *the Middle East and African market* are important gas exporters but the domestic gas prices in all gas producing countries of the region are substantially below the economic cost of gas supply (Darbouche 2012). Gas pricing in *the South American market* is diverse varying from market-based to social-based regulated pricing (IGU 2013).

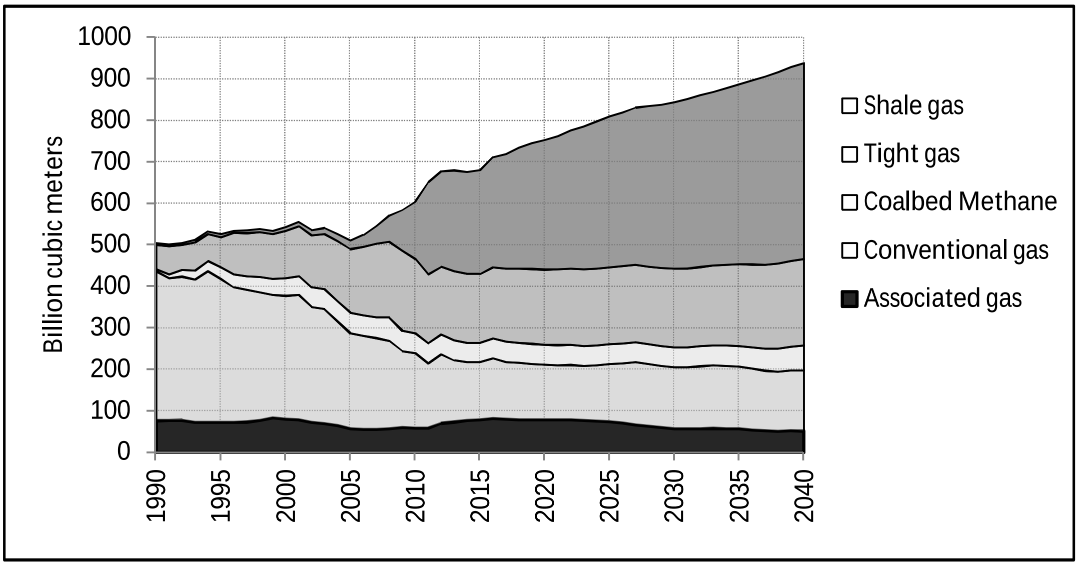
4.4.3 Evolution of oil and gas markets

The goal of the liberalization of natural gas markets is to let gas-to-gas competition set prices. Free competition would drive equilibrium prices to the long-run marginal costs of the supply just necessary to meet demand (Energy Charter 2009). Many observers expect that gas will become a global commodity with a global price like oil. As the previous section shows, the international gas markets depart substantially from the competitive ideal. However, certain recent developments have raised expectations of the change in gas trading and pricing. The four major topics presented in many recent European and American reports are the following:

First, oil-linked gas prices are outdated because gas competes more and more against electricity in industrial, commercial and residential sectors and against coal, nuclear power and renewable energy in electricity generation (IEA 2009).

Second, shale gas production in the USA has increased considerably due to advances in horizontal drilling and hydraulic fracturing. This trend is expected to continue. The 2013 reference scenario of the EIA presented in figure 4.16 expects the USA's gas production to increase 44% between 2011 and 2040, which decreases gas imports to the USA and changes the USA into a LNG exporter in the near future. The USA's success has encouraged exploration of shale gas in Europe, China, India, Australia, and elsewhere.

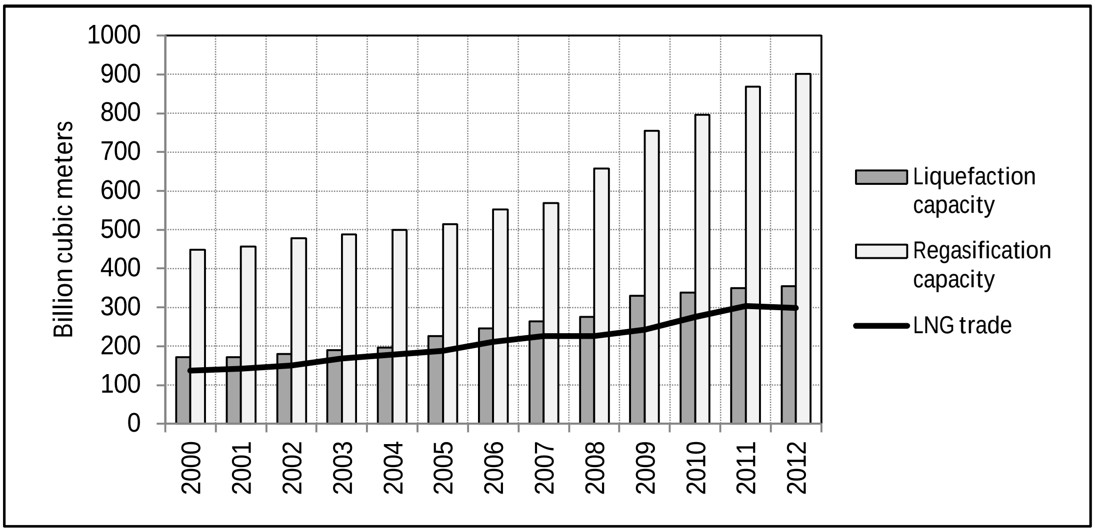
Figure 4.16 U.S. gas production history and projections



Source data: EIA 2012b

Third, the world's LNG liquefaction and regasification capacities and LNG trade have increased significantly in recent years (Figure 4.17) and are expected to increase further. According to the IEA, the capacity increase may be 20% by 2015 and 45% by 2020 (IEA 2011a). According to the EU's Market Observatory of Energy, major European gas importers have managed to get concessions from their suppliers to account for the differences between oil-linked and LNG spot prices (Market Observatory 2013a).

Figure 4.17 World LNG capacity and trade

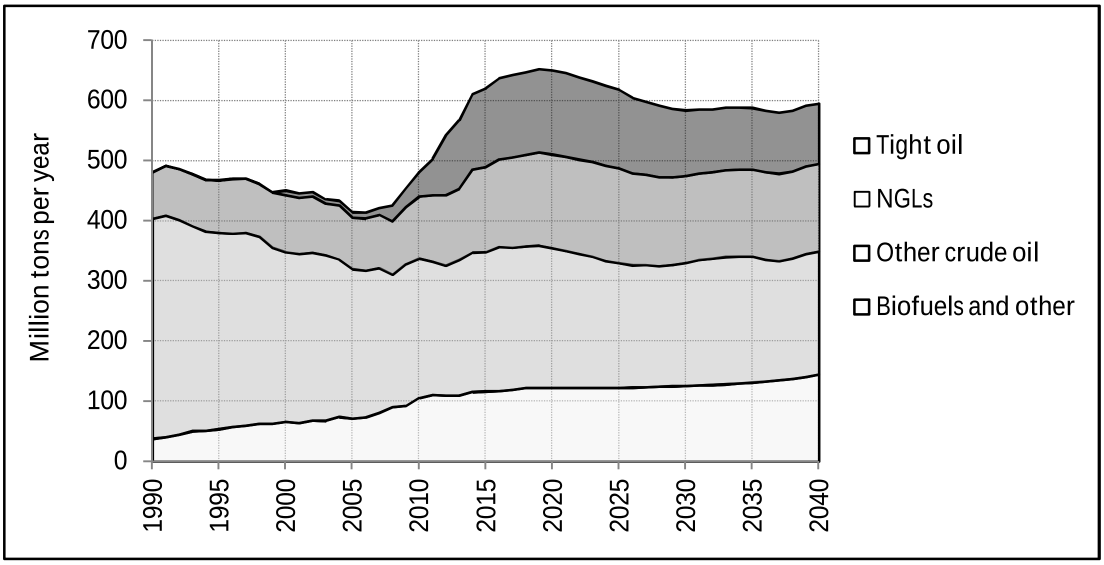


Source data: BP 2012, 2013a, GIIGNL 2011 and 2012, 2013.

Fourth, increasing shale gas production in the USA and other countries and increasing LNG trade will enhance competition in gas trade, weaken the oil link of gas pricing, moderate gas prices and have geopolitical effects. The share of Russian and Middle Eastern gas in the Europe and Asia markets will diminish. This will diminish the political bargaining power of Russia and certain Middle Eastern countries with respect to gas importing countries in Europe and Asia (Medlock et al. 2011).

Also, the USA's tight oil production has increased significantly in recent years and is expected to increase further. For example, the 2013 reference scenario of the EIA presented in figure 4.18 expects significant increases in the USA's tight oil and NGL production.

Figure 4.18 U.S. oil production history and projections



Source data: EIA 2013d

Many energy market experts expect that increasing unconventional oil production in North America, i.e., tight oil in the USA and oil sands in Canada and tight oil resources in other parts of the world will increase competition, bring down oil prices and, like shale gas, limit the market and political power of major oil exporters such as Russia, Saudi Arabia and Venezuela (e.g. Vihma 2013).

In the USA the production of shale gas and tight oil are intertwined technically, geologically and economically. The same technologies, horizontal drilling and hydraulic fracturing, are used in both oil and gas production. Gas deposits include varying amounts of natural gas liquids, NGLs, and oil deposits include varying amounts of associated gas which affect gas and oil production volumes (figures 4.16 and 4.18). Because gas prices have recently been low in the USA, many producers improve returns by producing wetter gas and consequent natural gas liquids or target deposits containing predominantly oil.

The development of shale gas and tight oil production in the USA has been convincing. Gas production has steadily increased since 2005, and crude oil production since 2008 and tight oil and shale gas resources have revolutionized the USA's oil and gas production, providing 29 percent of the USA's crude oil production and 40 percent of the USA's gas production in 2012 (EIA 2013e). Gas prices have been low since 2008 and well-known information agencies such as the IEA and EIA forecast significant growth in shale gas and tight oil production (EIA 2013d, IEA 2013b).

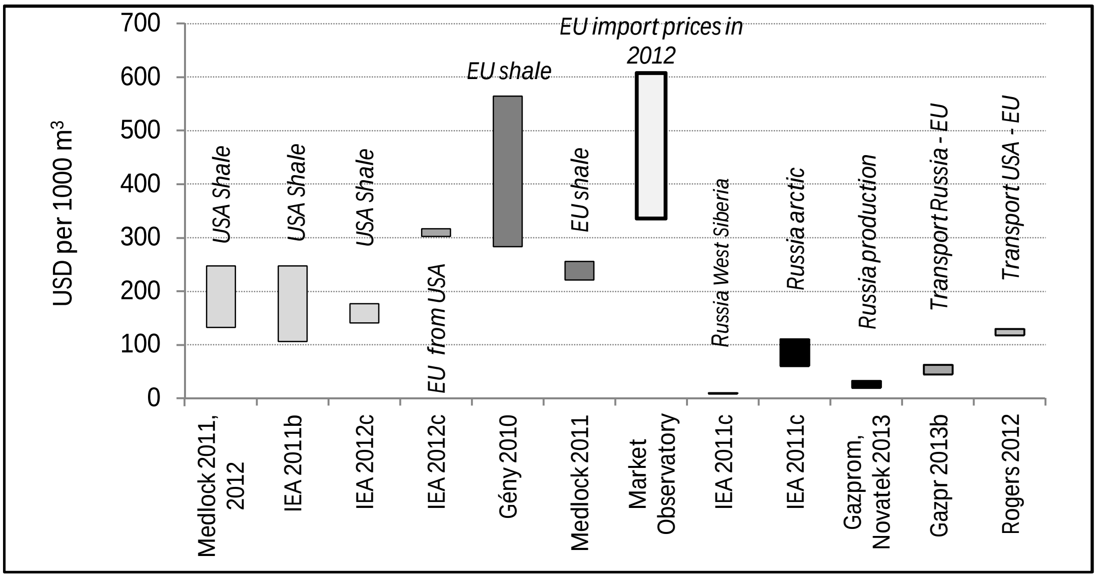
Nevertheless, the sustained growth of shale gas and/or tight oil production is not a certainty. It must first be remembered that the reported shale gas and tight oil resources quantities are technically recoverable resources, not proved reserves which can be extracted economically from known accumulations at today's prices using today's technology. In 2012, proved shale gas and oil reserves were reported only in the USA (BGR 2012).

The economic recoverability of oil and gas depends on the quantity of resources, the finding, development and production costs, the volumes produced, prices, and above-the-ground factors. Key positive above-the-ground factors in the North America that may not apply in other parts of the world include private ownership of subsurface rights, availability of many skilled independent operators and suitable technology, existing infrastructure, availability of water resources for hydraulic fracturing and favorable environmental regulations (EIA 2013e, Geny 2010). Thus, besides the above-ground factors, the uncertainty of economically recoverable quantities, production costs, prices of oil and gas and competing fuels, and characteristics of regional markets may undermine the expectations of cheap and widely available fuels. The four often mentioned arguments against the shale gas, LNG and tight oil revolution are the following.

First, the economically recoverable quantities of shale gas and tight oil are uncertain because oil and gas wells are only a few years old, and their long-term productivity is untested. Most of current production is largely confined to deposits that have the highest known production rates and costs are bound to rise as developers move away from high performance wells into more problematic areas (EIA 2013d). The lack of information is much greater in new production regions like Europe (BGR 2012).

Second, the estimates of shale gas and tight oil finding, development and production costs vary considerably and are difficult to interpret. Figure 4.19 presents estimates of gas production costs in the USA, Europe and Russia and the EU's gas import prices in 2012.

Figure 4.19 Gas production cost estimates and EU import prices USD/1000 m³



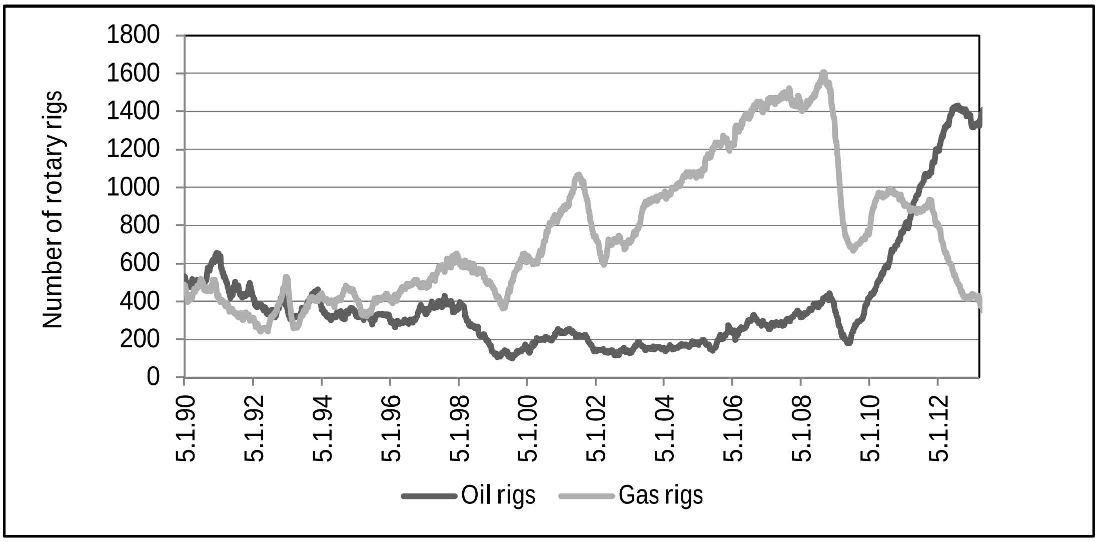
USA shale gas production costs mean the breakeven gas price which covers capital and operating costs. EU from USA is the sum of breakeven gas price and LNG costs from the USA to Europe. EU shale means capital and operating costs of shale gas production in Europe. EU import prices mean the EU's realized gas import price range in 2012. Russia West Siberia and Arctic include capital and operating costs. It is unclear whether production taxes are included. Russian production includes operating costs, production taxes and capital costs. Transport Russia – EU is the range of transport costs from West Siberia and Yamal. Transport USA – EU is the combined LNG liquefaction, transport and regasification cost. Source data: Gazprom 2013a, Gény 2010, IEA 2011a, IEA 2011b, IEA 2012a, Market Observatory 2013b, Medlock et al. 2011, Medlock 2012, Novatek 2013a, Rogers 2012.

As it can be seen, cost estimates from different sources vary considerably and the ranges of some estimates are large. One conclusion from figure 4.19 is that the competitiveness of shale gas in Europe is not yet clear, irrespective of whether the gas is imported from the USA or produced in Europe. In 2011, the IEA reported that the breakeven oil price for typical tight oil development is around 50 USD per barrel (IEA 2011b). However, it is also argued that the breakeven price is actually around 90 USD per barrel (Sen 2013).

Third, the gas production growth in the USA is in part a result of high oil prices, which improve the economics of gas deposits that have high concentrations of crude oil or natural gas liquids (EIA 2012a). In a low gas price environment companies begin to invest in other more profitable fuels thus decreasing gas supply. There are clear indications that the current price disparity between oil and gas in North America has shifted drilling from gas to oil. Figure 4.20 presents the development of the number of rotary oil and gas rigs actively drilling in the USA.

These rigs work on exploration or development wells and represent the activity level of new capacity development. From figure 4.20 it can be seen that the 2008 economic crisis and decreased oil and gas prices also decreased the number of oil and gas rigs. Since 2009 oil prices and oil rig count have considerably increased but gas prices and rig count have not. For example, the second largest gas producer in the USA, Chesapeake Energy, reports that CHK has responded to market signals and shifted to higher return liquid rich plays, and in 2013, 86% CHK's drilling and well completion capital expenditures are directed to liquids and 14% to dry gas (Chesapeake 2013).

Figure 4.20 U.S. oil and gas rig count since 1990



Source data: Baker Hughes 2013

Fourth, gas-to-gas competition does not necessarily guarantee low gas prices. It can drive gas prices higher than they would otherwise have been, due to strong regional or seasonal demand (IEA 2011a). Moreover, like oil, gas-to-gas competition may increase the influence of speculators on gas prices (Stern et al. 2011). Furthermore, from a buyer's point of view the essential thing is not the pricing mechanism but the price level compared to competing supplies or fuels.

Finally it should be remembered that although oil is a global commodity, the volatility of oil prices is high and the predictability of oil prices is low. Oil-linked gas prices have been less volatile than oil prices and spot gas prices substantially more volatile than oil prices (Alterman 2012). The long-run marginal cost of oil is well below the current market price of oil, generating significant economic rents to governments in taxes and oil companies in profits (IEA 2012a). Although shale gas production and LNG trade have increased, gas prices in the world have diverged rather than converged and the predictability of gas prices is low (figure 4.14). There is no guarantee that gas-to-gas competition would drive prices to long-run marginal costs.

The aim of the above discussion is not to argue that shale gas and tight oil, or more generally, unconventional gas and oil, have no future. The aim is to remind that there are many uncertainties related to unconventional production. According to the EIA, in the USA, the projections of future production inevitably reflect many uncertainties regarding to the actual level of resources available, the difficulty in extracting them, and the evolution of the technologies used to recover them (EIA 2013d). Compared to North America, in other parts of the world, much more information must be gained through drilling, production and technology experimentation to make more reliable production projections.

5 Benchmarking method

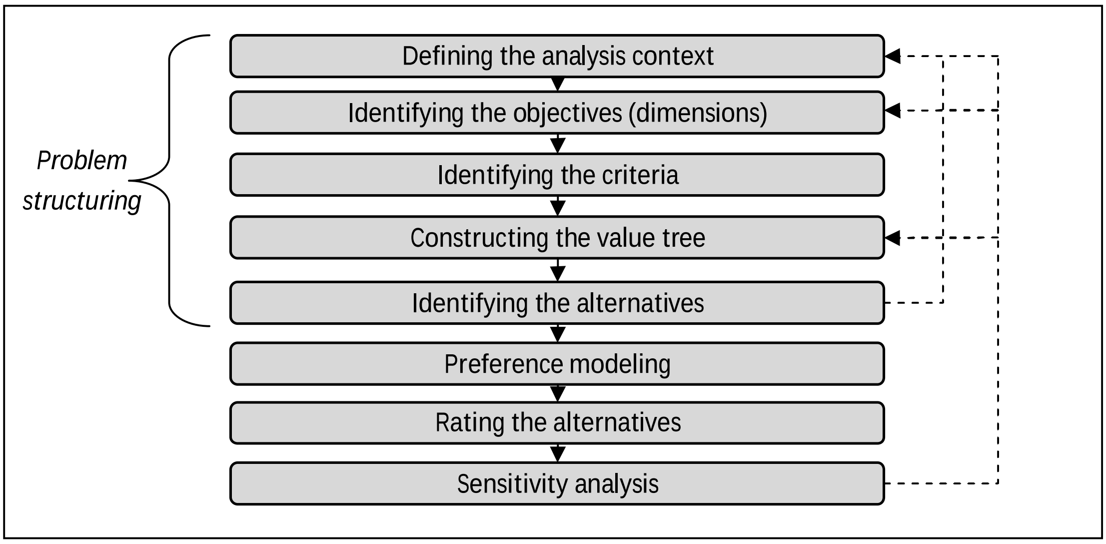
Because this study is multidimensional, the benchmarking method must enable the comparisons between different alternatives and between different assessment dimensions. It should also be such that the assessment results from different dimensions can be combined. Also, it must be easy to understand and use. The benchmarking method chosen for this analysis is based on value tree analysis.

5.1 Value tree analysis process

Value tree analysis is used in analyzing several alternatives under different criteria. An analyst or decision maker (DM) ranks the alternatives based on the quantitative assessment of a DM's preferences under each criterion and between different criteria. Figure 5.1 presents the value tree analysis process.

The main purpose of *problem structuring* is to create deep enough understanding of the problem and to create a framework for further quantitative analysis. Problem structuring as well as the analysis as a whole is often an iterative process.

Figure 5.1 Value tree analysis process



Modified from Beim et al. 2006, Belton et al. 2002, Clemen 1996, and HUT 2005

Analysis context refers to the setting in which the analysis is made (HUT 2005). In this case, the analysis context could include the purpose of this study, the objectives of this study, the intended audience of this study and the available information sources.

Objectives are the dimensions along which the analysis is done (French 1986). A noteworthy feature of different objectives is that they can conflict with each other in the sense that the improved achievement in one objective can only be accomplished at the expense of another. It is desirable that the set of objectives is: *essential*, so that each alternative influences each objective; *complete*, so that it covers all the important aspects of the problem; *measurable,* so that the achievement levels of objectives can be measured; *operational,* so that the required information can be gathered with a reasonable effort; *decomposable*, so that it is possible to assess one objective at a time;

nonredundant, so that the double counting of impacts can be avoided; *minimal*, so that the problem dimension is kept as small as possible; *understandable,* so that the objectives enable and facilitate communication between the stakeholders of the problem (modified from Keeney 1992).

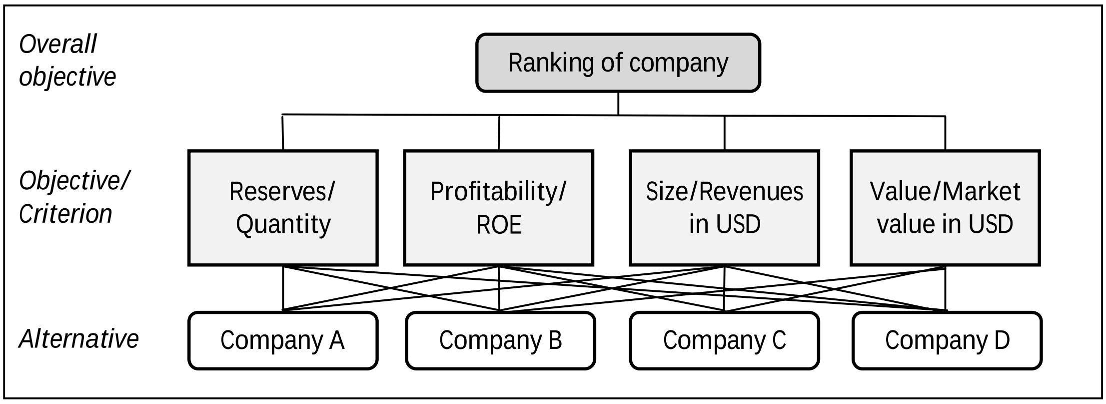
Criteria measure the achievement levels of objectives. The desirable properties of criteria are directly linked to the desirable properties of objectives. The criteria should be: *measurable,* so that they measure the objectives reflecting the value judgments that are essential; *operational,* so that they describe the actual achievement level of objectives and are value-relevant so that the appraiser's preferences can be attached to the different values of criteria; *understandable,* so that there is no ambiguity in describing achievement levels in terms of criteria and *vice versa* (Keeney 1992).

A *value tree* is the basis for the further quantitative analysis and presents the hierarchy of objectives and the interconnections between objectives and criteria. Figure 5.2 presents the key components of a value tree.

Alternatives are the subjects of assessment, like different companies in figure 5.2. The set of alternatives should be comprehensive, but not too large to manage, and overlapping alternatives should be avoided (Beim et al. 2006).

Preference modeling means the creation of a model representing the preferences of the DM. A preference model normally contains two primary components: preferences in terms of each individual criterion, i.e., criterion value functions describing the achievement level under each criterion, and an aggregated model, i.e., an aggregated value function which allows inter-criteria comparisons in order to combine preferences across criteria (Belton et al. 2002).

Figure 5.2 Fictitious value tree of company ranking



The alternatives (companies A, B, C and D) are rated in four dimensions: reserves, profitability, company size and company value using four criteria: reserves quantity, return on equity (ROE %), revenues in USD and the company's market value in USD, respectively. The ratings are combined to the overall rankings of the companies.

If the value tree and preference models are properly constructed, the *rating of alternatives* is straightforward: DM uses criteria, obtains estimates how alternatives perform under these criteria, converts actual performance estimates to values under each criterion and combines these values using the aggregated model in order to get an overall valuation of alternatives (Winterfeldt et al. 1986).

Sensitivity analysis is the objective examination of how changes in the input parameters of the model affect the output values of the model. The input parameters are the value functions and their parameters defined by the DM and the actual values of criteria. Sensitivity analysis will determine which, if any, of the input parameters have a critical influence on the overall valuation (Belton et al. 2002).

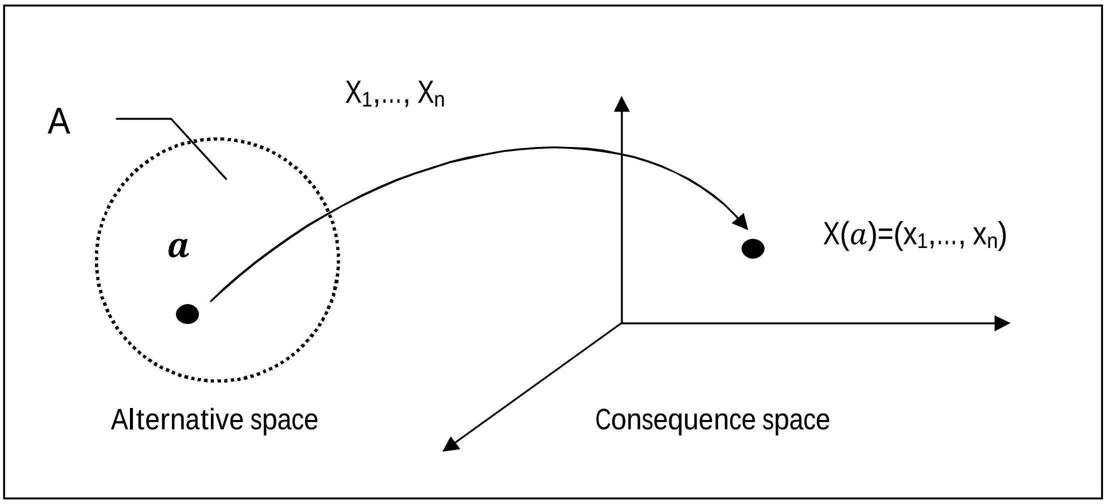
5.2 Value tree analysis, theory

Some concepts of decision theory are useful for constructing an assessment model of this analysis. Let a be a feasible alternative in the set of all feasible alternatives *A.* With each alternative a_j in A are associated *n* criteria X_i and a consequence $X(a)$ (formula 5.1).

(5.1) $X(a) = \left(X_1(a), \dots, X_n(a)\right) = (x_1, \dots, x_n)$

The consequence refers to the performance level of a certain alternative. The criteria $X_1, X_2, \dots, X_n$ create a mapping from the alternative space into the n-dimensional consequence space (Figure 5.3).

Figure 5.3 Mapping of alternatives to consequence space



Source: Keeney et al. 1993

DM's problem is to rank alternatives a_j in A according to his/her preferences. Thus, the aim is to specify a scalar-valued function V which assigns a number $V(X)$ to each consequence $X = (x_1, \dots, x_n)$ (formula 5.2).

(5.2) $V(x_1, \dots, x_n) \geq V(x_1', \dots, x_n') \Leftrightarrow (x_1, \dots, x_n) \gtrsim (x_1', \dots, x_n')$

The value $V(X)$ is greater than or equals ($\geq$) $V(X')$ if and only if ($\Leftrightarrow$) DM weakly prefers ($\gtrsim$) the consequence X to the consequence X', i.e., she/he holds X to be at least as good as X' (French 1986).

The value function of formula (5.2) is called an ordinal value function because it describes the preference order and only the preference order. It does not tell anything about the strength of the preferences. A scalar-valued function V is called a measurable value function when the following requirements are satisfied:

(5.3) $V(X_1) \geq V(X_2) \Leftrightarrow X_1 \gtrsim X_2$ and

(5.4) $V(X_1) - V(X_2) \geq V(X_3) - V(X_4) \Leftrightarrow (X_1 \leftarrow X_2) \gtrsim_e (X_3 \leftarrow X_4)$

Formulas 5.3 and 5.4 tell that the value difference of the consequences X_1 and X_2 is greater than or equals ($\geq$) the value difference of the consequences X_3 and X_4 if and only if ($\Leftrightarrow$) the exchange of the consequence X_2 to X_1 ($\leftarrow$) is at least as good as ($\gtrsim_e$) the exchange of the consequence X_4 to the consequence X_3 ($\leftarrow$). The measurable value function describes also the strength of preferences (French 1986).

The existence of the ordinal value function is based on four axioms related to the concept of weak preference order which is denoted by $a \gtrsim b$. These axioms, in turn, are based on the assumption that DM is a rational person. With certain additional axioms the existence of a measurable value function which also describes the strength of preferences can be guaranteed (for details and proofs see French 1986).

The following theorem is useful for defining a suitable value scale: A measurable value function is unique up to positive affine transformations, i.e., transformations of the form $\varphi(x) = \alpha x + \beta$ where $\alpha > 0$ (for details and proof see French 1986). Consequently, there is no absolute value scale.

The value function V can be decomposed in the following way:

(5.5) $V(x_1, x_2, \dots, x_n) = f[v_1(x_1), v_2(x_2), \dots, v_n(x_n)]$

The function $f(\cdot)$ is the aggregated value function and the functions $v_i(\cdot)$ are lowest level criterion value functions under each criterion X_i (Keeney et al. 1993).

The first step of preference modeling is the creation of criterion value functions $v_i(\cdot)$ which produce scores describing the performance levels of each alternative under each criterion. The range which is chosen for measuring the performance is an important factor. An often used choice is the actual range which is determined by the alternatives with the worst and best performance, but other ranges are also used. Once the range is established for each criterion there are a number of methods for eliciting values from the DM. Criterion scores are often scaled between 0 and 1, but other reference points can also be used. The important point is that all the subsequent analysis must be consistent with the chosen measurement ranges and value scales (Belton et al. 2002). An overview of methods for eliciting criterion value functions is presented, e.g., in HUT 2005.

The most widely used form of the aggregated value function $f(\cdot)$ is the additive model (5.6). It should be pointed out that the following notations slightly differ from those customary in the relevant literature. The aim is to shed light on the twofold nature of weighting coefficients, and also take into account certain special features of this analysis.

(5.6) $V_j(X) = \sum_{i=1}^{N} \mu_i \, v_i(x_i), \; i = 1, \dots, N$

$V_j(x)$ is the overall value of consequence X_j related to the alternative a_j, and $v_i(x_i)$ are the criterion value functions describing alternative a_j's performance under each criterion i. N is the number of lowest level criteria and μ_i are the weight coefficients reflecting the relative importance of each criterion i. The existence of an additive model requires that the criteria are mutually preferentially independent (Belton et al. 2002). Briefly defined, the preferential independence means that the preferences for specific outcomes of criterion X do not depend on the level of some other criterion Y (detailed presentation, see French 1986).

In formula (5.6) the most and least preferred achievement levels can be denoted by x_i^* and x_i^0 , respectively. Because the representation (5.6) is unique up to affine positive transformations, the scores of the worst achievement levels can be set equal to zero, i.e., $v_i(x_i^0) = 0$. It is customary to normalize the criterion value function so that the best criterion scores get a value equal to one and all criterion scores are multiplied by normalized criterion weights which add up to one. Formula (5.6) can be normalized through the following equalities (adapted from Gustafsson et al. 2001):

$$(5.7)\quad V(x) = \sum_{i=1}^{N} \mu_i v_i(x_i) = \sum_{i=1}^{N} \mu_i [v_i(x_i^*) - v_i(x_i^0)] \left[\frac{v_i(x_i) - v_i(x_i^0)}{v_i(x_i^*) - v_i(x_i^0)}\right] = \sum_{i=1}^{N} \mu_i \gamma_i v_i^N$$

Thus, criterion weights can be expressed as a product of two components (5.8):

$$(5.8)\quad \omega_i = \mu_i [v_i(x_i^*) - v_i(x_i^0)] = \mu_i \gamma_i,\ i = 1, \dots, N$$

ω_i are criterion weights without normalization and the normalized scores $v_i^N(x_i)$ and normalized weights ω_i^N can be defined by the following formulas:

$$(5.9)\quad v_i^N(x_i) = \frac{v_i(x_i) - v_i(x_i^0)}{v_i(x_i^*) - v_i(x_i^0)} \text{ and } \omega_i^N = \frac{\omega_i}{\sum_{i=1}^{N} \omega_i}$$

Formula (5.8) demonstrates three important things: Component μ_i denotes the psychological importance of criteria. For example, DM can consider reserves twice as important as profitability. Component γ_i reflects the effect of the measurement scale and represents that change in the aggregated value which is related to the shift of criterion scores from their worst level to their best level. The weights ω_i capture both the psychological concept of importance and the extent to which the measurement scale adopted in practice discriminates between alternatives (Belton et al. 2002).

A less formal representation of the above is: Paying attention to the ranges of the criteria in assigning weights is crucial. Too often we are tempted to assign weights on the basis of vague claims that criterion A is worth three times as much as criterion B. Suppose you are buying a car, though. If you are looking at cars that all cost about the same amount, but their features differ widely, why should price play a role in your decision? It should have a low weight in the overall score (Clemen 1996).

The prevailing practice is to estimate directly the weights ω_i and some weight elicitation method which takes into account both the psychological importance and the measurement scale applied. An overview of methods for eliciting weights is presented, e.g., in HUT 2005.

5.3 Preference models

As can be seen later in chapters 6 and 7, all the criteria used in this study are measured on the ratio scale, which simplifies the formulation of the value functions. The criterion scores are calculated with the following formula:

(5.10) $v_i(x_j) = 100 \cdot \frac{x_j}{x_j^*}$ $where\ x_j^* = max\, x_j$

The term x_j is the observed value of criterion *i* associated with the alternative *j* while x_j^* is the largest observed value of criterion *i* among all alternatives *j*. Thus the best alternative gets a score of exactly 100 and other alternatives get lower scores. Formula (5.10) means that the DM's preferences are linear within the whole range of each criterion, and the criterion scores linearly reflect the actual values of the criteria. Thus, e.g., the region richest in reserves gets a score of 100 and the region having exactly half as much reserves gets the score 50. The criterion scores can also get negative values reflecting phenomena which are regarded as negative also in the real life like negative export potential.

An additive model is chosen for the aggregated value function, and the aggregated scores of each alternative are determined by the following formula:

(5.11) $V_j(X) = \sum_{i=1}^{N} \mu_i\, v_i(x_i)$ $where\ \mu_i = \frac{1}{N}$

Formula 4.11 tells that the aggregated score is the weighted average of the criterion scores. The weighting is done with criterion weights summing up to 1, and they are the same for all the criteria in the base case.

It is important to understand that criterion weights have two components. In this study, the first component is inherently related to the measurement scale of each criterion, i.e., the greater the difference of the actual criterion values between different alternatives, the greater weight the criterion has in the final rating. This is in line with the principles of decision theory (Clemen 1996). The second component μ_i is the psychological weight. One criterion is simply regarded as more important than another. In this study the psychological weights are the same in the base case, i.e., the best values of the criteria are of the same value.

Naturally, the choice of formulas (5.10) and (5.11) is open to debate. It is fully possible that some other form of criterion value functions is better. However, there is no such data or actual DM which could be utilized in this respect. The choice to use the same weights for all the criteria in the base case can be justified with the results of the earlier research. There is no clear evidence supporting the different importance of the criteria. However, in the regional analysis (chapter 6), the different uncertainty and importance of criteria are taken into account when determining criterion weights in sensitivity analysis. In the company analysis (chapter 7), several different criteria are used to measure certain dimensions in order to examine and demonstrate the effects of choosing different criteria.

In this study, the combination of an alternative's criterion and aggregated scores is called a performance profile (PP). It can be defined as follows:

(5.12) $PP_j = \{v_{1j}(x_{1j}), \cdots, v_{ij}(x_{ij}), \cdots, v_{nj}(x_{nj}), f[v_{ij}(x_{ij})]\}, \ i = 1, \cdots, N$

$j = 1, \cdots, M, \ N = number\ of\ criteria\ and\ M = number\ of\ alternatives$

In certain situations, e.g., in comparisons between two alternatives or averages of several alternatives, an alternative's criterion scores, aggregated score or performance profile do not convey all available information of the superiority or inferiority of an alternative. In such cases the superiority coefficient can be used to describe the relative superiority or inferiority of two alternatives or two sets of alternatives using only one set of coefficients instead of two sets of scores. The superiority coefficient (SC) is defined as follows:

(5.13) $SC_{ijk} = \frac{v_i(x_{ij})}{v_i(x_{ik})}\ \ where$

$v_i(x_{ij})\ is\ the\ criterion\ score\ of\ criterion\ i\ of\ alternative\ j$

$v_i(x_{ik})\ is\ the\ criterion\ score\ of\ criterion\ i\ of\ alternative\ k$

The superiority coefficients are calculated by dividing the criterion scores and aggregated score of an alternative by the corresponding scores of another alternative. If it is desirable to present analysis results in condensed form, this presentation works well.

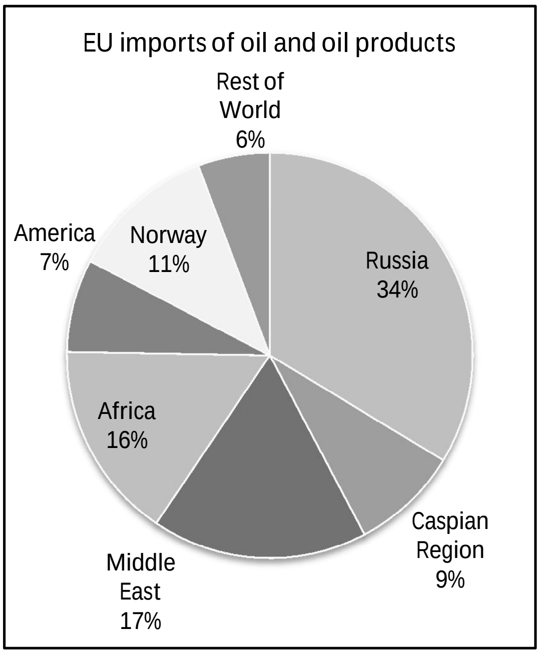
6 Assessment of oil and gas regions

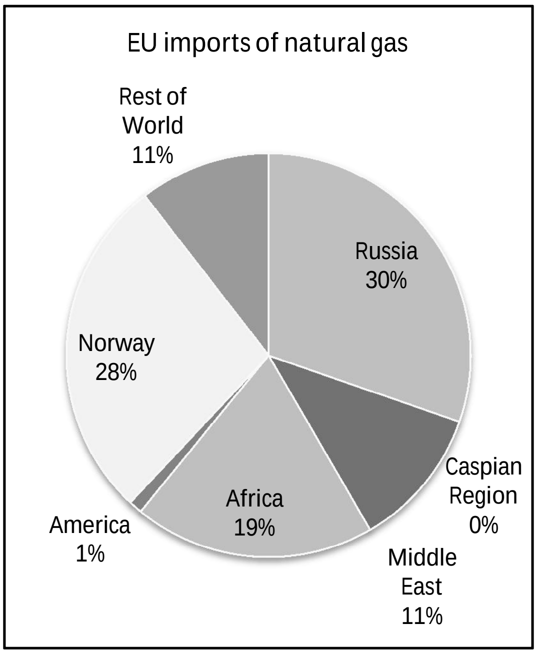
In this chapter, first the strategic oil and gas regions for benchmarking are chosen. Then the criteria used in the assessment of oil and gas regions and countries are discussed and the criteria used in this analysis are chosen. Finally, the chosen regions are benchmarked against each other using the chosen criteria.

6.1 Choice of regions

Figure 6.1 presents the regional distribution of the EU 27's oil and gas imports outside the EU's own region in 2011.

Figure 6.1 EU oil and gas imports outside EU region in 2011





Rest of World includes minor suppliers and supplies not specified. Source data: Eurostat 2013.

The diversification of oil and gas supply sources and routes is an important principle in the EU's energy policy. According to the strategy document "The EU Energy Policy: Engaging with Partners beyond Our Borders", Russia has a uniquely important role in Europe's energy market. Besides Russia, also other important hydrocarbon suppliers have an important position in the EU's energy policy. Norway and the Caspian and Middle East countries are important in current and future energy cooperation. African producers, countries in the American continent such as Brazil, Venezuela, and Canada hold significant potential for the EU diversification policy (EU 2011a).

If the EU's aspirations in its external energy policy and the distribution of the EU's current external oil and gas suppliers are taken into account, the choice of interesting strategic regions for benchmarking is an easy task. The strategic oil and gas regions of this study are the following: Russia, Caspian Region, Middle East, Africa, America, EU 27+ and Rest of World. EU 27+ means EU 27 plus Norway.

Russia: in 2012, Russia produced 12.8% and 17.6% of the world's oil and gas, respectively (BP 2013a). The main export routes of Russian oil are the Baltic Pipeline System (BPS) to the Primorsk oil terminal on the Gulf of Finland and the Baltic Pipeline System 2 (BPS-2) to the Ust-Luga oil terminal on the Gulf of Finland, Druzhba pipeline to the Eastern and Central Europe, pipelines from Samara to the Novorossiysk oil terminal on the Black Sea and the Eastern Siberia Pacific Ocean (ESPO) pipeline to Kozmino on the Pacific Ocean, with a branch to China. New pipelines under construction or in different planning stages are, *inter alia*, the enlargements of the Baltic Pipeline System 2 and the Caspian Pipeline Consortium (CPC) pipeline to the Novorossiysk oil terminal on the Black Sea (Transneft 2013).

The main export routes of Russian gas are the Yamal-Europe pipeline through Belarus and Poland to Germany, the Urengoy-Pomary-Uzhgorod pipeline through Ukraine to Europe, Blue Stream through the Black Sea to Turkey and Nord Stream through the Baltic Sea to Germany. New pipelines under different planning or construction stages are, *inter alia*, South Stream through the Black Sea to Bulgaria and further to other European Countries and Altai from West Siberia to China. The Central Asia-Center and proposed Pre-Caspian pipeline connect Russia's and Caspian Region's gas supply systems. Gazprom also owns a stake of a LNG liquefaction plant in Sakhalin in the Russian Far East (Minenergo 2013a).

Caspian Region: In this analysis, the Caspian Region includes Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan. Together they produced 3.5% and 4.7% of the world's oil and gas in 2012, respectively (BP 2013a). Currently, the Caspian Region exports only relative small quantities of oil to the EU. However, because of the region's great oil and especially gas resources and proposed new pipeline routes circumventing Russia's territory, the region's significance in the EU's energy imports may increase. Currently, four main oil pipelines: the BTC (Baku-Tbilisi-Ceyhan), the Baku-Novorossiysk, the Baku-Supsa, and the Caspian Pipeline Consortium (CPC) pipeline, connect the region to the world's oil markets via Georgia, Turkey and Russia. There are also pipelines to Russia (Atyrau–Samara) and from Kazakhstan to China (Atasu–Alashankou pipeline).

The main gas pipeline to Russia is the Central Asia–Center. The South Caucasus Pipeline (Baku-Tbilisi-Erzurum) carries gas from Azerbaijan's Shah Deniz field in the Caspian Sea to Georgia and Turkey. Azerbaijan also has gas pipeline connections to Russia and Iran. The Central Asia-China Pipeline transports gas from Turkmenistan through Uzbekistan and Kazakhstan to China. Turkmenistan also has gas pipeline connections to Iran.

Due to its geographic location and hydrocarbon resources, the Caspian Region has become a focal point of controversial interests of different international actors and there are numerous new pipeline proposals such as the EU-backed Nabucco gas pipeline through Turkey to Europe, Trans-Caspian gas pipeline through the Caspian Sea to Azerbaijan and the gas pipeline from Turkmenistan through Afghanistan to Pakistan and India (TAPI) (EIA 2013f).

Middle East: in 2012, Middle East produced 32.5% and 16.3% of the world's oil and gas, respectively, and the shares of the OPEC Middle East countries (Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and United Arab Emirates) were 94% and 89% of the region's oil and gas production, respectively (BP 2013a). Saudi Arabia is the leading oil country of the world having proved oil reserves approximately three times more than Russia. Iran and Qatar together have proved gas reserves comparable to Russia's proved reserves.

Natural gas is an important energy source in the Middle East for electricity production, desalination and re-injection to the oil fields. Thus, despite the increasing production, exports of gas have so far been minor except for Qatar, which is one of the leading LNG exporters (EIA 2013f). LNG liquefaction plants are also in the United Arab Emirates, Yemen and Oman. Because of its huge oil and gas resources and low production costs, the Middle East is the crucial actor in the world's petroleum arena, and the assessment of international petroleum activities without Middle East is impossible.

Africa: in 2012, Africa produced 10.9% and 6.4% of the world's oil and gas, respectively, and the shares of the OPEC Africa countries (Algeria, Angola, Libya and Nigeria) were 77% and 64% of the region's oil and gas production, respectively (BP 2013a). Algeria has gas pipeline connections to Italy and Spain and Libya to Italy. Algeria, Egypt, Equatorial Guinea, Libya and Nigeria also have LNG liquefaction capacities (EIA 2013f).

America: In 2012, America produced 26.7% and 32.1% of the world's oil and gas, respectively. In this study America includes both North and South American countries. Although America's share of the EU's oil and gas imports is small, the region is interesting because currently the world's greatest known unconventional oil and gas reserves and resources are in America. It is logical to expect that America's importance in the EU's energy supply will increase in the future both directly in the form of physical supplies and indirectly because America's diminishing oil and gas imports will divert oil and gas supplies to other regions including Europe.

European Union: In 2012, the countries of the EU produced 2.0% and 4.4% of the world's oil and gas, respectively. According to Eurostat, 90% of Norway's oil and 95% of Norway's gas exports were directed to the EU 27 in 2011 (Eurostat 2013). The EU regards Norway as part of the EU internal market (EU 2011a). Consequently, Norway and EU 27 are combined into the European region EU 27+ in order to restrict the number of regions in this analysis. As a whole EU 27+ is a net importer of oil and gas. Besides oil and gas pipelines from the North Sea, there are oil and gas pipelines from Russia and gas pipelines from North Africa to Europe. Moreover, there are significant LNG regasification capacities in Europe (EIA 2013f).

Rest of World: Rest of World includes all the countries which do not belong to the above strategic regions, i.e., certain European and Eurasian countries and the Asia Pacific countries. The countries belonging to Rest of World produced 11.6% and 18.5% and consumed 36.0% and 22.8% of the world's oil and gas in 2012, respectively. Many significant oil and/or gas consumers such as China, India, Japan and South Korea belong to the region. The region is a net importer of both oil and gas (BP 2013a).

6.2 Choice of criteria

The starting points for the choice of the criteria are the critical factors defined in chapter 3 and the factors affecting energy security from an importer's perspective. The problem is that energy security has many different definitions. The International Energy Agency (IEA) defines energy security as access to adequate, affordable and reliable supplies of energy (IEA 2009). According to the EU, secure, sustainable and competitive energy is of fundamental importance and a core goal of EU policy (EU 2011a). In this regional analysis, the energy security definitions of the Asia Pacific Energy Research Centre (APERC 2007) are used because they describe and measure the problems discussed in chapter 3 well.

The APREC defines the 4 A's of long-term energy security: availability, accessibility, affordability and acceptability. Availability means recoverable resources. Accessibility refers to the ability to access and use resources. Barriers to the accessibility are, *inter alia*, lack of sufficient investments in new production and infrastructure and geopolitical factors, e.g., political instability of certain regions. Acceptability refers to the environmental regulations affecting energy imports and also to the acceptable level of import dependence. Affordability means the prices of different fuels and their cost competitiveness (modified from APERC 2007).

The energy security of a specific country or region is often measured using indicators which measure the total energy security taking into account all supply sources and factors which are thought to affect energy security (cf. IEA 2007). In this study, the approach is different. Instead of the total security of oil and gas supplies, the strategic oil and gas regions are assessed and benchmarked against each other taking into account the factors which are thought to affect energy security.

Table 6.1 presents such criteria which can be used to describe the critical factors, different supply-side criteria from different sources, criteria used in this study and an evaluation of the availability and quality of required data.

Availability is often measured with reserves and resources quantities or the reserves-to-production ratio (R/P ratio) (Hobohm 2008). However, reserves and resources quantities alone are poor measures because they tell nothing about the production and consumption of the region or country in question.

Accessibility can be measured with export potential which takes into account production, consumption and infrastructure. Export potential is defined as production – consumption. Future export potential is based on production and consumption projections. Export potential depends also on other factors such as demand, competition and the existence of export contracts.

Besides difficulties in data availability, the comparison of investments between regions and companies is difficult because there are great differences in geology and capital efficiency. Consequently, the expenses required to maintain output on a certain level differ between regions (IEA 2012a). In this study, the recent reserves and production growth are used to describe the results of investments. Naturally, there are also other factors such as demand or restrictive actions, such as OPEC quotas, which affect reserves and production growth.

Table 6.1 Dimensions and criteria of regional assessment

Dimension/criteria	Critical factors	IEA 2007	APREC 2007	Other studies	This study	Data avail. and qual.
Availability						
-proved reserves	x		x	x	x	Good
-conventional resources	x		x	x	x	Moderate
-unconventional resources	x		x	x	x	Poor
Accessibility						
-recent export potential	x	x			x	Good
-future export potential	x	x			x	Poor
-investments			x			Poor
--reserves growth	x				x	Good
--production growth	x				x	Good
-political stability (indices)	x	x	x	x	x	Moderate
Acceptability						
-Dependency on exporter	x	x	x	x	x	Good
-bargaining power, competition	x			x		Moderate
-environmental factors			x			Moderate
Affordability						
-relative price level			x			Moderate
-price predictability				x		Poor

Other studies refer to Hobohm 2009 and Le Coq et al. 2012. Source data: APERC 2007, Hobohm 2009, IEA 2007, Le Coq et al. 2012.

The political stability of supply and transit regions is often taken into account using indices of political and economic stability such as the World Bank's Worldwide Governance Indicators (IEA 2007). In this study, the Euromoney Country Risk Rating (ECR) is used because it rates all the interesting countries and its scale 0-100 works well in this study.

Acceptability refers to import dependency and environmental factors. On the one hand, the concentration of imports and resources in one or a few regions is regarded as detrimental to energy security. On the other hand, it is argued that the greater share of a certain exporter's supplies belongs to an importer, the greater bargaining power the importer has (Le Coq et al. 2012). Most of the diversity indices used to measure energy security are such that the more suppliers and the smaller each supplier's market share, the better. Examples of such indices are the Shannon index and Herfindhal-Hirschman index (IEA 2007). Because this study benchmarks suppliers against each other, the simplest possible criterion, the relative market share of each supplier is used.

Because the focus of this study is only on oil and gas exporters, environmental acceptability of supplies has a minor role. It is thought that oil and gas production and transportation are environmentally problematic everywhere in the world. However, it is pointed out that compared to conventional oil and gas production, unconventional production usually has greater environmental effects (cf. figure 4.1).

Affordability, i.e., oil and gas prices, is not benchmarked in this study. The predictability of oil and gas prices is a great problem. These questions are discussed in chapter 4.

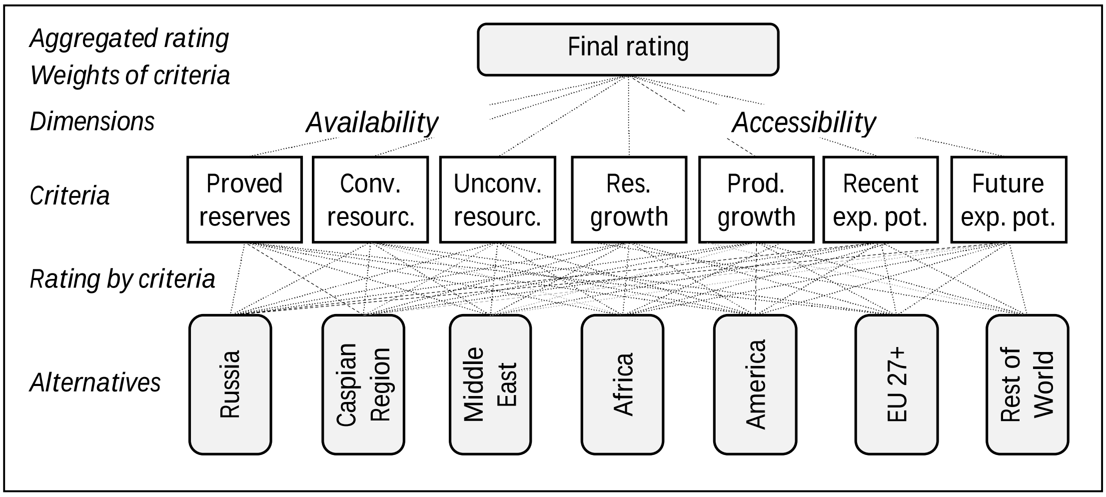
It is emphasized that there are no criteria that would unquestionably and absolutely correctly measure the given dimensions or any dimensions that would unquestionably and absolutely correctly describe the problem. Rather, everything influences everything else and different dimensions and criteria are tied to each other. The criteria of this analysis are chosen so that they look at the problem from many different perspectives which complement each other. The criteria look backwards in time but look also ahead, and they may well help analysts and decision makers to draw conclusions about the strengths, weaknesses and problems of different oil and gas suppliers.

6.3 Russia in global oil and gas arena

6.3.1 Introduction

In this section, the strategic oil and gas regions are benchmarked against each other using the following criteria: proved reserves, conventional resources, unconventional resources, reserves growth, production growth, recent export potential and future export potential using value tree analysis according to the principles presented in chapter 5 (figure 6.2). The oil and gas activities are assessed separately.

Figure 6.2 Benchmarking oil and gas regions



The criteria measuring the regions' political and economic stability and the regions' share of the EU 27's oil and gas imports are assessed separately.

First, regions are benchmarked and rated in each dimension using the appropriate criteria. All seven criteria are measured in the same unit, the ton of oil equivalent (toe). The structure of the criterion value function (formula 6.1) is such that the criterion scores linearly reflect the actual values of the criteria.

$$(6.1)\quad v_i(x_j) = 100 \cdot \frac{x_j}{x_j^*} \quad where\ x_j^* = max\, x_j$$

In formula 6.1 x_j is the value of criterion i attached to the region j and x_j* is the largest value of criterion i among all regions j. For example, the region richest in reserves gets the score 100 and the region having half as much reserves gets the score 50. Consequently, this analysis measures the relative contribution of each region to the global petroleum balance irrespective of which criterion is in question.

The criterion scores are combined using the aggregated value function (formula 6.2). Formula 6.2 tells that the aggregated score is the weighted average of the criterion scores.

(6.2) $V_j(X) = \sum_{i=1}^{N} \mu_i \, v_i(x_i), \; i = 1, \dots, N \; and \; \mu_i = \frac{1}{N}$

The number of criteria N=7 and all the criterion weights are the same, i.e., μ_i=1/7 in the base case. In the sensitivity analysis several different criterion weights are used.

The benchmarking results are examined using sensitivity analysis. Sensitivity analysis is often done using the one-factor method where the values of criteria or criterion weights are varied one at a time to examine which criteria are critical if the values of input parameters change. In this regional analysis, the one-factor method is not used because of the great number of criteria and alternatives. Instead, the different reliability and importance of the criteria are taken into account in determining the criterion weights.

Finally, the aggregated scores of each important region are presented together with the regions' political and economic stability scores and percentages describing their market shares of the EU's oil and gas imports. These two criteria are assessed separately from the other seven criteria because they are different by nature and are measured in different units.

Reserves and production growth are assessed using the data from the years 2003-2012. The values of the other criteria are calculated using the latest available data which in the cases of proved reserves, conventional resources, unconventional resources is from the year 2011, and in the case of recent export potential from the year 2012. The future export potential is calculated based on scenarios published in 2011 and extending to the year 2035.

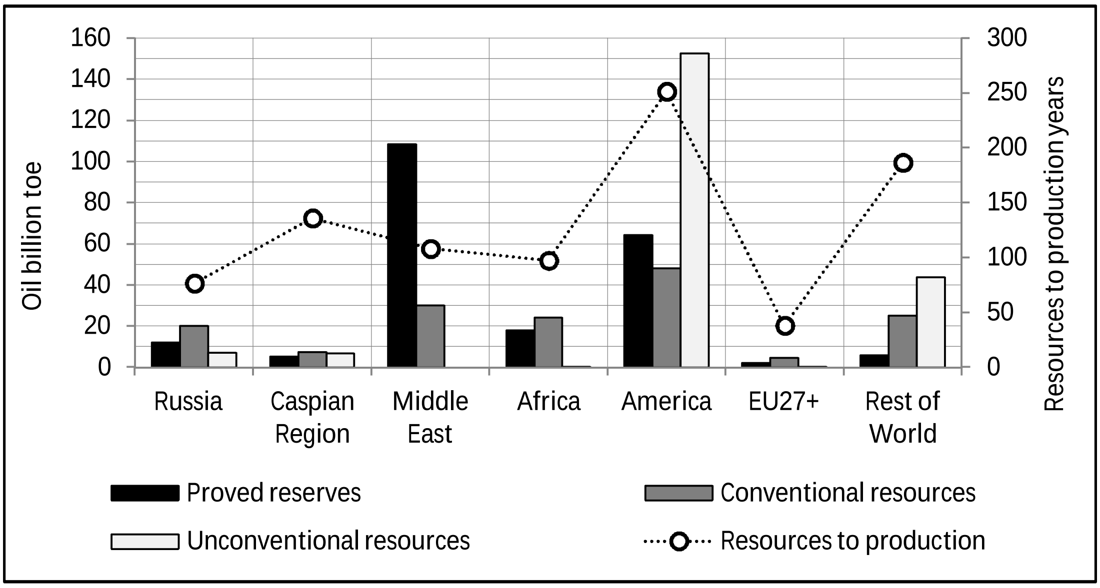
6.3.2 Reserves and resources

The availability of resources is assessed with the quantities of proved reserves, conventional resources and unconventional resources. These quantities are assessed separately because their estimates have different reliability and economic importance. Figure 6.3 presents the regions' oil resources and the recoverable resources-to-production ratios. Recoverable resources include proved reserves and conventional and unconventional resources.

On the one hand, it is not recommended to aggregate reserves and resources with each other (SPE 2007) but, on the other hand, it is argued that proved reserves estimates alone are a poor indicator of how much oil and gas remains to be produced (IEA

2004). The ratio of recoverable resources to production is used as an approximate complementary indicator describing the production potential of the regions.

Figure 6.3 Oil reserves and resources



Unconventional oil resources include oil sands, extra heavy oils and tight oil. Oil shales are not included. Source data: BGR 2012.

Approximately 75% of America's proved oil reserves and 95% of unconventional oil resources consist of Venezuela's extra heavy and tight oils and Canada's oil sands (BGR 2012). The reported unconventional oil reserves outside America are insignificant and unconventional oil resources outside America are approximately 40% of America's unconventional resources (BGR 2012).

The quantities of oil reserves and resources and the corresponding criterion scores are presented in the following table 6.2. Figure 6.3 and table 6.2 tell that compared to other important oil producers, Russia's proved oil reserves are small and Russia is only fourth in the quantity of conventional resources. According to current knowledge, Russia's recoverable resources are modest taking into account its current production volume.

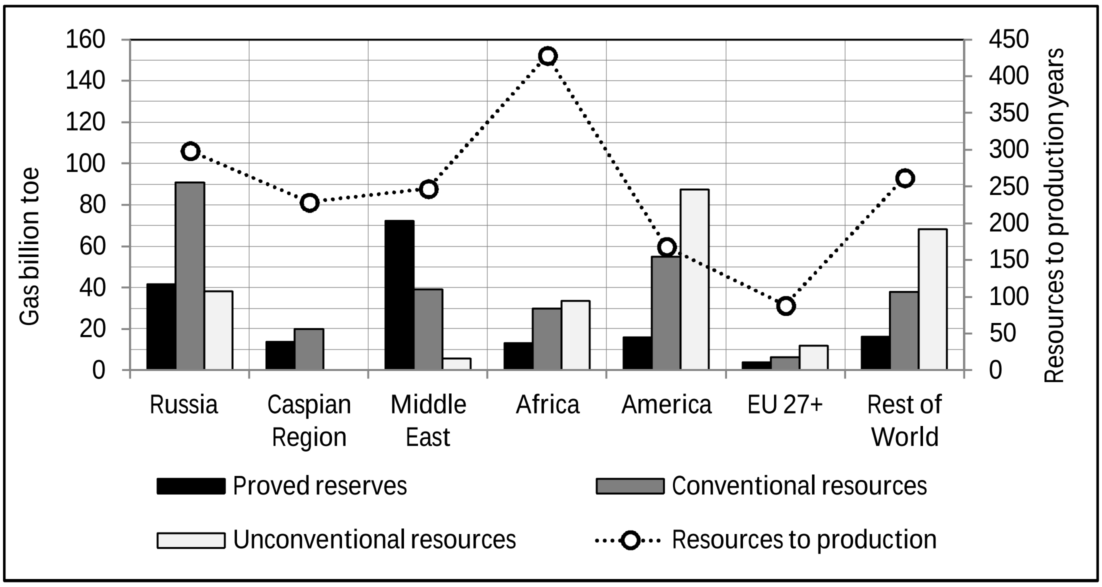
Table 6.2 Oil reserves, resources, billion toe and scores

	Russia	Caspian Region	Middle East	Africa	America	EU 27+	Rest of World
Reserves, value	12	5	109	18	64	2	6
Conv. resources, value	20	7	30	24	48	5	25
Unconv. resources, value	7	7	0	0	153	0	44
Reserves, scores	*11*	*5*	*100*	*17*	*59*	*2*	*5*
Conv. resources, scores	*42*	*15*	*62*	*50*	*100*	*9*	*52*
Unconv. resources, scores	*5*	*4*	*0*	*0*	*100*	*0*	*29*

The following figure 6.4 and table 6.3 tell that gas resources are more evenly distributed around the world and more abundant compared to production than oil resources. Russia is clearly better endowed with gas resources than with oil resources. It is ranked second in proved reserves, first in conventional resources and it also has significant unconventional gas resources which are mostly coal bed methane (CBM).

Approximately 65% of the Caspian Region's proved gas reserves are in Turkmenistan, where the Galkynysh gas field (formerly South Iolotan) is the world's second largest gas field (IEA 2012a).

Figure 6.4 Gas reserves and resources



Source data: BGR 2012.

Figure 6.4 and table 6.3 also tell that from the European perspective there are four important gas resources owners, namely Russia, the Caspian Region, Middle East and Africa. America's strength is its great unconventional oil and gas resources. Presumably, the quantity of unconventional oil and gas resources will increase in the future also in the other regions including Russia, as new data accrues.

Table 6.3 Gas reserves, resources, billion toe and scores

	Russia	Caspian Region	Middle East	Africa	America	EU 27+	Rest of World
Reserves, value	42	14	72	13	16	4	16
Conv. resources, value	91	20	39	30	55	6	38
Unconv. resources, value	38	0	6	34	87	12	68
Reserves, scores	*58*	*19*	*100*	*18*	*22*	*5*	*22*
Conv. resources, scores	*100*	*22*	*43*	*33*	*60*	*7*	*42*
Unconv. Resources, scores	*44*	*0*	*7*	*38*	*100*	*14*	*78*

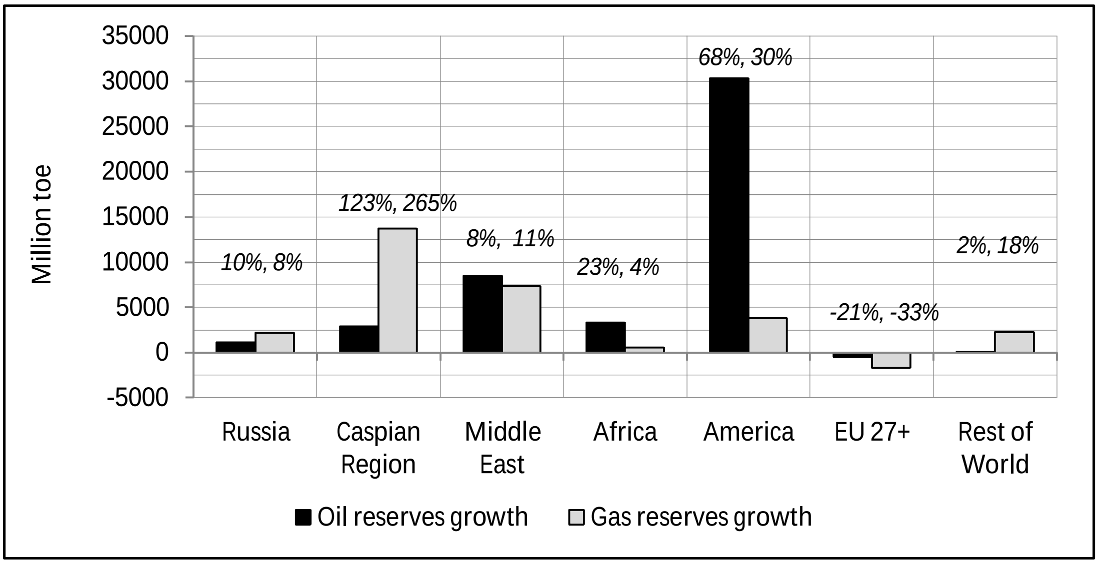
6.3.3 Reserves and production growth

Sustainable growth in production also requires growth in reserves. However, a number of factors complicate the objective assessment of reserves and production growth. Besides variations in demand, examples of such factors are the OPEC quotas, the dominant role of long-term contracts in gas deliveries, capacity restrictions in transportation, and different regulatory and political activities affecting oil and gas production and transportation. It is also reminded that the quantities of proved reserves depend on oil and gas prices.

On the other hand, the changes in production rates and reserves quantities attract great attention from observers, and besides the problems with transit countries, the sharpest criticism against Russian oil and gas is focused on too small investments and consequent small reserves and production growth. Reserves and production growth are here used as a proxy for the investments in exploration, production and infrastructure.

Reserves growth is the difference between the proved reserves quantities in the last and first assessment year. Production growth is the difference between the yearly production of the last and first assessment year. Undoubtedly, reserves and especially production growth are sensitive to the length of the assessment period. In this study, the assessment period 2003-2012 is chosen because it is considered long enough to eliminate at least part of the stochastic variations. Figure 6.5 and table 6.4 present the regions' oil and gas reserves growth. Although this assessment is based on the absolute quantities, also the growth percents are presented in figure 6.5 in order to give a more comprehensive picture of the situation.

Figure 6.5 Oil and gas reserves growth in 2003-2012, million toe



The percentage on the left shows oil reserves growth and on the right gas reserves growth. Source data: BP 2013a

The growth of both Russia's oil and gas reserves is modest compared to the other important regions, except for the growth of Africa's gas reserves. The Caspian Region's oil reserves have increased especially in Kazakhstan and the Middle East's in Iran, Iraq and Kuwait. Libya has the greatest contribution to Africa's oil reserves growth. America's significant oil reserves growth is a consequence of booking new great unconventional oil reserves in Venezuela.

Table 6.4 Reserves growth 2003-2012, million toe and scores

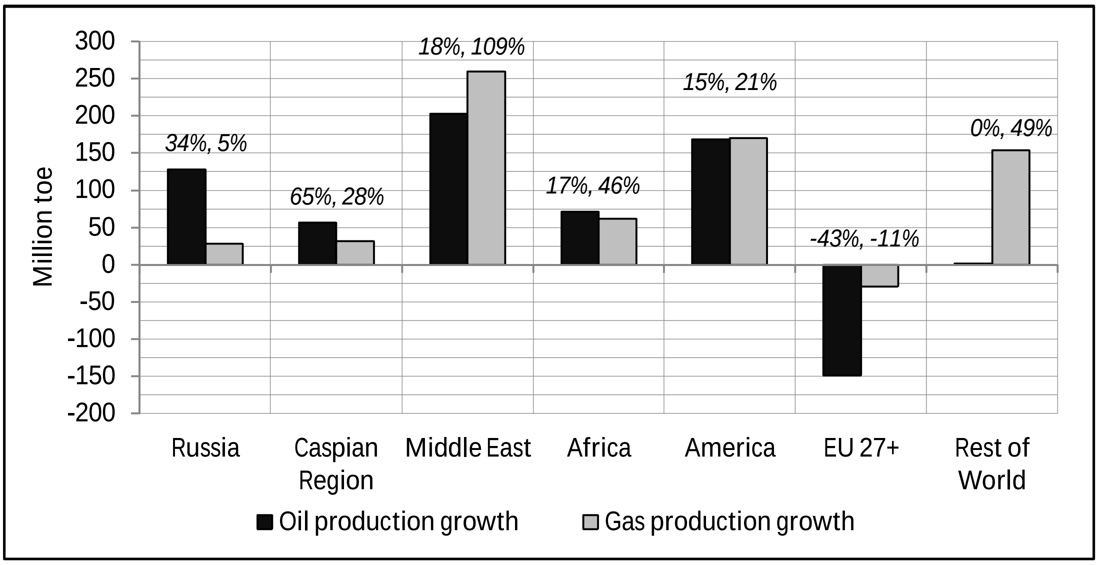
	Russia	Caspian Region	Middle East	Africa	America	EU 27+	Rest of World
Oil res. growth, value	1119	2873	8458	3288	30341	-505	101
Gas res. growth, value	2180	13714	7356	545	3814	-1726	2271
Oil res. growth, scores	*4*	*9*	*28*	*11*	*100*	*-2*	*0*
Gas res. growth, scores	*16*	*100*	*54*	*4*	*28*	*-13*	*17*

The great gas reserves growth in the Caspian Region is a consequence of booking new significant reserves in Turkmenistan's Galkynysh field. The Middle East's gas reserves have increased primarily in Iran. America's gas reserves have increased above all in the USA due to the new unconventional gas reserves. The EU 27+ is the only region where oil and gas reserves have decreased.

Figure 6.6 and table 6.5 present the regions' actual oil and gas production growth. Also the growth percents are presented in figure 6.6. Russia's and the Caspian Region's oil production growth have been significant taking into account their reserves. Iran, Iraq, Kuwait, Qatar, Saudi Arabia and United Arab Emirates have been the main contributors to the Middle East's oil production growth. In Africa, oil production has increased in Angola and Nigeria. America's oil production growth has primarily taken place in the USA, Canada, Brazil and Colombia.

Compared to the Middle East and America, Russia's and the Caspian Region's gas production growth has been modest. If both the absolute and relative growth are taken into account, Russia's gas production growth is modest compared to the other important regions. The Middle East's gas production has increased above all in Iran, Qatar and Saudi Arabia, Africa's in Egypt and Nigeria and America's in the USA. The EU 27+ is the only region where oil and gas production has decreased.

Figure 6.6 Oil and gas production growth in 2003-2012, million toe



Oil production growth includes also biofuels. The percentage on the left shows oil production growth and on the right gas production growth. Source data: BP 2013a, EIA 2013a

Table 6.5 Production growth 2003-2012, million toe and scores

	Russia	Caspian Region	Middle East	Africa	America	EU 27+	Rest of World
Oil production growth, value	128	57	203	71	168	-149	2
Gas production growth, value	28	31	259	62	170	-29	154
Oil production growth, scores	*63*	*28*	*100*	*35*	*83*	*-73*	*1*
Gas production growth, scores	*11*	*12*	*100*	*24*	*66*	*-11*	*59*

A region which increases its reserves relatively less than production is on an unsustainable path. The balance between reserves growth and production growth can be evaluated with the growth balance index, GBI (cf. section 7.2.5). If this index has a value that is smaller than 1, the compound growth of reserves is smaller than the compound growth of production (or compound decrease of reserves is greater than that of production), which means that the reserves to production ratio (R/P) of a region is decreasing. Table 6.6 presents the R/P ratios and GBIs of the regions.

Table 6.6 R/P ratios in 2011 and GBIs in 2003-2012

	Russia	Caspian Region	Middle East	Africa	America	EU 27+	Rest of World
Oil R/P ratio, years	24	37	81	36	50	10	12
Gas R/P ratio, years	78	98	145	68	16	16	35
Oil GBI	0,83	1,35	0,92	1,05	1,46	1,40	1,01
Gas GBI	1,02	2,84	0,53	0,71	1,07	0,75	0,79

The production-to-reserves (R/P) ratio tells for how many years current proved reserves last if the production rate is the same as in the assessment year (cf. formula 7.14). The growth balance index (GBI) is calculated by dividing the compound growth of proved reserves by the compound growth of production (cf. formula 7.18). If the value of GBI is smaller than 1, the region has a decreasing reserves-to-production ratio and *vice versa*. Source data: BP 2013b.

Critical regions are those whose R/P ratios and GBI's are low. In the oil sector, such regions are Russia and Rest of World and in the gas sector Africa, the EU 27+ and Rest of World. The oil GBI of the EU 27+ is an interesting special case. The value of GBI is greater than 1 because the oil production of the EU 27+ has decreased relatively more than oil reserves.

6.3.4 Export potential

A region's oil and/or gas production volume alone tells little about a region's significance from an importer's perspective. Equally important is a region's consumption and its balance with production. Export potential is the difference between domestic production and consumption without taking into account re-exports. Extracted crude oil is directed either to exports or domestic refining and part of refined products is also exported. Thus, oil export potential includes both crude oil and oil products. Export potential is estimated in two cases. Recent export potential is based on production and consumption statistics, and future export potential is based on future production and consumption projections published by recognized research and information agencies.

Figure 6.7 and table 6.7 present the recent oil and gas export potentials in 2012. Figure 6.8 and table 6.8 present the future oil and gas export potentials in 2030. The future export potentials are mostly based on the data of the U.S. Energy Information Administration's (EIA) reference scenario of the 2013 International Energy Outlook. Some information is also from the International Energy Agency's (IEA) World Energy Outlook 2012. The EIA's scenarios are chosen because their regional breakdown is significantly better than in the other scenarios. The reference scenario is chosen because there is no clear reason to prefer some other scenario.

Figure 6.7 and table 6.7 tell that in 2012 Russia had remarkable oil export potential which was more than one third of the Middle East's and more than the oil export potential of any other region. Russia's gas export potential is clearly the greatest followed by the Middle East and Africa. It is noteworthy that gas export potentials are significantly lower than oil export potentials in equivalent units. Figure 6.7 also clearly shows the problem of the EU 27+ and Rest of World, i.e., the great dependence on imported oil and gas.

Figure 6.8 and table 6.8 presenting the future export potential tell the same things as figure 6.7 and table 6.7. However, the differences between regions are greater. Russia, the Caspian Region, Middle East and Africa will increase both oil and gas export potentials and America will decrease the oil import dependence and increase the gas export potential. The oil and gas deficits of the EU 27+ and Rest of World will increase.

Figure 6.7 Recent oil and gas export potential in 2012

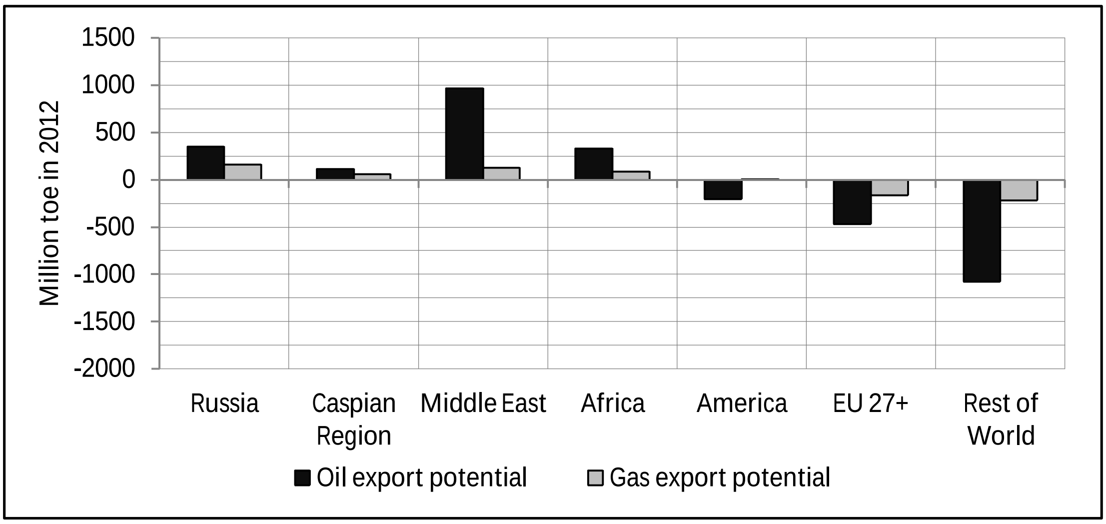
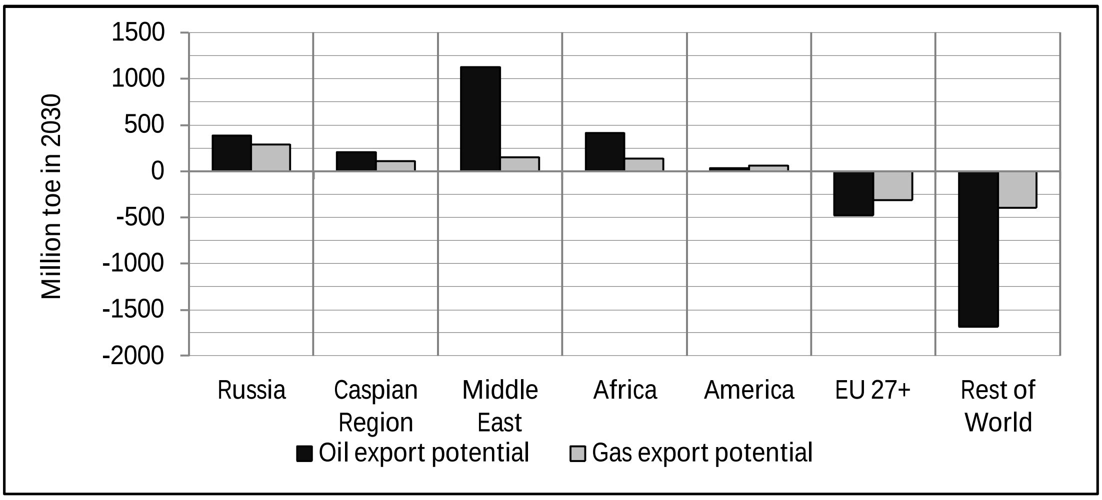


Figure 6.8 Future oil and gas export potential in 2030



Source data: BP 2013a, EIA 2013a, EIA 2013g, IEA 2013b

Table 6.7 Oil and gas export potential 2012, million toe and scores

	Russia	Caspian Region	Middle East	Africa	America	EU 27+	Rest of World
Oil export potential, value	353	116	963	330	-202	-470	-1078
Gas export potential, value	160	61	124	85	2	-167	-221
Oil export potential, scores	*37*	*12*	*100*	*34*	*-21*	*-49*	*-112*
Gas export potential, scores	*100*	*38*	*78*	*53*	*1*	*-104*	*-138*

Table 6.8 Oil and gas export potential 2030, million toe and scores

	Russia	Caspian Region	Middle East	Africa	America	EU 27+	Rest of World
Oil export potential, value	383	204	1125	413	30	-476	-1685
Gas export potential, value	288	106	152	136	62	-313	-393
Oil export potential, scores	*34*	*18*	*100*	*37*	*3*	*-42*	*-150*
Gas export potential, scores	*100*	*37*	*53*	*47*	*21*	*-109*	*-136*

In the name of objectivity, it is mentioned that by no means do all scenarios see the future of Russia's oil and gas production as positive as the EIA's scenario used in this analysis. Table 6.9 presents the projections of Russia's oil and gas production, consumption and export potential in 2030 according to scenarios from different sources.

Table 6.9 Projections of Russia's oil and gas for 2030

	Oil million toe				Gas million toe		
	Minec 2013	WEO 2013	IEO 2013	OPEC 2013	*Minec 2013*	*WEO 2013*	*IEO 2013*
Production	512	478	573	533	*771*	*687*	*756*
Consumption	161	159	189	184	*502*	*475*	*468*
Export potential	351	319	383	349	*269*	*212*	*288*

Source data: EIA 2013g, IEA 2013b, Minecon 2013, OPEC 2013

Table 6.9 tells that Russia's export potential for both oil and gas in 2030 is greater according to the EIA's reference scenario (IEO 2013) than according other scenarios presented in table 6.9. These other scenarios are WEO 2013 in the IEA's World Energy Outlook 2013, OPEC 2013 in the OPEC's World Oil Outlook in 2013 and Minec 2013 of the Ministry of Economic Development of the Russian Federation. Thus, the EIA's reference scenario sees Russia's oil and gas production and consumption more positively than the other scenarios. Scenarios are not forecasts but rather projections under determined conditions and scenarios from different sources are based on different assumptions and different models are used to generate the projections.

6.3.5 Aggregated scores and sensitivity analyses

This section gathers together the criterion scores and presents the aggregated scores and the results of the sensitivity analyses. The criterion scores linearly reflect the actual criterion values compared to the best performing alternative, i.e., the alternative whose score is 100. The aggregated score of each alternative is the weighted average of the criterion scores. Weighting is done in accordance with the criterion weights. The criterion weights are defined in four different cases: equal weights, reliability, importance and combined reliability and importance of the criteria.

The criterion weights are defined in the following way: the reliability value 0.9 is given to proved reserves. The values given to the other criteria describe their reliability compared to the proved reserves. The values are based on the literature and personal judgment. The reliability values are normalized so that they sum up to 1 in order to get the criterion weights.

In order to define the importance values of the criteria, the importance value 1 is given to proved reserves. The importance values given to the other criteria describe their importance compared to proved reserves. The relative importance of conventional and unconventional resources is based on their total quantity, estimated utilization costs and personal judgment. The importance values of the other criteria are based on personal judgment. The importance values are normalized to get the criterion weights. To get the combined values of reliability and importance, the reliability values and importance values of the criteria are multiplied by each other and the combined values are normalized to get the criterion weights (table 6.10).

Undoubtedly, a better and more objective way to define the criterion weights would be to use the above-described method or some other preference elicitation method and the support and opinions of a group of experts and/or decision makers. Unfortunately, such a resource is not available in this study, but if experts and/or decision makers are rational, they are likely to consider also the reliability and importance of criteria.

Table 6.10 Criterion weights in different sensitivity cases

	Equal weights	Reliability	Importance oil/gas	Reliability and importance oil/gas
Proved reserves in 2011	1/7	0,21	0,18/0,15	0,25/0,23
Conventional resources in 2011	1/7	0,07	0,11/0,22	0,05/0,12
Unconventional resources in 2011	1/7	0,03	0,12/0,15	0,03/0,04
Reserves growth 2003-2012	1/7	0,21	0,09/0,07	0,13/0,12
Production growth 2003-2012	1/7	0,21	0,05/0,04	0,08/0,07
Export potential in 2012	1/7	0,21	0,27/0,22	0,38/0,35
Export potential in 2030	1/7	0,07	0,18/0,15	0,08/0,08

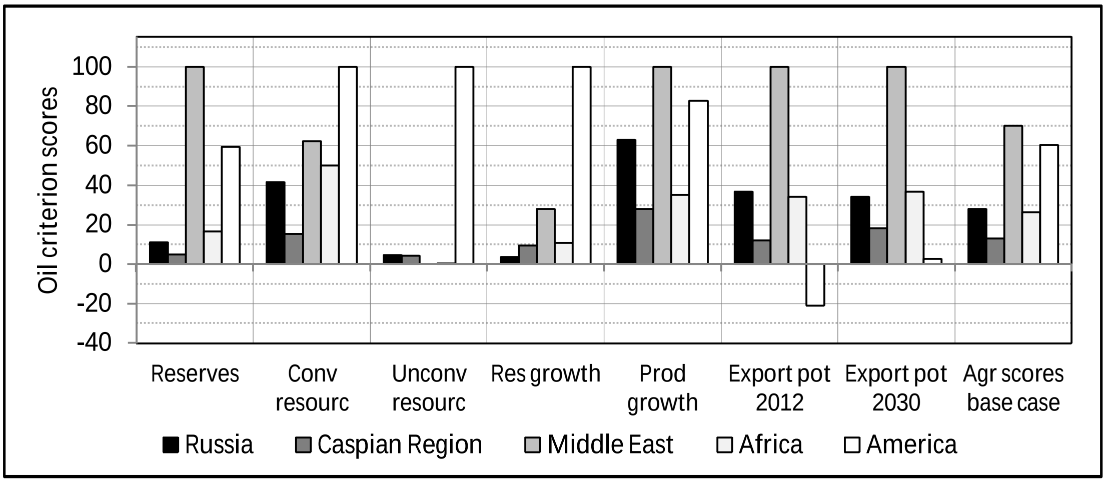
The following table 6.11 presents the regions' oil criterion scores and aggregated oil scores in the four sensitivity cases. The combination of an alternative's criterion scores and aggregated score is called a performance profile.

Table 6.11 Oil criterion and aggregated scores in different cases

	Russia	Caspian Region	Middle East	Africa	America	EU 27+	Rest of World
Proved reserves	11	5	100	17	59	2	5
Conventional resources	42	15	62	50	100	9	52
Unconventional resources	5	4	0	0	100	0	29
Reserves growth	4	9	28	11	100	-2	0
Production growth	63	28	100	35	83	-73	1
Export potential 2012	37	12	100	34	-21	-49	-112
Export potential 2030	34	18	100	37	3	-42	-150
Equal weights (base case)	*28*	*13*	*70*	*26*	*61*	*-22*	*-25*
Reliability	*29*	*14*	*79*	*26*	*56*	*-27*	*-28*
Importance	*27*	*12*	*77*	*27*	*42*	*-23*	*-46*
Reliability and importance	*27*	*12*	*86*	*27*	*34*	*-27*	*-50*

The following figure 6.9 presents the performance profiles of five important oil suppliers: Russia, the Caspian Region, Middle East, Africa and America. In order to make the figure clearer, the EU 27+ and Rest of World are not presented because they have negative recent and future export potentials. Although also America has negative recent oil export potential, it is included in the figure because it has a significant resources base and production growth.

Figure 6.9 Oil performance profiles



Aggregated scores are according to the case "equal weights"

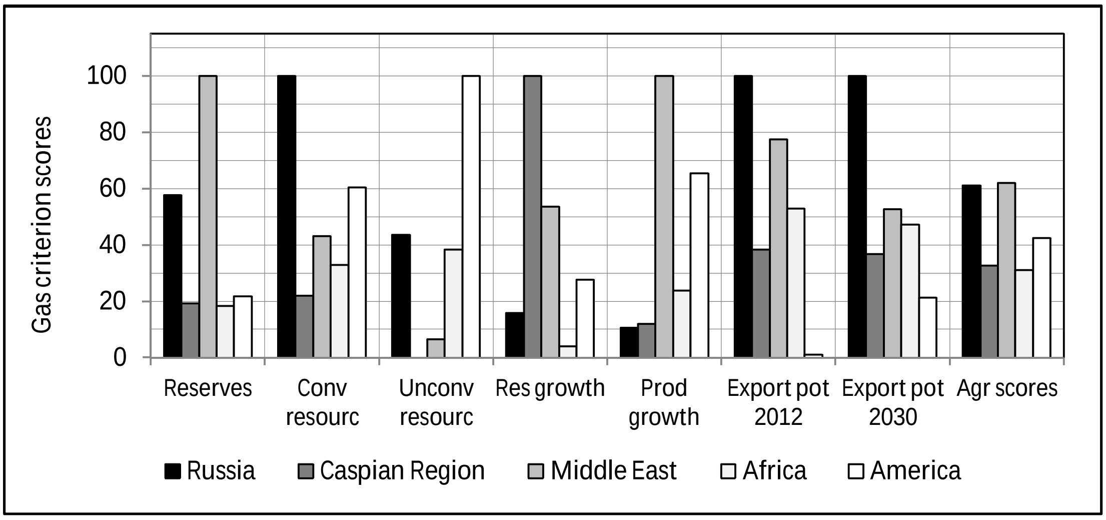
If the focus is on Russia's performance, the following findings and conclusions can be made. Russia's greatest weaknesses are the proved reserves quantity and proved reserves growth both compared to the other regions and other criteria. Russia has the second smallest oil reserves after the Caspian Region and the smallest reserves growth among all the important regions. Russia's greatest strengths are its fourth largest conventional resources, third largest production growth and future export potential and second largest recent export potential. Compared to America, Russia's and the other regions' unconventional oil resources are insignificant. America's large reserves and great reserves growth are mostly based on unconventional oil in Canada and Venezuela. In the aggregated scores, Russia ranks third after the Middle East and America. According to the earlier presented complementary information (table 6.6), excluding EU 27+ and Rest of World, Russia has the lowest oil R/P ratio and the lowest balance between reserves and production growth, which further highlight Russia's greatest weaknesses.

Table 6.12 presents the regions' gas criterion scores and aggregated gas scores in the four sensitivity cases and figure 6.10 presents the performance profiles of five important gas suppliers: Russia, Caspian Region, Middle East, Africa and America.

Table 6.12 Gas criterion and aggregated scores in different cases

	Russia	Caspian Region	Middle East	Africa	America	EU 27+	Rest of World
Proved reserves	58	19	100	18	22	5	22
Conventional resources	100	22	43	33	60	7	42
Unconventional resources	44	0	7	38	100	14	78
Reserves growth	16	100	54	4	28	-13	17
Production growth	11	12	100	24	66	-11	59
Export potential 2011	100	38	78	53	1	-104	-138
Export potential 2030	100	37	53	47	21	-109	-136
Equal weights (base case)	*61*	*33*	*62*	*31*	*43*	*-30*	*-8*
Reliability	*53*	*39*	*75*	*27*	*33*	*-32*	*-12*
Importance	*75*	*29*	*58*	*36*	*40*	*-36*	*-22*
Reliability and importance	*72*	*36*	*73*	*34*	*26*	*-44*	*-39*

Figure 6.10 Gas performance profiles



Aggregated scores are according to the case "equal weights"

If the focus is again on Russia's performance, the following findings and conclusions can be made. Russia's greatest weaknesses are reserves and production growth both compared to the other regions and the other criteria. It has the second smallest gas reserves growth after Africa and the smallest gas production growth. Russia's greatest strengths are the largest conventional gas resources, recent and future export potential and the second largest proved gas reserves after the Middle East. In the aggregated scores, Russia ranks second approximately on the same level with the Middle East.

According to the earlier presented complementary information, excluding EU 27+ and Rest of World, Russia has the second lowest relative gas reserves and the lowest relative gas production growth (figure 6.5 and 6.6), which further highlight Russia's greatest weaknesses.

Figures 6.11 and 6.12 present the results of the sensitivity analysis in which four different patterns of criterion weights: equal weights, reliability, importance and combined reliability and importance of the criteria are used (cf. table 6.9).

Figure 6.11 Sensitivity analyses of aggregated oil scores

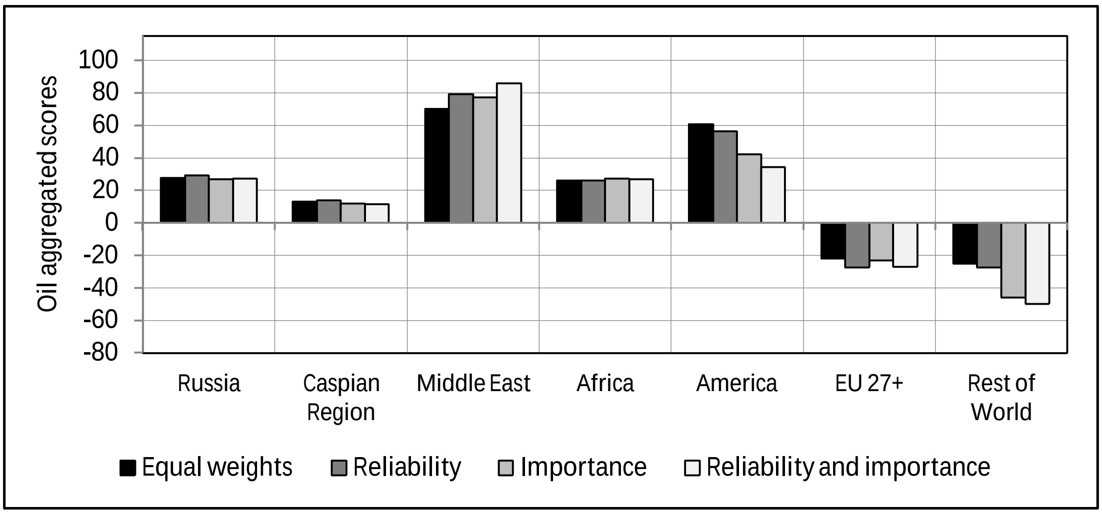
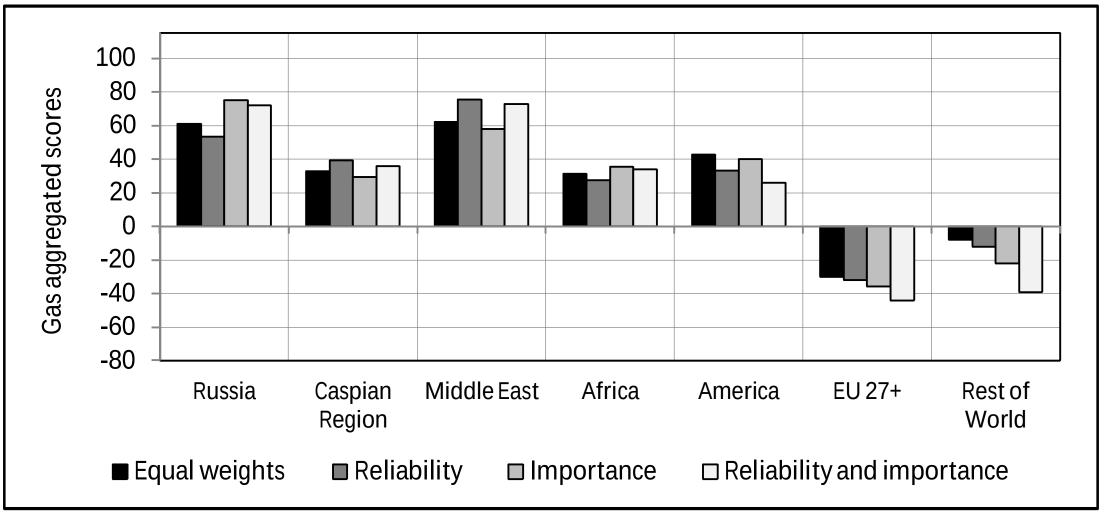


Figure 6.12 Sensitivity analyses of aggregated gas scores



The main messages of figures 6.11 and 6.12 are that the aggregated score of an alternative is sensitive to the changes in the weights of such criteria whose scores are relatively high or low and that the criterion weights may have great influence on the aggregated scores.

The aggregated scores in figures 6.11 and 6.12 reflect the combined effect of all the criterion weights and scores. However, e.g., the following cause and consequence relations can be presented: the Middle East's aggregated oil score increases when reliability and importance are taken into account because the Middle East has great proved reserves and export potential which have relatively high weights; America's oil score decreases when reliability and importance are taken into account because America has large conventional and unconventional resources, which have relatively low weights and negative export potential which has a relatively high weight; Russia's aggregated gas score decreases when reliability is taken into account because it has great conventional and unconventional gas resources which have relatively low weights and increases when importance is taken into account because it has great recent and future export potential which have relatively high weights.

The criteria describing political and economic stability and market share in the EU are assessed separately because they are, by nature, different from the other seven criteria. In principle, value tree analysis suits well to combining criteria which are measured in different units. In this study, it is preferred to present the regions' aggregated scores, political and economic stability scores and market shares in the EU 27 separately. It can be thought that the aggregated score tells a region's supply potential while the political and economic stability score and market share tell how rational and acceptable it is to use this supply potential.

Euromoney Country Risk (ECR), which is used in this regional analysis, describes political and economic stability. ECR is an online tool for analyzing country risk using a consensus survey of expert opinion. The ECR scores are scaled from 0 to 100 (0=maximum risk, 100=no risk) and take into account economic factors, political factors, structural factors such as infrastructure and other factors including access to capital, credit ratings and debt indicators (Euromoney 2013). A region's risk score is a weighted average of the ECR country risk scores. The weighting is made by the countries' total oil and gas production. The market shares of the EU 27's oil and gas imports are the region's market share percentages in 2011.

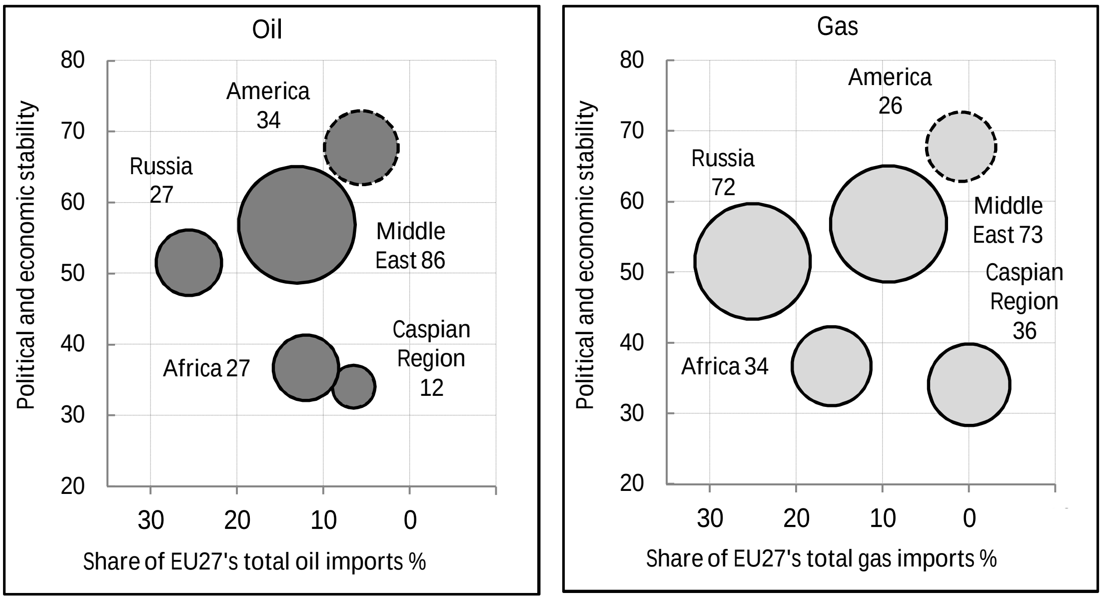
Table 6.13 and figure 6.13 present the final results of the regional analysis. Both the oil and gas aggregated scores are according to the case "combined reliability and importance" because it is regarded as the most realistic. It is not argued that the criterion weights in this case are the best possible but it is argued that they reflect steps in the right direction when considering the factors influencing criterion weights.

Table 6.13 Final results of regional analysis

	Russia	Caspian Region	Middle East	Africa	America	EU 27+	Rest of World
Aggregated oil score	27	12	86	27	34	-27	-50
Share of EU 27's oil imports %	26	7	13	12	6	33	4
Aggregated gas score	72	36	73	34	26	-44	-39
Share of EU 27's gas imports %	25	0	9	16	1	40	9
Region's ECR risk score	52	34	57	37	68	81	57

Aggregated oil and gas scores are calculated according to the case combined reliability and importance. Source data: Euromoney 2013, Eurostat 2013

Figure 6.13 Final results of regional analysis



The number after the region's name is the region's aggregated score and the bubble areas are proportional to the aggregated scores. In principle, the smaller the bubble and the more to the left and downwards the bubble is located, the worse the situation.

Some remarks concerning the interpretation of the results are worthwhile. First, some regions include several countries whose country risks or market shares in the EU can substantially differ from each other. For example, in America, Canada's country risk score is 82.3 and Venezuela's 32.3 and in the Middle East, Qatar's country risk score is 72.6 and Iran's is 24.4. In 2011, practically all American gas imported to the EU 27 originated from Trinidad & Tobago. Especially America includes countries that are net importers of oil and/or gas and countries that are net exporters of oil and/or gas. Furthermore, most of America's aggregated oil scores stem from Canada's and Venezuela's unconventional oil and gas scores from the USA's unconventional gas. Therefore, America's criterion and aggregated scores shall be interpreted as averages and a more detailed analysis would be necessary to give the right picture of America's position in the global oil and gas markets. However, such an approach is outside of the scope of this regional analysis.

Russia has the third largest aggregated oil score (27) and Russia's greatest weaknesses in the oil sector are the smallest reserves growth (4) and the second smallest proved reserves (11). Russia's greatest strengths are the third largest production growth (63), second largest recent export potential (37) and third largest future export potential (34).

Russia has the second largest aggregated gas score (72) and Russia's greatest weaknesses in the gas sector are the second smallest reserves growth (16) and the smallest gas production growth (11). Russia's greatest strengths are the largest conventional gas resources (100), largest recent export potential (100) and largest future export potential (100). Russia has the largest share of the EU27's gas imports, 25% of total imports, and also the largest share of oil and oil products imports, 26% of total imports. Russia has the third best (or the third worst) regional risk rating in terms of its ECR score (52).

7 Assessment of oil and gas companies

In this chapter, first the companies which are benchmarked are chosen. Then the methods and criteria which can be used in the assessment of oil and gas companies are discussed and the criteria used in the benchmarking are chosen. Finally, the chosen companies are benchmarked against each other using the chosen criteria.

7.1 Choice of companies

Besides the fact that companies are different and unique, the use of different accounting standards and different reserves reporting rules complicate comparisons between oil and gas companies. Furthermore, most of the national oil companies in the Middle East, Africa and the Caspian Region disclose only limited amounts of financial information (IEA 2008). The readability of this analysis also restricts the number of companies. For these reasons, it is decided to benchmark leading Russian oil and gas companies: Gazprom, Gazprom Neft, Lukoil, Rosneft and Tatneft against the Western oil and gas majors: Chevron, Exxon Mobil, Shell and Total. Because the western companies have activities everywhere in the world, it can be thought that Russian companies are benchmarked against the western effectiveness and efficiency in worldwide oil and gas activities. Table 7.1 presents the average geographical distribution of the oil and gas production of the western companies included in this analysis.

Table 7.1 Average geographical distribution of production in 2012

	USA	Other America	Europe	Africa	Middle East	Asia	Australia/ Oceania
Oil production %	17	8	12	30	18	13	2
Gas production %	22	7	21	6	17	19	8

Source data: Chevron 2013a, Exxon 2013b, Shell 2013a, Total 2013a

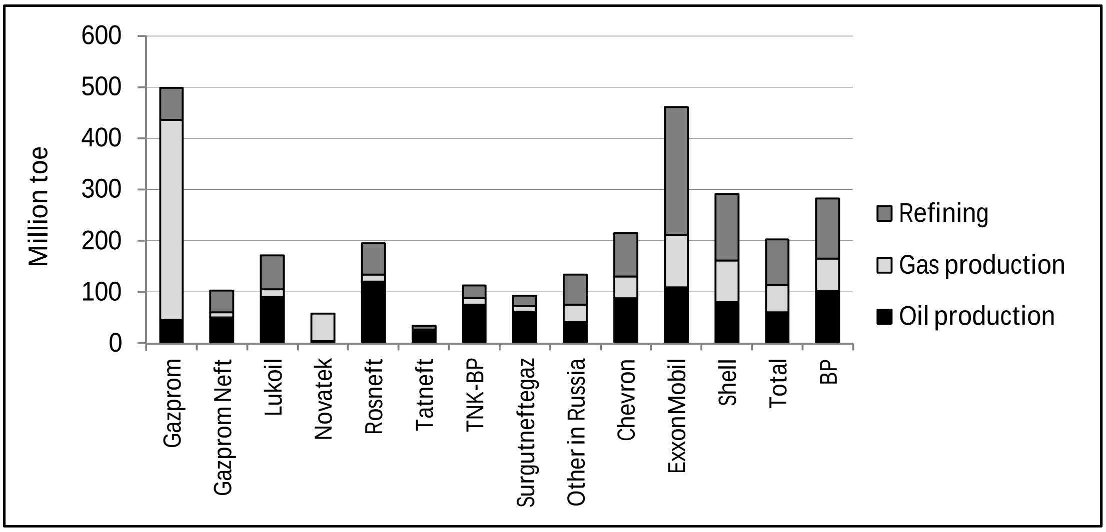
All the chosen companies are integrated oil and gas companies which are engaged in oil and gas exploration, production, processing, distribution and marketing activities. Many companies produce also oil- and gas-based chemicals and other types of energy, like electricity and renewables. Also, most of the Russian companies have exploration, production, distribution and marketing activities abroad.

Gazprom owns the Unified Gas Supply System of Russia (UGSS) stretching for 168.3 thousand km and has an exclusive right to export gas from Russia (Gazprom 2013b). Chevron, Exxon Mobil, Shell, Total and Lukoil are privately owned companies. The Russian State owns controlling stakes of 50.002% and 69.50% in Gazprom and Rosneft, respectively. Gazprom owns 95.68% of Gazprom Neft’s shares. The Republic of Tatarstan owns 33.59% of Tatneft’s share capital and has a “Golden Share”, a special governmental right, in the company (Tatneft 2013a).

In March 2013 Rosneft announced that it has completed the acquisition of a 100% stake in TNK-BP, a large private oil and gas company earlier owned by British BP and a group of Russian investors (Rosneft 2013c). In 2012, 42% of BP’s oil came from TNK-BP (BP 2013b). Because of the changed situation both BP and TNK-BP are excluded from this analysis. One significant Russian company Surgutneftegaz is excluded because it uses only the Russian reserves reporting system and until 2012 it used only the Russian accounting standards (RAS), both of which differ significantly from the western systems.

OAO Novatek Russia's second largest gas producer is only partly analyzed in this study. In the recent years, Novatek has strongly grown due to active acquisitions of resources and active exploration and development activities in a favorable operating environment in West Siberia. Novatek's recent growth has been so strong that the company does not fully fit in a relative analysis used in this study. However, the actual values of Novatek's operational and financial criteria are presented in the appropriate chapters. Figure 7.1 presents the production volumes and structures of certain interesting companies.

Figure 7.1 Companies' production and its structure in 2012



BP's production includes 50% of TNK-BP's production; Gazprom's production includes Gazprom Neft's production from its consolidated subsidiaries. Source data: Annex 1, BP 2013b, Surgutneftegaz 2013

Besides the differences in reporting systems, ownerships and geographical distribution of activities, the companies differ from each other both in production volume and structure. This means that they are differently exposed to risks related to prices and demand of oil, gas and oil products. One guideline in relative valuation is to choose similar companies for comparisons (Damodaran 2002). The only answer to this recommendation is that, after all, the set of suitable candidates for benchmarking is rather small. The Russian companies included in this analysis produced 58% of Russia's oil, 78% of Russia's gas and 61% of Russia's oil products in 2012.

7.2 Description and choice of criteria

7.2.1 Assessment methods

The assessment of a company's performance is often based on its value and the factors influencing it. A company which performs better has more value and companies themselves strive for higher values. To estimate a company's value, an analyst has various methods at his/her disposal. The three main approaches are: Discounted cash flow (DCF) method, real option method and relative valuation. Because all these methods use information from a company's financial statements, the fictitious US GAAP financial statements are presented in table 7.2 in order to support the following discussion. US GAAP statements are chosen because they are widely used by Russian and western oil and gas companies.

Ideally, the valuation of a company or project should be made using the discounted cash flow method because it is the foundation on which the other valuation approaches are constructed (Damodaran 2002). The present value (PV) of a company is determined by discounting the expected cash flows at the company's cost of capital. The value of a company can be expressed by the following two formulas (Brealey et al. 2008):

$$(7.1)\quad PV = \frac{FCF_1}{1+WACC} + \frac{FCF_2}{(1+WACC)^2} + \cdots + \frac{FCF_H}{(1+WACC)^H} + \frac{TV}{(1+WACC)^H}$$

$$(7.2)\quad WACC = r_D(1 - T_C)\frac{D}{D+E} + r_E\frac{E}{D+E}$$

FCF is the free cash flow of a company. Free cash flow is the cash which remains with investors after a company has paid all its expenses, including investments. TV is the terminal value of a company after the valuation horizon H. WACC is the weighted average cost of capital, which takes into account the capital structure and risks of a company. D and E are the market values of a company's debt and equity, respectively, and r_D and r_E are their expected rates, i.e., the costs of debt and equity. T_C is the income tax rate, and the coefficient ($1-T_C$) takes into account the tax shield stemming from the interest on the debt being deductible in income taxation. In practice, a company can have many different sources of financing, like different bonds, debts, preferred and common stocks, and WACC is calculated as the weighted average of a company's financing portfolio (Damodaran 2002).

The discounted cash flow method underestimates the value if there are real options embedded in the investment or asset. In such situations, the real option method can be used. A real option is the right, but not the obligation to undertake a decision, typically the option to make a capital investment or postpone the investment decision. The real option valuation is based on an underlying asset whose value changes in an unpredictable way over time. In the oil and gas environment an underlying asset could be, e.g., undeveloped reserves, whose value depends on the price of oil. The current value of reserves can be such that the development of reserves is not profitable. However, the value has upside potential due to the variation of oil prices, and the real option has a positive value. The option value can be defined using an option pricing method and the real option premium can be added on the discounted cash flow valuation (Damodaran 2002, Dixit et al. 1994).

An external analyst is facing a Herculean task if he/she tries to apply the discounted cash flow or real option method. The use of these methods requires detailed data, like the value and quantity of economically recoverable resources, estimates of future production profiles, future capital and operational costs and a company's cost of capital. Most of this data is not available to outsiders because it is of competitive value to companies (Mitchell 2004). Therefore, analysts often use relative valuation, which compares the values of relevant criteria to those of other companies. The criteria used in relative valuation are multiples and fundamentals (adapted from Antill et al. 2000).

Table 7.2 US GAAP financial statements

Balance sheet		*Income statement*	
Assets		Total revenues	320
Current assets		Costs and deductions	
Cash and cash equivalents	20	Operating expenses	(30)
Other current assets	30	Cost of purchased oil and oil products	(110)
Total current assets	50	Transportation expenses	(10)
Property, plant and equipment [1)]	100	General and administrative expenses	(10)
Goodwill and other intangible assets	10	Depreciation, depletion and amortization[2)]	(10)
Other non-current assets	30	Taxes other than income taxes [3)]	(40)
Total assets	240	Excise and export tariffs [3)]	(50)
Liabilities and equity		Exploration expenses [4)]	(5)
Current liabilities		Other expenses	(10)
Short term debt	10	Income from operating activities	55
Other current liabilities	30	Interest expense	(5)
Total current liabilities	40	Interest and dividend income	0
Long term debt	100	Other non-operating expense (income)	(5)
Other non-current liabilities	60	Minority interest	(5)
Minority interest in subsidiaries	10	Income before income tax	40
Total liabilities	210	Income tax	(10)
Shareholders' equity	30	Net income	30
Total liabilities and equity	240	Available for dividends	30
Cash flow statement		*Certain accounting indicators*	
Net income	30	Earnings before interest and taxes	
Adjustments of non-cash items		EBIT=Net income + income tax + interest expense	
Depreciation, depletion and amortization	10	-interest and dividend income	
Dry hole costs	3		
Other adjustments net	5	Earnings before interest, taxes, depreciation and	
Change in working capital	2	Amortization	
Cash flow from operations (CFO)	50	EBITDA=EBIT + depreciation, depletion and	
		amortization	
Cash flow used for investment activities		T=income tax rate	
Capital expenditures	(40)		
Other purchases and sales net	(30)	Free cash flow	
Net cash used in investment activities	(70)	FCF=CFO - capital expenditures + (1-T) x interest	
Cash flows from financing activities		expense	
Net movements of short term debt	10		
Proceeds from long term debt	30	Debt adjusted cash flow	
Principal payments of long term debt	(10)	DACF=CFO + interest expense x (1-T)	
Dividends paid	(5)		
Other items net	5	Capital employed (CE)	
Net cash from financing activities	30	CE = Shareholders' equity + long term debt +	
Effect of exchange rate changes	(5)	Short term debt + minority interest in subsidiaries	
Net increase (decrease) in cash	5		
Cash at the beginning of year	15		
Cash at the end of year	20		

1) Includes also capitalized exploration and development costs. 2) Includes also depreciation of capitalized exploration and development costs. 3) Upstream taxes and tariffs are sometimes included in revenues and sometimes not 4) Includes expensed exploration costs (adapted from Lukoil 2013a).

Multiples are market-based indicators whose values are signals from financial markets. They measure the relative value of a company. The value of an asset is divided by some accounting or non-accounting figure because absolute values cannot be compared (Damodaran 2002). If multiples are used alone, they can give a one-sided picture of a company's performance. Therefore analysts use also other performance measures, fundamentals, which are supposed to drive the value of a company or otherwise deliver useful information.

Because financial statements may include shortcomings and biases, it is recommended that analysts also rely on non-accounting information (Osmundsen et al. 2006, Quirin et al. 2000). In this study, fundamentals measure profitability, efficiency, growth and risk. The following sectors 7.2.2-7.2.6 present the criteria used in this analysis. Only then the choice of criteria is discussed in sector 7.2.7 because the choice of criteria is easier to justify if the criteria and their alternatives are already known.

7.2.2 Assessing value

In this study, value is assessed using the multiples: enterprise value to debt-adjusted cash flow (EV/DACF), enterprise value to proved reserves (EV/reserves) and price to earnings ratio (P/E). Other often used multiples are enterprise value to earnings before interest, income tax, depreciation, depletion and amortization (EV/EBITDA) and enterprise value to revenues (EV/revenues) (cf., e.g., Antill et al. 2000, Lukoil 2013c). Enterprise value (EV) and market capitalization (MC) are defined as follows:

(7.3) $EV = Market\ cap + Long\ term\ debt + Short\ term\ debt - Cash$

(7.4) $MC = Number\ of\ outstanding\ common\ shares \times Share\ price$

The use of EV instead of MC is recommended because MC takes into account only equity financing. The aggregated cash flows generated by a company are attributable to the sum of equity and debt financing. The formula for EV/DACF is the following (adapted from Antill et al. 2000):

(7.5) $\frac{EV}{DACF} = \frac{EV}{Cash\ flow\ from\ operations + Interest\ expense \times (1 - T_C)}$

The $(1\text{-}T_C)$ term in the denominator takes into account the tax shield. DACF can roughly be interpreted as the amount which remains for reinvestments and interest and dividend payments.

The ratio of the enterprise value to the quantity of proved reserves (EV/reserves) is often used to benchmark companies against each other as well as against the value of asset transactions, e.g. the acquisition of an oil field. The price-to-earnings ratio P/E (market value of share/net income per share) focuses only on the equity stake of a company but is often used in comparisons between companies (Antill et al. 2000).

The value of a multiple is a signal from financial markets. Consequently, the greater the value compared to benchmarks, the better the situation from a seller's point of view, but on the other hand, low value may mean share price appreciation potential, which is good from a buyer's point of view.

7.2.3 Assessing profitability

In this study, profitability means a company's ability to generate revenues compared to expenses. Analysts use different accounting figures, like earnings and cash flows in the numerator and revenues or different capital measures, like equity, total assets and capital employed in the denominator for constructing different profitability ratios (Antill et al. 2000, Lukoil 2013c).

Three different profitability ratios that are used in the oil and gas industry and also in this study are presented. Return on average capital employed (ROACE) is widely used in the industry, but it is also criticized in several research reports. One of the many formulas of ROACE is the following (Antill et al. 2000):

$$(7.6)\quad ROACE = 100 \times \frac{Net\ Income + Interest\ exp \times (1 - T_C) + Minority\ interest}{Average\ capital\ employed}$$

Capital employed (CE) can be defined from a debt and equity or asset and liability perspective. The value is the same.

$$(7.7)\quad CE = Equity + Long\ term\ debt + Short\ term\ debt + Minority\ share$$
$$= Total\ assets - Liabilities\ excluding\ debt\ and\ minority\ share$$

The $(1 - T_C)$ term in the numerator takes into account the tax shield. Minority share (or minority interest in subsidiaries) belongs to other investors and minority interest is the corresponding share of income. Capital employed is often calculated as the average of the accounting period. ROACE represents the return to capital providers before dividend and interest payments. ROACE takes into account both debt and equity financing.

Some Russian companies use EBITDA in their reports and the EBITDA margin as a measure of profitability. The EBITDA margin can be written as follows (Steven 2008, Rosneft 2013b):

$$(7.8)\quad EBITDA = Net\ income + Income\ tax + Interest\ expense - interest$$
$$and\ dividend\ income + Depreciation, depletion\ and\ amortization$$

$$(7.9)\quad EBITDA\ margin\ \% = 100 \times \frac{EBITDA}{Revenues}$$

A shortcoming of EBITDA is that it ignores the very real costs of income taxation and capital expenditures. An analyst should also be careful with revenues because some companies include sales and production-based taxes in revenues and some do not (cf. e.g. Lukoil 2013a, Shell 2013a). Cash flow to assets measures a company's ability to generate cash from its current operations and it avoids certain shortcomings of the EBITDA margin. It can be defined in the following way:

$$(7.10)\quad Cash\ flow\ to\ assets\% = 100 \times \frac{Cash\ flow\ from\ operations}{Total\ assets}$$

Some other often used profitability indicators are: net income to total assets (ROA) and return on equity (ROE).

In principle, the value of ROACE should be greater than a company's cost of capital. The criticism against ROACE and corresponding indicators focuses on the differences in companies' depreciation policies, which may distort profitability values. For example, the ROACE of a company which has fully depreciated old but productive oil fields may be disproportionally high compared to a growing company which has invested in new production.

7.2.4 Assessing efficiency

A company which is capable of producing oil or gas or of adding reserves at lower cost than its competitors is also able to create more value. According to research and company reports, the most often used efficiency indicators are production costs, finding costs and finding and development costs (cf. Antill et al. 2000, Osmundsen et al. 2006, Exxon 2013b).

Production costs, sometimes called lifting costs, include, *inter alia*, labor, repair and maintenance, material and energy costs required to operate the wells and related equipment. In this analysis, production costs do not include production taxes.

Finding costs (FC) are calculated by dividing the annual exploration costs by the annual volume of discoveries. However, a more comprehensive indicator is finding and development costs (FDC) because the cost of bringing new oil and gas reserves on stream is not merely the cost of finding them, but also the cost of bringing them into production.

(7.11) $Production\ costs = \frac{Production\ costs}{Production\ volume}$

(7.12) $FDC = \frac{Explor.\ costs + Develop.\ costs + Acquisition\ \ of\ unproved\ res.}{Extensions\ and\ discoveries\ of\ proved\ reserves}$

Practical experiments show that the yearly FDC of a company can vary considerably. This is logical because the denominator of FDC is more or less stochastic by nature. Development costs in the numerator are typically the largest cost item. Development costs have no direct connection with the denominator because they also address purchased undeveloped proved reserves. At the very least, FDC must be calculated as an average of a longer evaluation period, e.g., three years as many companies do (cf. Exxon 2013b, Lukoil 2013c).

Many companies use different versions of an indicator "proved reserves replacement costs". Compared to FDC, the numerator of this indicator also includes costs of acquisition of proved reserves and the denominator all the additions of proved reserves: extensions and discoveries, revisions, improved recovery and purchases (Exxon 2013b). Practical experiments show that in such cases where revisions have an important role this indicator is very unstable and costs can even be negative.

Comparisons between companies using production or finding and development costs or corresponding indicators may sometimes be difficult because some companies, e.g., Gazprom, do not disclose production and reserves replacement costs or data required to calculate them. In the case of gas, there may also be cost allocation problems because many development projects include huge investments in transport infrastructure. Most companies report production and reserves replacement costs, as well as the data for them, as an average per barrel of oil equivalent including both oil and gas costs. Presumably, oil and gas costs differ from each other. If companies use different reserves reporting rules, e.g., the SEC and PRMS, the comparisons between reserves additions are not fully correct.

7.2.5 Assessing growth

The foundation of oil and gas companies' upstream operations is their resources and their resources' balance with production. Stable growth requires growth also in reserves. The key principle is that a company or region which increases its reserves relatively (e.g. in percents) less than production is on an unsustainable path. Besides quantities as such, two often used indicators describing the balance between reserves and production are the reserves replacement ratio and reserves to production (R/P) ratio (Antill *et al.* 2000):

(7.13) $Res.replacement\,ratio\;(\%) = 100 \times \frac{Proved\,reserves\,addition(i)}{Production\,volume(i)}$

(7.14) $\frac{R}{P}\,ratio\;(years) = \frac{Proved\,reserves(i)}{Production\,volume(i)}$

The reserves replacement ratio tells whether a company or region has increased or decreased its proved reserves during the assessment period i. The reserves-to-production ratio tells how many years proved reserves last if the production rate is the same as in the assessment year i and the quantity of reserves does not change.

If interest is on sustained growth, the comparison between the compound growth (CG), compound annual growth (CAG) or compound annual growth rate (CAGR) of reserves and the production or growth balance index (GBI) may work better if a long enough assessment period is used (formulas 7.15-7.18).

(7.15) $CG = \frac{Volume(last\ year\ of\ assessment\ period)}{Volume(first\ year\ of\ assessment\ period)}$

(7.16) $CAG = CG^{1/n}$, $n\ is\ the\ length\ of\ assessment\ period$

(7.17) $CAGR = 100 \times (CAG - 1)$

(7.18) $GBI = \frac{CG(reserves)}{CG(production)}$

If the value of the growth balance index (GBI) is less than one, the company or region has a decreasing R/P ratio.

All the above indicators are rather blunt instruments if they are used without the corresponding production volumes and if they are based only on one year's data. For example, a company or region whose production is in sharp decline could get excellent values in all the above indicators. The reserves replacement ratio and R/P ratio are not fully correct in comparisons between companies using different reserves reporting rules.

7.2.6 Assessing risk

The weighted average cost of capital (WACC) reflects the medium- and long-term risks to which a company is exposed. The formula of WACC (formula 7.19) divides risk into two components: equity risk and default risk.

(7.19) $$WACC = r_D(1-T_C)\frac{D}{D+E} + r_E\frac{E}{D+E}$$

T_C is the income tax rate of a company and D and E are values of debt and equity, respectively. Equity risk is related to dividends and fluctuations of share prices. The return on equity can be determined e.g. by the capital asset pricing model (CAPM) (formula 7.20).

(7.20) $$r_E = r_f + \beta_L(r_m - r_f)$$

(7.21) $$\beta_L = (1 + (1-T_C)\frac{D}{E})\beta_i$$

The return on equity r_E is determined based on the risk free rate r_f, the return of the relevant market index r_m and beta (β_i). The term r_m- r_f is the risk premium. β_i is a measure of the volatility of stock price. β_i is adjusted by the leverage ratio (D/E) of a company (formula 7.21). Thus, companies with higher leverage have higher betas and higher equity risk and cost of equity (Brealey et al. 2008).

Default risk is related to the promised cash flows from debt and interest payments, and is often measured by default spreads. The default spread is the premium which compensates for the risk of default. The default spread can be determined based on country ratings and companies' credit ratings assigned by independent rating agencies, such as Standard & Poor's and Moody's. Their ratings are related to default spreads expressed in basis points. The basis point is a unit that is equal to 1/100th of 1% (Damodaran 2002).

The key determinants in country ratings are political and economic risk and the main components of company credit ratings are business risk and financial risk. In a certain country, a company's cost of capital can be determined, e.g., in the following way (Damodaran 2012):

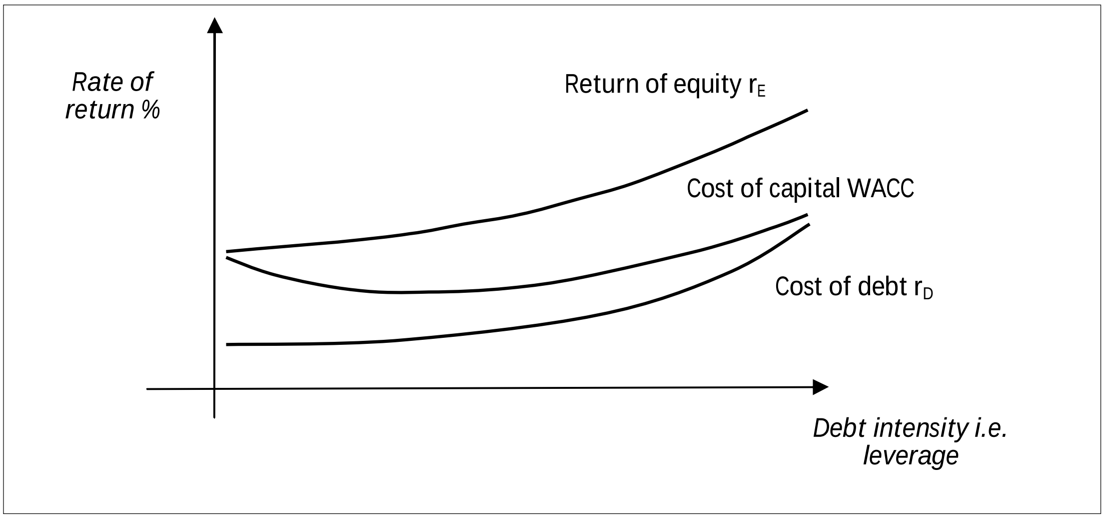
(7.22) $$r_E = r_f + \beta_L \times US\ risk\ premium + Country's\ default\ spread$$

(7.23) $$r_D = r_f + Country's\ default\ spread + Company's\ default\ spread$$

Company ratings are clearly tied to the measures of indebtedness, although there are also other important factors like a company's size and in the oil and gas environment, oil and gas prices and the quantity of reserves (Standard & Poor's 2013). However, ratings alone do not fully determine a company's cost of debt. Other important factors are, e.g., debt maturity and once again leverage (Damodaran 2012).

In perfect markets, it makes no difference whether a company finances itself with debt or equity (Brealey et al. 2008). However, oil and gas companies do not operate in perfect markets. There are many benefits to using debt, including the tax benefits of interest deductibility and control of managements by financial markets. There are also costs to using debt, including expected losses of financial distress and decreasing flexibility in financial decisions (Brealey et al. 2008). Consequently, to a certain company-specific point leverage brings benefits but beyond that point costs outweigh benefits (figure 7.2).

Figure 7.2 Costs of equity, debt and capital



Adapted from Damodaran 2012

It can be deduced that the higher a company's leverage, the more risky the company is. Three measures of debt intensity used also in the oil and gas industry, namely debt to equity, debt to market value of equity and debt to cash flow, are presented.

(7.24) $$\text{Debt to equity} = \frac{\text{Long term debt} + \text{Short term debt} + \text{other debt}}{\text{Equity}}$$

Debt and equity can be calculated based on book values or market values. The market value of debt is often replaced by the book value because market value may be difficult to calculate and book and market values of debt normally converge (Damodaran 2002). The market and book values of equity can differ considerably from each other, and the market capitalization of a company is often used as the market value of equity. If a company has many types of shares and debt, they all are taken into account when defining risk.

The purpose of the debt-to-cash flow indicator is to assess a company's ability to pay off its debts compared to other companies. In principle, it can be thought that this indicator tells how many years a company needs to pay off its debts.

(7.25) $$\text{Debt to cash flow} = \frac{\text{Total debt}}{\text{Cash flow from operations}} = \frac{D}{CFO}$$

Oil and gas companies' market capitalization and cash flow (CFO) are usually sensitive to changes in oil and gas prices. Consequently, indicators including them are often rather unstable. Companies often use book values of equity in their reports but textbooks and many research papers recommend using market values (cf. Exxon 2013b, Damodaran 2002).

7.2.7 Choice of criteria

The criteria used in this company analysis are chosen taking into account the critical factors, the recommendations presented in relevant research reports and literature, the criteria used in companies' reports and the availability of relevant data.

The critical factors can be described by the potential, growth, value, profitability, efficiency, and debt intensity of Russian oil and gas companies. The problem in determining the appropriate criteria is that only an analyst's imagination sets limits on the quantity of possible alternative criteria measuring the same dimensions. Table 7.3 presents the critical factors, the criteria proposed or recommended by certain sources, the criteria which companies use in their reports and the criteria used in this study.

Table 7.3 Dimensions and criteria for assessment of companies

Dimension/criteria	Critical factors	Antill et al. 2000	Steven 2008	American	Osmundsen	Companies	This study
Value	x						
EV/DACF or EBITDA		x	x	x	x	1	xx
EV/reserves		x	x				x
P/E		x	x			3	x
Total shareholder's return						4	
Profitability	x						
ROACE or ROA or ROE		x	x		x	8	xx
EBITDA margin			x			2	x
Net income or profit margin			x	x		5	
Cash flow to assets				x			x
Efficiency	x						
Res. replacement costs	x	x		x	x	4	
Production costs	x	x	x		x	7	xx
Growth	x						
Reserves quantity or R/P ratio		x		x			xx
Reserves growth	x	x	x	x	x	4	xx
Production growth	x	x	x	x		1	xx
Risk or financial distress	x						
Debt to market capitalization							x
Debt to equity		x				8	xx
EBITDA interest coverage						5	
Debt to cash flow						1	x
Market conditions					x		

American means Quirin et al. 2000, Berry et al. 2001. Osmundsen refers to Osmundsen et al. 2006 and 2007. The "companies" column tells the number of companies in this analysis using the criterion in question. "This study" column tells the criteria used in this study. The primary criteria are denoted by xx and secondary criteria used in sensitivity analysis by x.

The different sets of criteria presented in table 7.3 are briefly commented upon in the following. Antill et al. 2000 present a number of criteria, including ROACE, which can be used for assessing integrated oil and gas companies. Such criteria used by Antill et al. which are suitable for measuring the critical factors are selected in the table.

A bit later, Antill et al. 2002 present criticism against the use of ROACE. Their main argument is that the most profitable assets of many companies are old, almost completely depreciated oil and gas fields which generate large cash flows and high ROACEs. On the other hand, companies which have invested more in exploration look less profitable. A larger part of their capital is less depreciated, and invested in assets which are not yet generating cash. Hence, the pursuit of too high profitability restrains promising investments in exploration and development. Furthermore, ROACE and other similar indicators do not provide an adequate measure of profitability due to the difference between accounting depreciation and economic depreciation. Economic depreciation means the decline of the market value of an asset.

Steven 2008 proposes a set of indicators which can be used for assessing both private international oil and gas companies and partly national oil and gas companies. These criteria are presented in table 7.3. Gazprom, Gazprom Neft, Rosneft and Tatneft are partly national companies.

Some researchers use value relevance analyses in order to find suitable criteria for assessing oil and gas companies. The purpose of value relevance analyses is to examine the relationship between a company's market value and fundamentals in order to assess the usefulness of fundamentals in valuation. The results of three such analyses are briefly presented.

Quirin et al. 2000 use the data of the U.S. exploration and production companies from the years 1992-1996. They find that the EV/EBITDA of the previous year, cash flow, reserves replacement costs and reserves and production growth are value relevant. Berry et al. 2001 use a sample of U.S. oil and gas companies from the years 1990-1993. They find that reserves quantity, exploration expenses and historical values of equity and net income are value relevant. The criteria recommended by Quirin et al. and Berry et al. are presented in the column "American" in table 7.3.

The data set of Osmundsen et al. 2006 and 2007 consists of stock price and financial and operational information of 14 international oil and gas companies over the period 1990-2003. They use the multiple EV/DACF and their fundamentals include oil and gas production, reserve replacement ratio, production costs, finding and development costs, ROACE and oil prices. Their main findings are the following: the price of oil has a negative correlation with EV/DACF. The negative effect of the price of oil to EV/DACF is explained by the supposition that a high oil price inflates and a low price deflates DACF, i.e., DACF is more sensitive to oil prices than EV. Company size measured by oil and gas production has positive correlation with EV/DACF. This is explained by the belief that big companies possess several scale benefits in taxation, marketing and resource utilization. The reserves replacement ratio has, to some extent, a positive correlation with EV/DACF.

Osmundsen et al. find that in contrast with common perceptions ROACE is not an important value driver. They offer some possible explanations for this result, e.g., ROACE does not necessarily measure the true economic profitability (Osmundsen et al. 2006).

Also, investors may want a more balanced tradeoff between ROACE and sustained growth measured by reserves replacement (Osmundsen et al. 2007).

As a conclusion of the recommendations and value relevance analyses, it could be deduced that reserves and production growth, production and reserves replacement costs, reserves quantity, oil price, net income, cash flows and equity behave as could be expected. Moreover, some words in defense of ROACE and similar indicators are called for. If the starting point is that companies' assets are undervalued, and for this reason, companies do not sufficiently generate new projects, ROACE will in any case, sooner or later, go down. Presumably, the portfolios of big oil and gas companies include several projects in different stages of development, which smoothes the movements in the values of ROACE. Finally, it can be argued that profitability is ultimately the only thing that really matters to a business. Another thing is too high short-term profitability at the expense of long-term profitability.

The utilization of the previous recommendations and research results is problematic because they are based on old samples from western countries. The Russian business environment, the recent high and volatile oil prices and changes in the perspectives of gas trade and production may have a great effect on the valuation of oil and gas companies.

The comparisons between companies are further complicated by the fact that Gazprom, Gazprom Neft, Rosneft, Shell, Tatneft and Total use IFRS (International Financial Reporting Standards) accounting and the other companies use US GAAP (United States Generally Accepted Accounting Principles). Moreover, Gazprom Neft, Rosneft and Tatneft previously used US GAAP. IFRS differs in certain respects from US GAAP (PwC 2011). Consequently, the values of financial indicators based on IFRS financial statements may differ from the values obtained if US GAAP were applied. The question is: how much do the figures in financial statements differ if US GAAP is used instead of IFRS or *vice versa*?

In the EU all publicly traded companies have been required to use IFRS since 2005. The U.S. Securities and Exchange Commission (SEC) required earlier that foreign companies listed in the USA made a reconciliation of IFRS net income and equity to US GAAP. In 2007 this requirement was removed (IFRS 2012). This means that the possible years for the comparisons of the differences between IFRS and US GAAP are 2005 and 2006. The International Accounting Standard Board (IASB) and the US Financial Accounting Standards Board (FASB) have been working together since 2002 to achieve convergence of IFRSs and US GAAP (IFRS 2012). In Russia, IFRS financial statements are required for publicly traded companies beginning in the financial year 2012 and for companies which already prepare US GAAP financial statements beginning 2015 (MinFin 2011). Consequently, the problems with comparisons between European, Russian and U.S. oil and gas companies will exist many years.

In order to get a picture of the differences of IFRS and US GAAP, the financial statements from the years 2005 and 2006 of five big European oil and gas companies listed in the USA were analyzed. Also, the US GAAP and IFRS financial statements of Rosneft for the years 2009, 2010 and 2011 were analyzed. Rosneft switched to IFRS in 2012 and published financial statements in accordance with both systems. Also, two relevant earlier research reports were analyzed. Henry et al. 2009 analyzed the differences between US GAAP and IFRS using 2004-2006 reconciliations of net income and equity. Smith 2011 presents statistics of the differences between IFRS and US GAAP based on reports of 126 companies from the EU from the years 2005 and 2006. According to Smith 2011, substantive differences between IFRS and US GAAP involve inventory valuation, valuation of fixed assets and their depreciation and valuation of leases and deferred taxes. The reconciliations between IFRS and US GAAP made by companies confirm the above.

Based on the above studies, table 7.4 presents the coefficients by which the IFRS values should be multiplied to get the corresponding US GAAP value. It is emphasized that the values in table 7.4 are based on relatively small samples with relatively great dispersions. The right interpretation of the discussion above and table 7.4 is that the differences between the two sets of accounting standards do not lead to significant over-all differences. However, there can be notable differences for specific items of individual companies. More precisely, comparisons of net income and equity or items including them are more risky than comparisons of revenue, total debt or cash flows. Consequently, in the previous table 7.3, the “risky” indicators are the P/E ratio, ROACE, net income margin, EBITDA margin, and debt to book value of equity.

Table 7.4 Differences between IFRS and U.S. GAAP

	Revenue	Net income	Total assets	Total debt	Equity	Cash flow
Oil company study	0.98	1.01	1.02	0.99	1.13	0.96
Smith 2011	1.10	1.22	0.94	n.a.	0.77	n.a.
Henry et al. 2009	n.a.	0.79	n.a.	n.a.	1.02	n.a.

The numbers in the cells are the means of the coefficients by which IFRS values should be multiplied to get the corresponding US GAAP value. Source data: BP 2007, Eni 2007, Repsol 2007, Rosneft 2012, Shell 2007, Total 2007, Henry et al. 2009, Smith 2011.

Besides the differences in accounting, companies also use different systems in reporting oil and gas reserves. Gazprom reports PRMS reserves and Lukoil reported PRMS reserves until 2010 before switching to SEC reporting. The same proved reserves of Tatneft are SEC or PRMS reserves depending on the report (cf. Tatneft 2012a, 2012b). The other Russian companies report SEC or both PRMS and SEC reserves. Western companies report SEC reserves. The SEC rules are regarded as stricter than PRMS rules. Consequently, the SEC reserves may be smaller than the corresponding PRMS reserves. For example, the PRMS proved reserves of NOVATEK, which operates in Northern and Western Siberia like Gazprom, were 20% greater than the corresponding SEC reserves in 2012 (Novatek 2013a, b). Undoubtedly, reserves quantities are company specific. Notwithstanding, this 20% gives some kind of picture of the differences.

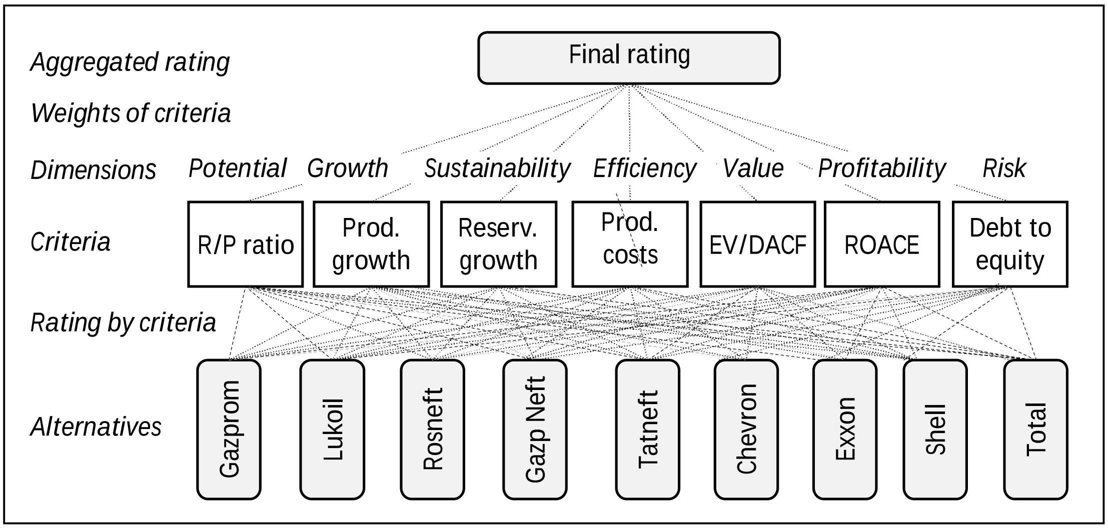
In a word, the choice of criteria is anything but simple and straightforward. The base set of criteria is: R/P ratio, production growth, reserves growth, production costs, EV/DACF, ROACE and debt to equity. The secondary criteria are: EV/reserves and P/E ratio instead of EV/DACF, EBITDA margin and cash flow to assets instead of ROACE, and debt to market capitalization and debt to cash flow instead of debt to equity. Secondary criteria are used in the sensitivity analysis to show how the choice of different criteria affects the analysis results.

7.3 Russian versus Western companies

7.3.1 Introduction

In this section, the Russian and western companies are benchmarked against each other with respect to the following dimensions: growth potential, growth, sustainability of growth, efficiency, value, profitability and risk using the appropriate criteria (Figure 7.3). Benchmarking is done with value tree analysis according to the principles presented in chapter 5.

Figure 7.3 Benchmarking oil and gas companies



All the criterion scores are calculated using the following linear criterion value function:

(7.26) $v_i(x_j) = 100 \cdot \frac{x_j}{x_j^*}$ *where* $x_j^* = max\, x_j$

In formula 7.26 x_j is the value of criterion *i* attached to the company *j* and x_j^* is the largest observed value of criterion *i* among all companies *j*. Thus the best company gets a score of exactly 100 and other companies get lower scores.

Criterion scores are combined to get the final rating using an additive value function:

(7.27) $V_j(X) = \sum_{i=1}^{N} \mu_i\, v_i(x_i)$ *where* $\mu_i = \frac{1}{N}$

The number of criteria N=7 and all the criterion weights are the same, i.e., μ_i=1/7 because there is no clear evidence supporting the different importance of the criteria. For more on the value relevance of criteria, see section 7.2.7. The companies are assessed as a whole, including oil, gas and other activities. An equivalent unit ton of oil equivalent (toe) is used to express oil and gas quantities.

Because part of operational and financial data, such as reserves additions, stock prices, revenues and earnings, is more or less stochastic by nature, the averages of the recent years are used. The assessment period of reserves and production growth is 2007-2012 and the assessment period of the other criteria is 2010-2012.

The benchmarking results are examined using sensitivity analysis. Sensitivity analysis is often made using the one-factor method in which the values of criteria or criterion weights are varied one at a time to examine which criteria are critical if the values of input parameters change. In this analysis, one-factor sensitivity analysis is not performed because of the great number of the criteria and alternatives whose values should be varied.

Instead of one-factor sensitivity analysis, three different criteria are used to measure each market and accounting dimension: value, profitability and risk. It is interesting to examine and demonstrate how the use of different criteria affects ratings and rankings. It is pointed out that different companies often use and different researchers often recommend different criteria to measure the same dimension.

The values of all the financial and operational criteria are calculated according to the formulas presented in sections 7.2.2-7.2.6. Thus, some values differ from those reported by the companies if companies have used different calculation rules. The companies' criterion scores, aggregated scores and the average scores of the Russian and western companies are calculated in the following four cases: base case, sensitivity 1, sensitivity 2 and sensitivity 3.

7.3.2 Potential, growth and its sustainability

Growth potential, growth and sustainability of growth are measured with the reserves-to-production ratio and compound growth of production and reserves, respectively, according to the following formulas:

(7.28) *Reserves to production ratio* $\frac{R}{P} = \frac{1}{3} \cdot \sum_{i=2010}^{i=2012} \frac{R(i)}{P(i)}$

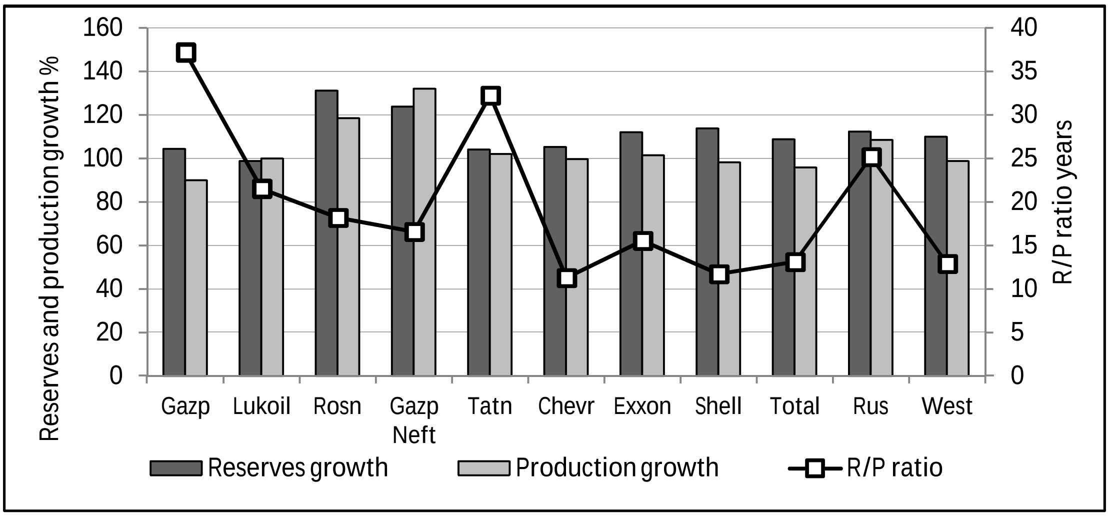
(7.29) *Compound growth* $CG = 100 \cdot \frac{Volume\ (2012)}{Volume(2007)}$

The average and compound values of three and six years are used to diminish the effect of stochastic and exceptional changes.

Gazprom's proved reserves quantities are a bit problematic. Until 2009 Gazprom reported SEC proved reserves but since 2010 it has reported PRMS proved reserves. However, the reported historical reserves quantities are practically the same according to both systems (Gazprom 2010, 2011b). The criterion scores of R/P ratio are calculated in two cases. In the case of R/P Gazprom's PRMS reserves are used and in the case of R'/P Gazprom's reserves are 20% smaller in order to approximate Gazprom's SEC reserves. Lukoil's reserves growth is calculated using the period 2009-2012 because Lukoil earlier used the PRMS system instead of the SEC system. It is supposed that the growth of the PRMS and SEC reserves with the same percentage is of the same value.

It is also reminded that the new SEC rules became effective on 1.1.2010. Presumably, the same reserves are greater under the new SEC rules than the old ones (cf. section 4.2). Consequently, comparisons between companies and also between different points of time are in many cases made under different rules. This cannot be avoided and it is supposed that the rules treat the companies objectively. The following figure 7.4 presents the actual values of the companies' reserves-to-production ratios, compound production and reserves growth and the average values of the Russian and western companies.

Figure 7.4 R/P ratio and production and reserves growth



Reserves and production growth are the percentages compared to the base year 2007 and whose value is set to 100. Novatek's reserves and production growth are 266% and 196%, respectively and the R/P ratio 28. Source data: Annex1.

The main observations from figure 7.4 are the following: Gazprom and Tatneft have clearly the greatest R/P ratio. The average R/P ratio of the Russian companies is twice as large as that of the western companies. Rosneft is the leader in reserves growth and Gazprom Neft in production growth. Except for Lukoil and Gazprom Neft, all the other companies have increased their reserves more than production. Consequently, their R/P ratios have been increasing. Lukoil and Gazprom Neft have had decreasing R/P ratios. The average production and reserves growth of the Russian companies are slightly greater than those of the western companies. Table 7.5 presents the numerical values and criterion scores of the R/P ratio and reserves and production growth. Practical experiments show that both reserves and production growth are sensitive to the length of the assessment period. This weakness of the analysis cannot be avoided if production and reserves growth are regarded as interesting and important.

Table 7.5 R/P ratio, reserves and production growth

	Gazp	Lukoil	Rosn	Gazp Neft	Tatn	Chevr	Exxon	Shell	Total	Rus	West
R/P, value	37	22	18	17	32	11	16	12	13	25	13
R'/P, value	30	22	18	17	32	11	16	12	13	24	13
RG, value	105	99	131	124	104	105	112	114	109	112	110
PG, value	90	100	118	132	102	100	101	98	96	109	99
R/P , scores	*100*	*58*	*49*	*45*	*87*	*30*	*42*	*32*	*35*	*68*	*35*
R'/P , scores	*92*	*67*	*56*	*51*	*100*	*35*	*48*	*36*	*41*	*73*	*40*
RG, scores	*80*	*75*	*100*	*94*	*79*	*80*	*85*	*87*	*83*	*86*	*84*
PG, scores	*68*	*76*	*90*	*100*	*77*	*75*	*77*	*74*	*73*	*82*	*75*

R/P is the R/P ratio, RG is reserves growth and PG is production growth. Rus is the average of the Russian companies and West is the average of the western companies. Value is the actual value of the criterion and scores are the criterion scores. In the case of R/P Gazprom's PRMS reserves are used and in the case of R'/P Gazprom's reserves are 20% smaller (approximation of SEC reserves). Source data: Annex 1.

7.3.3 Efficiency

Efficiency means the cost efficiency of a company when it adds proved oil and gas reserves and produces oil and gas. Efficiency is measured with production costs (PC) and finding and development costs (FDC):

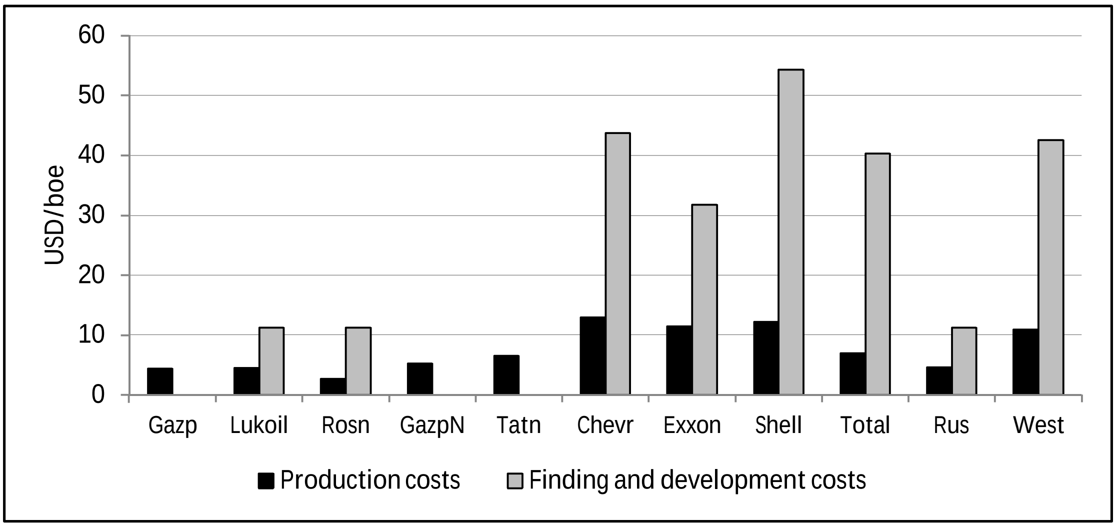
(7.30) $PC = \frac{1}{3} \cdot \sum_{i=2010}^{i=2012} \frac{production\ costs\ (i)}{production\ volume\ (i)}$

(7.31) $FDC = \frac{1}{3} \cdot \sum_{i=2010}^{i=2012} \frac{AC(i)+EC(i)+DC(i)}{proved\ reserves\ extensions\ and\ discoveries\ (i)}$

In formula 7.31, AC is the acquisition costs of unproved reserves, EC is exploration costs and DC is development costs.

Except for Gazprom, Gazprom Neft and Tatneft, the companies' production and finding and development costs are calculated based on the information in the supplementary oil and gas disclosure of the companies' financial statements. Gazprom's production costs are calculated based on the segment information in Gazprom's financial statements. These costs are in line with the costs occasionally reported by the management of Gazprom (e.g. Gazprom 2013a) and certain other sources (cf. EEGA 2013). Gazprom Neft and Tatneft report the data for calculating production costs but they do not report finding and development costs or data required to calculate them. All the costs are average oil and gas costs because separate costs are usually not available. The costs are calculated from the consolidated subsidiaries. Production costs do not include production taxes and/or royalties. Figure 7.5 presents the actual values of production and finding and development costs. Figure 7.5 also presents the average costs of the Russian and western companies.

Figure 7.5 Production and finding and development costs



Novatek's production and finding and development costs are 0.6 USD/boe and 1.5 USD/boe, respectively.

Table 7.6 presents the actual values and the criterion scores of the production costs. Finding and development costs are not used in the final rating because they are not available from all the companies and are in many cases unreliable. The criterion scores are calculated from the inverse of the production costs because in this case smaller is better.

Table 7.6 Production and finding and development costs

	Gazp	Lukoil	Rosn	GazpN	Tatn	Chevr	Exxon	Shell	Total	Rus	West
PC, values	4,4	4,5	2,7	5,3	6,5	13,0	11,5	12,2	7,0	4,7	10,9
FDC, values	n.a.	11,3	11,3	n.a.	n.a.	43,8	31,8	54,3	40,3	11,3	42,5
PC, scores	*62*	*61*	*100*	*51*	*42*	*21*	*24*	*22*	*39*	*58*	*25*

Source data: Annex 1

Rosneft has the lowest production costs. The company itself claims that it has a reserve base of unique size and quality and Russia's lowest per barrel upstream operating expenses. This may be true because a significant part of Rosneft's production comes from fields, such as the Priobskoye and Vankor fields, where the productivity of wells is high (Rosneft 2013e).

Presumably, companies' average production costs depend on production regions and their challenges, types of oil and gas, the shares of oil and gas in companies' production and the depletion rates of fields. Although the western companies have oil and gas production in the Middle East, most of their production comes from more challenging and costly regions such as America, Europe, Africa and Asia, where costs are higher than in Russia also according to other sources (e.g. IEA 2012a).

7.3.4 Value and profitability

In this analysis, value means a company's relative market value and profitability the relative surplus of revenues compared to expenses. In the base case, value is measured by enterprise value to debt adjusted cash flow (EV/DACF) and profitability by return on average capital employed (ROACE) using the average values from the years 2010-2012.

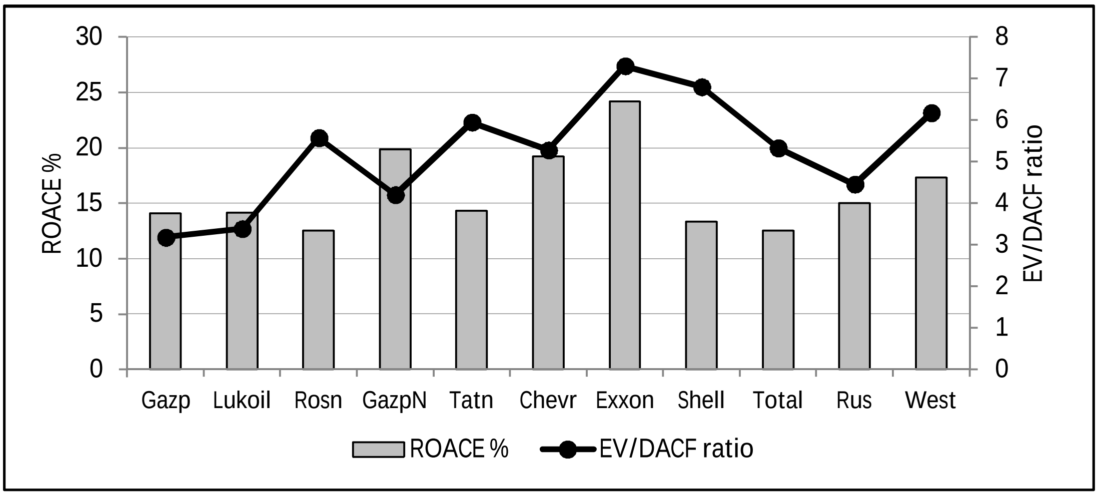
$$(7.32)\quad \frac{EV}{DACF} = \frac{1}{3}\sum_{i=2010}^{i=2012}\frac{Market\ capitalization + Total\ debt - Cash}{CFO + Interest\ expense \times (1 - T_C)}$$

$$(7.33)\quad ROACE = 100 \cdot \frac{1}{3}\sum_{i=2010}^{i=2012}\frac{NI + Interest\ exp \times (1 - T_C) + MI}{Average\ capital\ employed}$$

In the above formulas CFO is cash flow from operations, T_C is the income tax rate, NI is net income, MI is minority interest and average capital employed is the sum of equity, total debt and minority interest calculated as an average of the accounting period. Figure 7.6 presents the actual values of the companies' EV/DACF and ROACE and the averages of the Russian and western companies. Table 7.7 presents the corresponding numerical values and criterion scores.

The most interesting finding from figure 7.6 and table 7.7 is that there are not very big differences between the profitability of the Russian and western companies when profitability is measured by ROACE. The relative value of the western companies is clearly higher than that of the Russian companies when value is measured by EV/DACF. Exxon Mobil has the highest ROACE and EV/DACF. The average ROACE of the western companies is 16% higher and the average EV/DACF is 37% higher than those of the Russian companies. Some analysts compare the values of a multiple, such as EV/DACF and a fundamental, such as ROACE and recommend buying the shares of such companies which have low relative value and high profitability (Damodaran 2012, Osmundsen et al. 2007). According to this reasoning and figure 7.6, Gazprom Neft is an attractive buying target.

Figure 7.6 ROACE and EV/DACF



Novatek's ROACE is 27% and EV/DACF is 20.

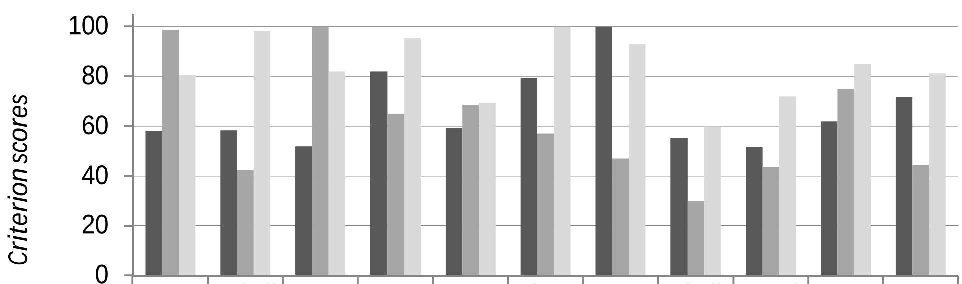
Table 7.7 ROACE and EV/DACF, values and criterion scores

	Gazp	Lukoil	Rosn	GazpN	Tatn	Chevr	Exxon	Shell	Total	Rus	West
ROACE, value	14	14	13	20	14	19	24	13	13	15	17
EV/DACF, value	3	3	6	4	6	5	7	7	5	4	6
ROACE, scores	*58*	*58*	*52*	*82*	*59*	*79*	*100*	*55*	*52*	*62*	*72*
EV/DACF, scores	*44*	*46*	*76*	*58*	*81*	*72*	*100*	*93*	*73*	*61*	*85*

Source data: Annex 1

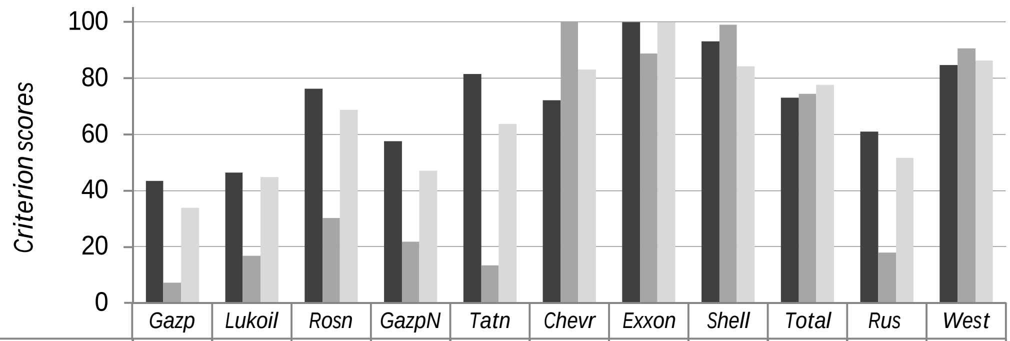
The situation changes when other criteria are used to measure the companies' profitability and relative value. In the sensitivity analysis, ROACE is substituted for the EBITDA margin and cash flow to assets and EV/DACF is substituted for EV/reserves and the P/E ratio. The following figures 7.7 and 7.8 present the criterion scores of the three criteria measuring value and profitability.

Figure 7.7 Sensitivity of profitability to different criteria



	Gazp	Lukoil	Rosn	GazpN	Tatn	Chevr	Exxon	Shell	Total	Rus	West
ROACE	*58*	*58*	*52*	*82*	*59*	*79*	*100*	*55*	*52*	*62*	*72*
EBITDA margin	*99*	*42*	*100*	*65*	*69*	*57*	*47*	*30*	*44*	*75*	*45*
Cash flow to ass	*80*	*98*	*82*	*95*	*69*	*100*	*93*	*60*	*72*	*85*	*81*

Figure 7.8 Sensitivity of value to different criteria



	Gazp	Lukoil	Rosn	GazpN	Tatn	Chevr	Exxon	Shell	Total	Rus	West
EV/DACF	44	46	76	58	81	72	100	93	73	61	85
EV/reserves	7	17	30	22	13	100	89	99	74	18	91
P/E ratio	34	45	69	47	64	83	100	84	78	52	86

Source data: Annex 1.

Compared to ROACE, the EBITDA margin clearly favors Russian companies, which have relatively large debt and depreciation. Cash flow to assets behaves indifferently and the differences between companies are smaller than in ROACE or the EBITDA margin.

The average relative value of the Russian companies is lower than that of the western companies. It is especially low when value is measured by EV/reserves. The P/E ratio behaves approximately like EV/DACF. There are certain logical and possible reasons which can explain the low EV/reserves values of the Russian companies. The degree of the vertical integration of the Russian oil producers is significantly lower than that of the western companies (cf. figure 7.1). Besides greater risk and smaller synergy advantages, this also means less downstream assets and cash flows relative to reserves. One possible reason is also the Russian factor. The investment climate in Russia, including confiscatory taxation, gas price regulation, state ownership and interventions and the doubts concerning the economic and social development may draw down reserves value. In the case of Gazprom, the low regulated domestic gas prices, uncertain demand and prices of gas in export markets and high investments required in gas transport infrastructure may affect reserves value. In any case, the low market capitalization, consequently also low enterprise value, is a weakness of the Russian companies.

The above observations and discussion gives us reason to make the following, more general, conclusions: the choice of the profitability and value criteria clearly affects a company's rating and the ranking of the companies. Some criteria favor some companies at the expense of others. Consequently, the buying recommendations based on value multiples and profitability fundamentals, if relevant at all, are sensitive to the choice of multiples and fundamentals. At least in this analysis context, the EBITDA margin seems only to tell something about the relative amount of interest, depreciation and income taxes of a company. Because EBITDA does not measure real cash flow and ignores the very real costs of taxation and investments, its explanatory value seems to be low.

7.3.5 Risk

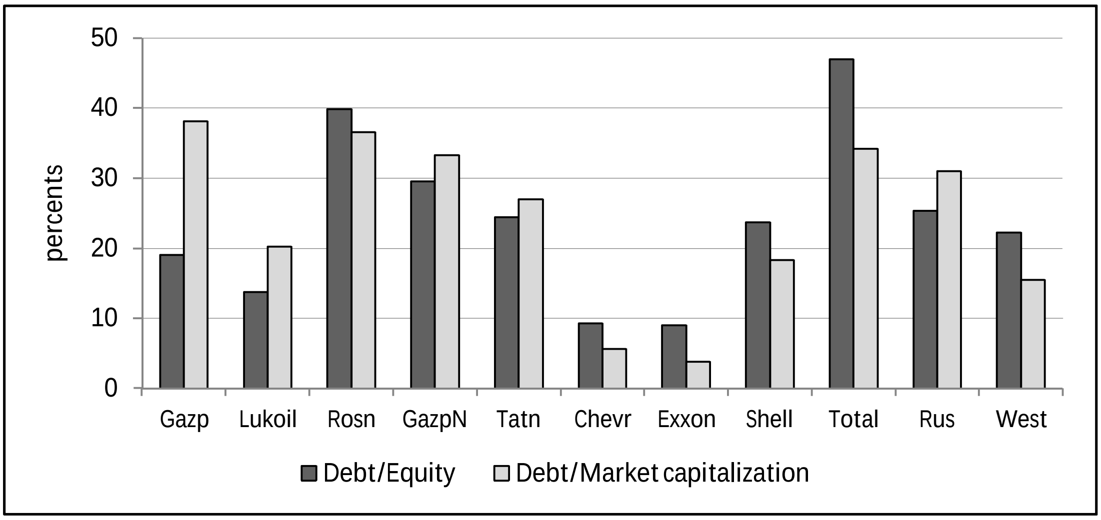
In this study, risk means a company's susceptibility to the increase in the costs of financing and financial distress. In the base case, risk is measured by the debt-to-equity (D/E) ratio using the average values from the years 2010-2012.

$$(7.34)\quad \frac{D}{E} = 100 \cdot \frac{1}{3} \sum_{i=2010}^{i=2012} \frac{Long\ term\ debt + Short\ term\ debt + other\ debt}{Equity}$$

The problem is whether to use book value of equity, i.e., shareholder's equity or market value of equity, i.e., market capitalization in formula 7.34. Many textbooks and research papers recommend to using market value (e.g. Damodaran 2012, Shivdasani et al. 2005) or give contradictory advice (e.g. Brealey et al. 2008). On the other hand, many analysts and companies use book values (cf. e.g. Exxon 2013b). Because market capitalization is already included in the multiple EV/DACF, it is decided to use the ratio of debt to book value of equity in the base case. If the market value were used, the low market capitalization would twice punish the Russian companies.

Figure 7.9 presents the actual values of debt to equity and debt to market capitalization and the average values of the Russian and western companies. Table 7.8 presents the numerical values and criterion scores of the debt-to-equity ratio. All the criterion scores of the debt ratios are calculated from the inverses of the ratios because smaller is in this case better.

Figure 7.9 Debt to equity and debt to market capitalization



Novatek's debt to equity is 43% and debt to market capitalization is 9.

Table 7.8 Debt to equity

	Gazp	Lukoil	Rosn	GazpN	Tatn	Chevr	Exxon	Shell	Total	Rus	West
D/E, value	19	14	40	30	24	9	9	24	47	25	22
D/E, scores	*47*	*66*	*23*	*31*	*37*	*97*	*100*	*38*	*19*	*36*	*41*

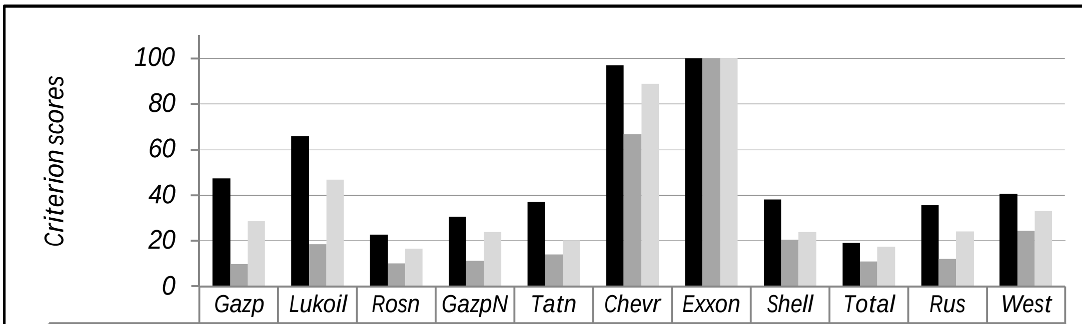
Source data: Annex 1

Exxon Mobil and Chevron have clearly the lowest debt ratios. The differences in the ratios are great between companies, irrespective of whether they are Russian or western.

Figure 7.9 tells that on average the Russian companies have only slightly greater debt-to-equity ratios but significantly greater debt-to-market capitalization ratios than the western companies.

Figure 7.10 presents the results of the sensitivity analysis, i.e., the criterion scores of debt to equity, debt to market capitalization and debt to cash flow.

Figure 7.10 Sensitivity of risk to different criteria



	Gazp	Lukoil	Rosn	GazpN	Tatn	Chevr	Exxon	Shell	Total	Rus	West
D/E	47	66	23	31	37	97	100	38	19	36	41
D/Markcap	10	19	10	11	14	67	100	21	11	12	24
D/CFO	29	47	17	24	20	89	100	24	17	24	33

Source data: Annex 1.

From figure 7.10 it can be seen that Exxon Mobil and Chevron have the highest scores in all the ratios. Rosneft and Total have the smallest scores. Like profitability and value, it can be seen that the choice of criteria measuring risk affects the companies' rating and their ranking.

7.3.6 Aggregated scores and sensitivity analyses

The aggregated scores and their sensitivity to the use of different criteria are calculated according to the benchmarking and sensitivity analysis plan presented in table 7.9. It is reminded that only an analyst's imagination sets limits on the quantity of alternative criteria and their different combinations. For example, the criteria presented in table 7.9 can be combined into 54 different sets of criteria.

Table 7.10 presents the companies' criterion scores, aggregated scores and the average scores of the Russian and western companies in the following four cases: base and sensitivity 1-3.

Because table 7.10 may be cumbersome to read and interpret, the key information is presented in the following figures 7.11-7.13. Figure 7.11 presents the companies' performance profiles. The performance profile includes the criterion scores and aggregated score of a company or a group of companies. Performance profiles can be used in comparisons to reveal the strengths and weaknesses of a company or a group of companies. Perhaps the most interesting finding from figure 7.11 is that although the criterion scores differ significantly between the companies, the differences between the aggregated scores are much smaller. Different companies have different strengths and weaknesses which decreases the differences between the companies' aggregated scores.

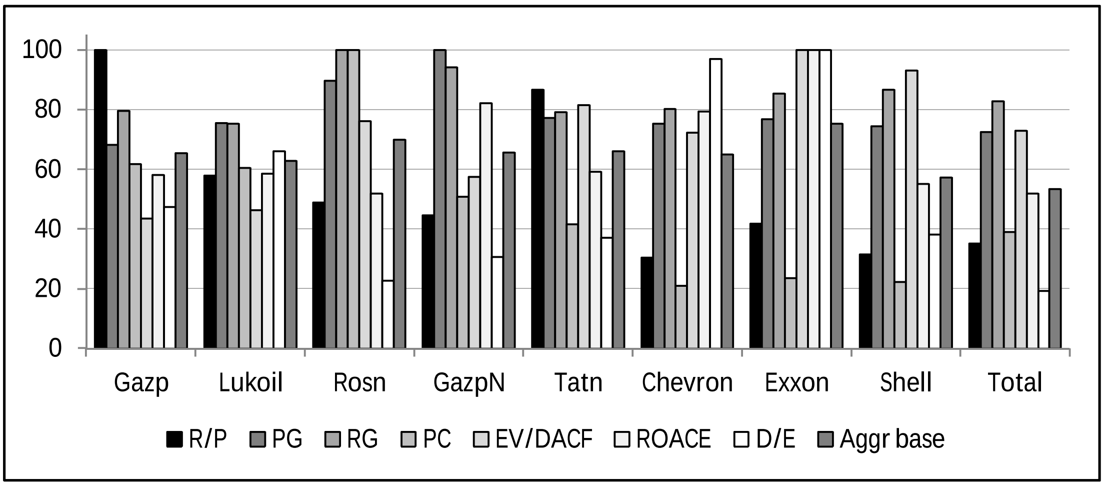
Table 7.9 Benchmarking and sensitivity analysis plan

	R/P ratio	R'/P ratio	Prod. growth	Res. growth	Prod. costs	EV/DACF	EV/reserves	P/E ratio	ROACE	EBITDA margin	CFO/assets	D/Equity	D/Market cap	D/CFO
Base	x		x	x	x	x			x			x		
Sensitivity 1		x	x	x	x	x			x			x		
Sensitivity 2	x		x	x	x		x			x			x	
Sensitivity 3		x	x	x	x			x			x			x
Favor Russian	x		x	x	x	x				x		x		
Favor western		x	x	x	x		x		x				x	

Table 7.10 Criterion and aggregated scores

	Gazp	Lukoil	Rosn	GazpN	Tatn	Chevr	Exxon	Shell	Total	Rus	West
R/P ratio	*100*	*58*	*49*	*45*	*87*	*30*	*42*	*32*	*35*	*68*	*35*
R'/P ratio	*92*	*67*	*56*	*51*	*100*	*35*	*48*	*36*	*41*	*73*	*40*
Prod growth	*68*	*76*	*90*	*100*	*77*	*75*	*77*	*74*	*73*	*82*	*75*
Res growth	*80*	*75*	*100*	*94*	*79*	*80*	*85*	*87*	*83*	*86*	*84*
Prod costs	*62*	*61*	*100*	*51*	*42*	*21*	*24*	*22*	*39*	*58*	*25*
EV/DACF	*44*	*46*	*76*	*58*	*81*	*72*	*100*	*93*	*73*	*61*	*85*
ROACE	*58*	*58*	*52*	*82*	*59*	*79*	*100*	*55*	*52*	*62*	*72*
D/Equity	*47*	*66*	*23*	*31*	*37*	*97*	*100*	*38*	*19*	*36*	*41*
EV/reserv	*7*	*17*	*30*	*22*	*13*	*100*	*89*	*99*	*74*	*18*	*91*
EBITDA mar	*99*	*42*	*100*	*65*	*69*	*57*	*47*	*30*	*44*	*75*	*45*
D/market cap	*10*	*19*	*10*	*11*	*15*	*67*	*100*	*21*	*11*	*12*	*24*
P/E ratio	*34*	*45*	*69*	*47*	*64*	*83*	*100*	*84*	*78*	*52*	*86*
CFO/assets	*80*	*98*	*82*	*95*	*69*	*100*	*93*	*60*	*72*	*85*	*81*
D/CFO	*29*	*47*	*17*	*24*	*20*	*89*	*100*	*24*	*17*	*24*	*33*
Base case	*66*	*63*	*70*	*66*	*66*	*65*	*75*	*57*	*53*	*65*	*59*
Sensitivity 1	*64*	*64*	*71*	*67*	*68*	*66*	*76*	*58*	*54*	*65*	*60*
Sensitivity 2	*61*	*50*	*68*	*55*	*54*	*62*	*66*	*52*	*51*	*57*	*54*
Sensitivity 3	*64*	*67*	*73*	*66*	*65*	*69*	*75*	*55*	*57*	*66*	*61*

Figure 7.11 Performance profiles

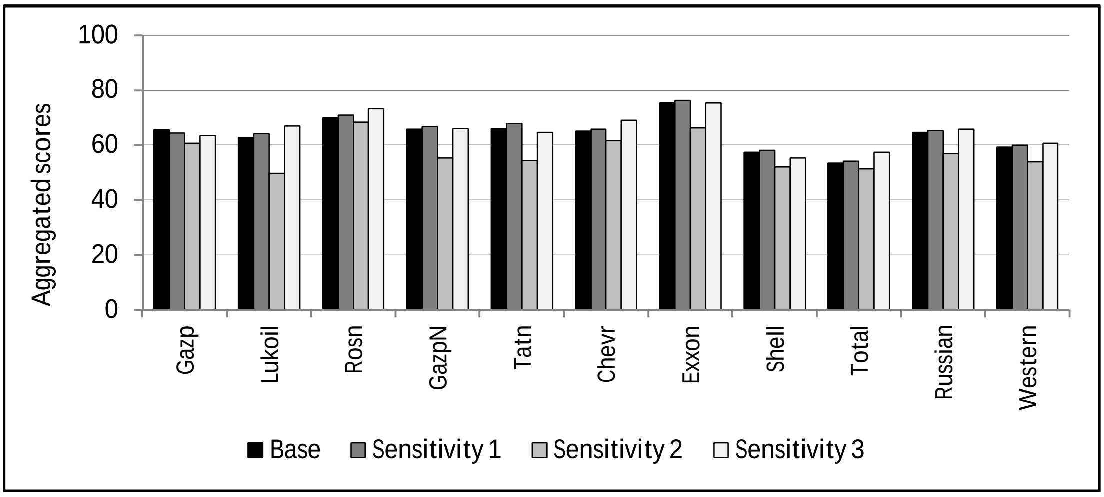


R/P: R/P ratio, PG: production growth, RG: reserves growth, PC: production costs, EV/DACF: EV/DACF, ROACE: ROACE, D/E: debt to equity, Aggr base: aggregated scores in base case.

In the base case, the best performing companies are Exxon, Mobil and Rosneft with scores of 75 and 70, respectively. Gazprom has a score of 66, Lukoil 63, Gazprom Neft and Tatneft 66, Chevron 65, Shell 57 and Total 53.

Figure 7.12 presents the companies' aggregated scores in the base and three sensitivity cases. Although the criterion scores of different criteria measuring the same dimension (value, profitability and risk) differ significantly from each other as can be seen from table 7.10, the aggregated scores differ only a little from each other.

Figure 7.12 Aggregated scores in different sensitivity cases



The following figure 7.13 presents the average performance profiles of the Russian and western companies. All the criteria and sensitivity cases used in this analysis are included. The purpose of this figure is to demonstrate the strengths and weaknesses of the Russian companies compared to the western companies.

Figure 7.13 Average profiles of Russian and Western companies

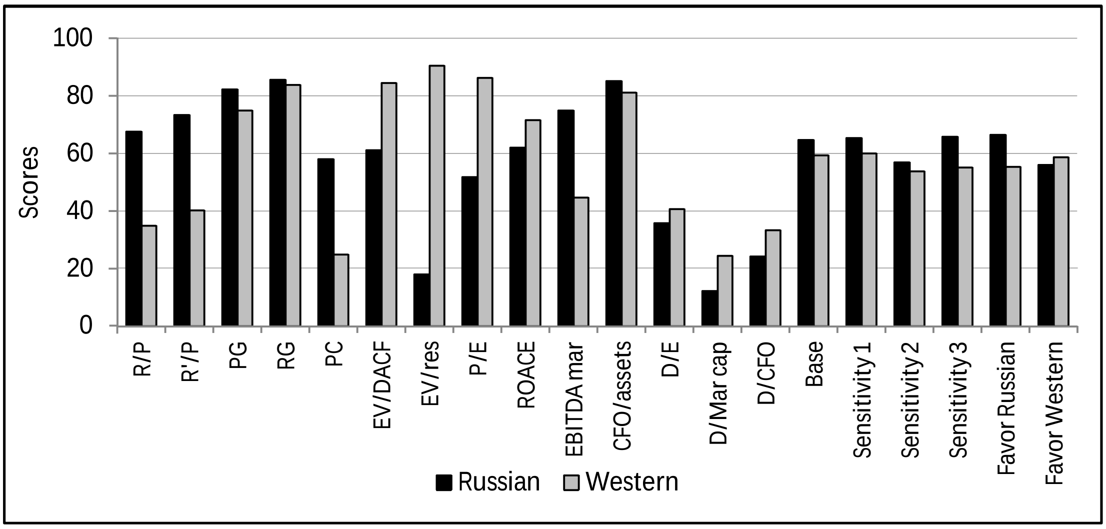


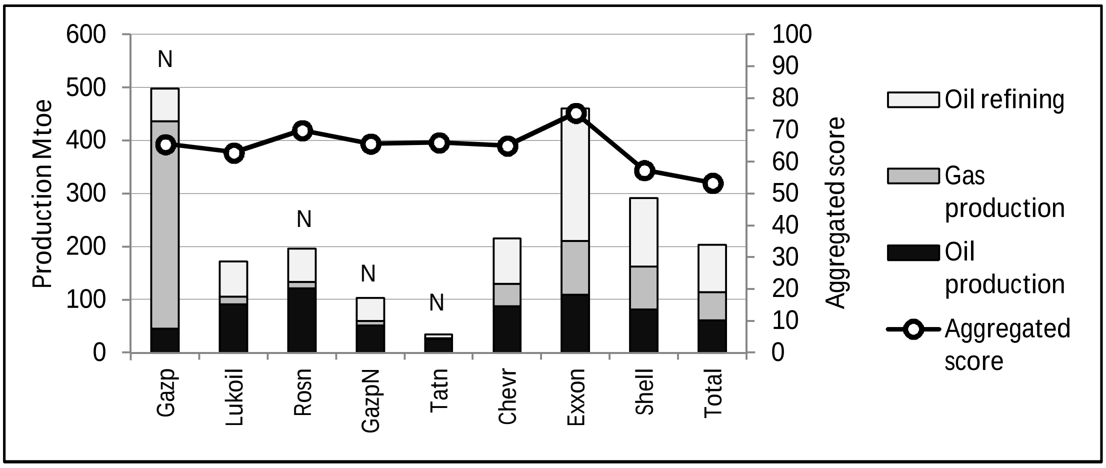
Figure 7.13 tells that the greatest strengths of the Russian companies are the great reserves compared to production (R/P ratio), low production costs (PC) and the greatest weakness is the low relative value (EV/DACF, EV/res and P/E) because of the low market capitalization of the Russian companies. The production and reserves growth (PG and

RG) of the Russian companies are slightly greater than those of the western companies. The ranking in profitability (ROACE, EBITDA margin and CFO/assets) depends on the criteria used. The Russian companies have lower scores in all the criteria measuring debt intensity (D/E, D/Market capitalization and D/CFO). The criteria EV/reserves and D/market capitalization clearly favor Western companies while the criterion EBITDA margin clearly favors the Russian companies compared to the alternative criteria.

The aggregated scores of the Russian companies are in all the sensitivity cases greater than those of the western companies because the Russian companies perform well in the operational criteria. Criterion scores and aggregated scores can be manipulated by choosing suitable criteria. For interest's sake the aggregated scores are also calculated for two additional cases "Favor Russian" and "Favor Western" using suitable criteria (cf. table 7.7, figure 7.13).

The following figure 7.14 concludes this chapter and presents the aggregated scores of the base case and also reminds that the companies differ significantly from each other in size and production and ownership structure.

Figure 7.14 Conclusion of company analysis



N means a partly national company

It is reminded that part of Gazprom Neft's financial and operational information is partly included in Gazprom's information. It is also reminded that the criterion and aggregated scores of OAO Novatek, Russia's second largest gas producer, are not presented because the values of reserves and production growth, productions costs and company's relative value are many times better than those of all the other companies. Some research results suggest that company size and reputation are important factors affecting a company's value. However, company size or/and reputation cannot be used as a criteria in this relative analysis. Also, some research results suggest that national oil and gas companies underperform private companies in profitability and efficiency (Victor 2007). The number of companies in this study is too small for testing this proposition. Supposedly, a company's production structure may also affect a company's value, because oil, gas, oil products and other production have different costs and prices and their production can be differently exposed to different risks.

8 Results and discussion

The purpose of this study was to develop methods for assessing oil and gas suppliers and to present an objective picture of Russia's position in the global oil and gas markets. To enhance objectivity, the following requirements were set to the assessment process: the assessment shall use benchmarking and it shall be multidimensional, quantitative, transparent and updatable.

This chapter first evaluates the most significant risks to which Russia's oil and gas supplies are exposed. These risks were identified in chapter 3 and they are risks from either the Russian, European or both perspectives. After that, the problems and choices related to the assessment model are discussed. Then the strengths and weaknesses of Russia's oil and gas sectors and Russian oil and gas companies are evaluated based on the risks and the results of chapters 6 and 7. Finally, the study evaluates how justified the criticism against Russian oil and gas is and how the objectives of this study were achieved.

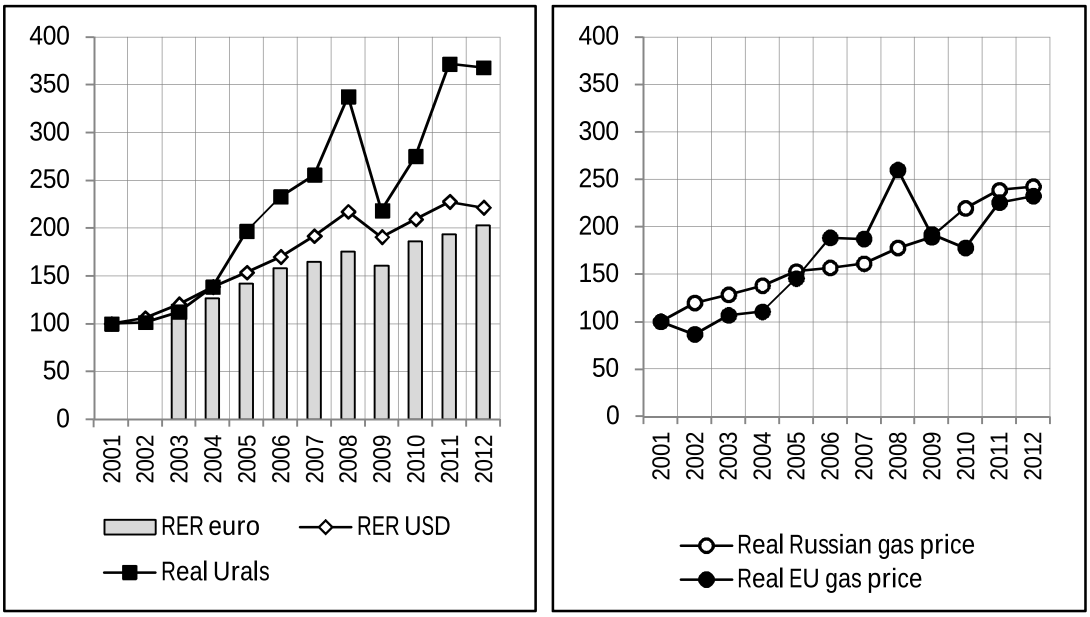
8.1 Risks

Chapter 3 identified 12 significant risks to which Russia's oil and gas supplies are exposed. The effects of the following six risks are evaluated based on statistical data: world oil and gas prices, ruble inflation and exchange rates, regulated domestic gas prices, oil and gas sector taxation, Russia's dependence on oil and gas export revenues and competition in the European gas market.

The movements in world oil and gas prices affect Russian oil and gas companies' revenues and Russia's tax revenues. Real oil and gas prices which take into account inflation can be used for evaluating the development of international oil and gas prices. The development of the real exchange rate of the Russian ruble can be used for evaluating the competitiveness of Russian oil and gas. The ruble real appreciation (depreciation) against the U.S. dollar and euro due to inflation and changes in the exchange rates affect companies' incomes. When the ruble appreciates, it becomes less competitive relative to the U.S. dollar or euro, i.e., Russian goods and services become more expensive in U.S. dollars or euros. Because the revenues of Russian oil and gas companies are mostly denominated in U.S. dollars or euros, while most of expenses are denominated in rubles, the appreciation of the ruble has a negative effect on companies' incomes.

The domestic ruble-denominated regulated gas prices have increased in recent years but the ruble inflation has eroded part of the effects of the price increases. The real Russian domestic gas price index can be used for evaluating the development of Russia's domestic gas prices. Figure 8.1 presents the compound real Urals price, European gas price, Russian domestic gas price and real ruble exchange rate indices since 2001.

Figure 8.1 Real ruble, Urals and gas price indices

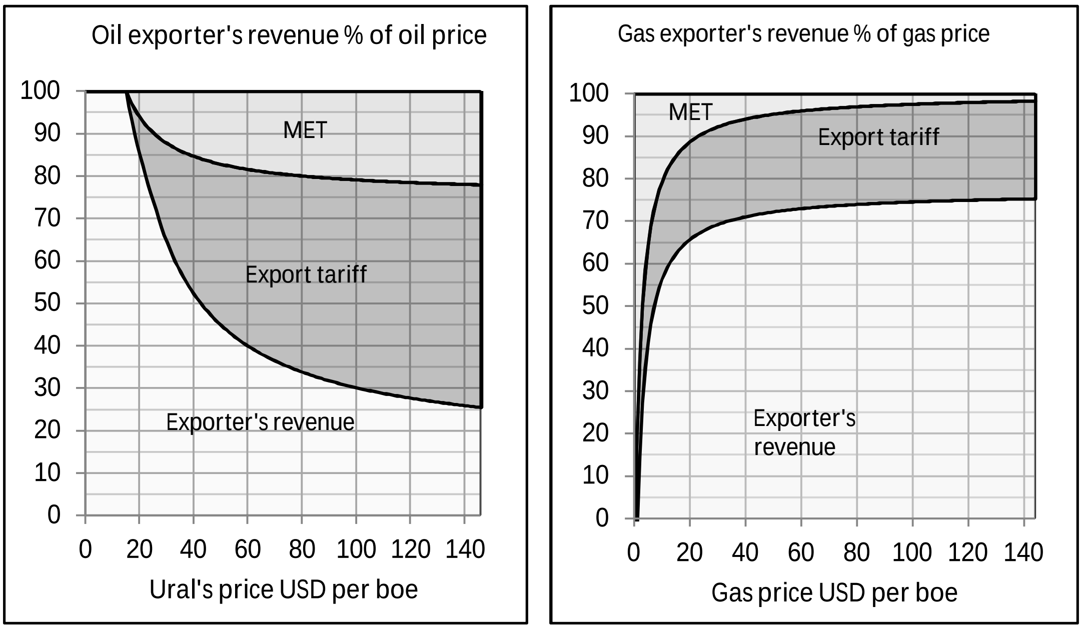


The base year is 2001=100. Urals is a Russian crude oil blend. The Real Urals price is the compound nominal U.S. dollar Urals price deflated by the U.S. CPI (consumer price index). RER USD is the compound real exchange rate of the ruble against the U.S. dollar. RER euro is the compound real exchange rate of the ruble against the euro. The euro time series begins from 2003 because earlier data is not available. The 2003 euro index value = 2003 U.S. dollar index value = 120. The Real Russian gas price index is the compound nominal domestic ruble gas price deflated by the Russian CPI. The Real EU gas price index is the compound nominal average EU's U.S. dollar import gas price deflated by the U.S. CPI. Source data: Bank of Russia 2013, BP 2013a, Gazprom 2013a, Lukoil 2013b, c, U.S. Bureau of Labor Statistics 2013.

Figure 8.1 tells that the real Urals price index has been on a higher level than the real U.S. dollar and euro exchange rate indices. The real EU gas price index is approximately on the same level as the real U.S. dollar exchange rate index and higher than the real euro exchange rate index. The real domestic gas price index has increased since 2001. Consequently, the increases in oil and gas export prices have compensated for the appreciation of the ruble and domestic gas prices have clearly increased. It is pointed out that Russian oil and gas companies also have ruble denominated revenues from oil, oil products and gas sales in Russia, which reduces the effect of the ruble inflation and exchange rate movements.

Besides value added tax, income tax, property tax and contributions to social funds, Russian oil and gas companies are subject to the following taxes which depend on production or/and sales volumes and prices: mineral extraction tax for oil and gas, excise taxes for oil products and export duties for oil, oil products and gas. The mineral extraction tax for oil together with the oil export duty is the most significant part of the tax burden on oil companies (Lukoil 2013b). Figure 8.2 presents how mineral extraction taxes and export duties affect both oil and gas exporters' revenues. Figure 8.2 tells that oil taxes and tariffs are strongly progressive and cut an exporter's revenues much more effectively than gas taxes and tariffs.

Figure 8.2 Taxation of oil and gas export revenues

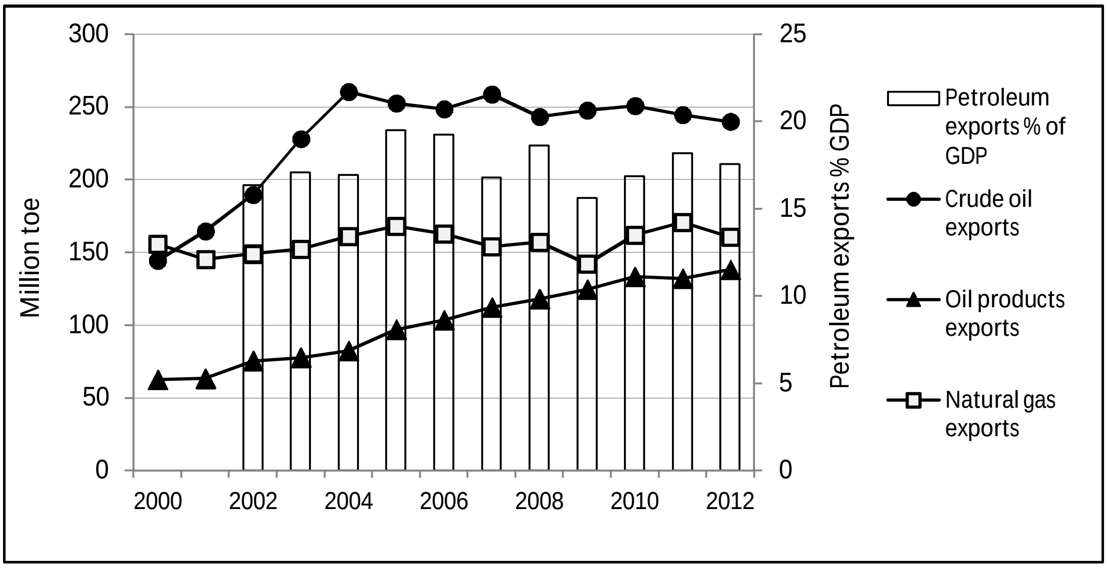


MET is the mineral extraction tax. When writing this, the 60-66-90 oil export duty regime is in effect. The maximum increase of oil export duty is 60% of the price increase, the duty on oil products is 66% of crude oil's duty except for gasoline and naphtha, whose duty is 90% of crude oil's duty. Excise tax of oil products paid on domestic sales depends on the prices and environmental characteristics of oil products. Gas MET has increased in recent times. Gazprom's gas mineral extraction tax is higher than other producers'. Gas export duty is 30% of the value of gas for customs purposes. This value is not exactly known but the export duty is estimated from Gazprom's reports. Source data: Gazprom 2013f, Lukoil 2013b, Rosneft 2013b.

It is really difficult to evaluate how the tax burden of Russian oil and gas companies has developed because some taxes and tariffs depend on oil prices and exchange rates. Besides the base rates of taxes and tariffs, oil and gas of certain types or produced in certain regions or exported to certain countries have a reduced or zero tax or customs duty. Moreover, a decrease in some tax or tariff has typically resulted in an increase in some other tax or tariff. As an example, Lukoil's effective rate of all taxes and tariffs of the income before taxes and tariffs has varied between 74% and 81% in 2007-2012 (Lukoil 2013b, c). It seems that Russian authorities aim to promote the development of new oil and gas fields, increasing the quality of oil products, securing the supply of oil products to domestic markets and balancing the domestic gas prices with the economic development of Russia.

Figure 8.3 presents the oil, oil products and gas exports from Russia and the share of their export revenues in Russia's GDP. Russia's policy is to increase the exports of the products with high added value like oil products and decrease the share of energy exports in the GDP. Figure 8.3 shows that oil products exports have increased. However, the increase also reflects the fact that the residual fuel oil has dominated in oil products exports because of the favorable export duties and the low conversion capacities of most Russian refineries (Minenergo 2013a, b). The share of oil, oil products and gas exports in the GDP has not decreased, except for during periods of low oil prices.

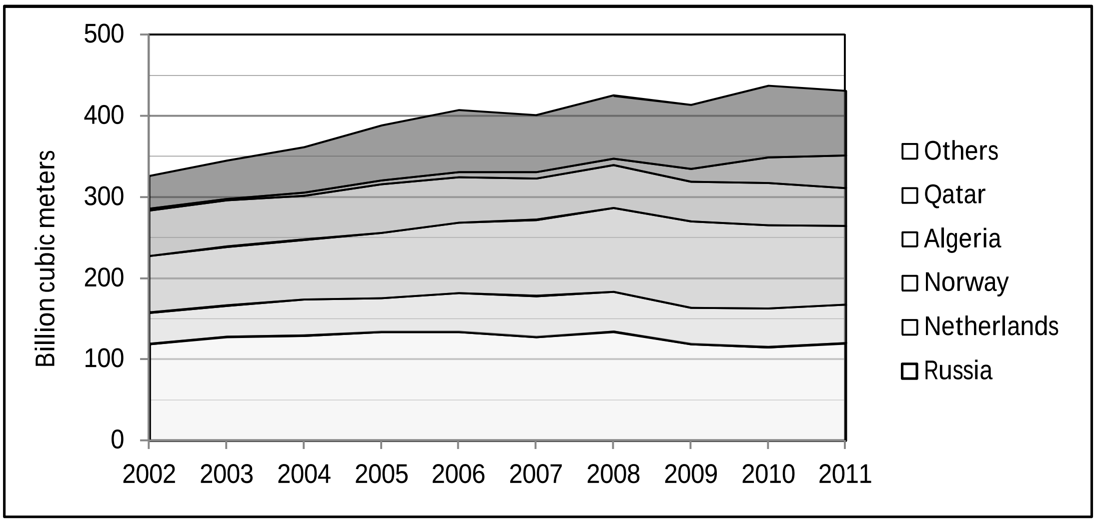
Figure 8.3 Exports of oil, oil products and gas



GDP figures before 2002 are not comparable with later figures. Source data: Bank of Russia 2013, Rosstat 2013.

Russia's gas exports face increasing competition in the European gas market because of increasing unconventional gas production, increasing LNG trade and the liberalization of the European gas market. Figure 8.4 presents the EU 27 countries' gas imports from Russia and its most important competitor countries. Gas imports from Russia have slightly decreased but Russia's market share has decreased significantly.

Figure 8.4 Distribution of EU 27's gas imports



Others include, *inter alia,* Nigeria, United Kingdom, Trinidad and Tobago, Egypt and Libya. Source data: Eurostat 2013.

Besides the six risks evaluated above, chapter 3 also identified the following six risks: restriction of foreign investments, depletion of old resources and more expensive new resources, state ownership and political interests, diversification of exports, problems with transit countries, poor condition of infrastructure and low energy efficiency. The identification of these risks is important but their quantitative evaluation is outside the scope of this study. However, the following four remarks are made. First, the state ownership has increased because Rosneft acquired TNK-BP in 2013. Second, Russia is intensively developing oil and gas infrastructure in the Russian Far East and diversifying oil and gas exports. Third, Russia has developed and is developing new oil and gas transport routes circumventing transit countries. Fourth, the energy intensity of Russia's economy has slightly decreased in recent years (World Bank 2012).

According to western and Russian reports, the above 12 risks have resulted in too small investments in new oil and gas production. Too small investments have a number of negative consequences, which are called critical factors. The critical factors are: insufficient renewal of oil and gas resources, stagnating or decreasing oil and gas production and exports, increasing economic and political distress, companies' low operational and financial condition including growth, efficiency, profitability, value and, debt intensity. These critical factors were the starting point of the problem formulation and further analysis.

8.2 Model, choices and problems

The first objective of this study was to construct a benchmarking model for assessing oil and gas suppliers that takes into account the critical factors, results of relevant research, industry practices and the availability of relevant data. The benchmarking model is based on value tree analysis and its key elements are: alternatives, criteria, criterion value functions, criterion weights and information sources. The quality of this analysis depends on the quality of the key elements. The arguments for choosing the key elements and the problems related to the choices are discussed in this section.

In the regional analysis, the alternatives are Russia, the Caspian Region, Middle East, Africa, America, EU 27+ and Rest of World. EU 27+ means EU 27 plus Norway. The choice of these alternatives takes into account the EU 27 countries' current important oil and gas suppliers, the EU's strategies and plans for future supplies, global coverage of this analysis, optimal number of alternatives and, availability of the relevant data. Oil and gas activities are assessed separately. An equivalent unit ton of oil equivalent (toe) is used to express oil and gas quantities. Consequently, the actual oil and gas quantities are comparable according to their energy contents.

In the company analysis, the alternatives are the Russian companies Gazprom, Gazprom Neft, Lukoil, Rosneft and Tatneft and the western companies Chevron, ExxonMobil, Shell and Total. The western companies are from the USA and Europe but have worldwide oil and gas activities. The companies are assessed as a whole including oil, gas and other activities. An equivalent unit, ton of oil equivalent (toe), is used to express the total oil and gas quantities.

It seems that the set of alternatives in the regional analysis works well. In the company analysis, it would be ideal to benchmark Russian companies against a few companies from each chosen region. However, most of the national oil and gas companies in the Middle East, Africa and the Caspian Region disclose only restricted financial and operational information. Therefore, it was decided to benchmark Russian companies against well known western companies and western effectiveness and efficiency in worldwide operations.

The regional criteria are the following: proved reserves, conventional resources, unconventional resources, reserves growth, production growth, recent export potential, future export potential, the region's political and economic stability and the region's market share in the EU 27. The criteria are based on the critical factors and the factors affecting energy security from an importer's perspective.

The following question can be asked: why use so many criteria? Why not use only future export potential, which could be important when considering strategic decisions? The future export potential is based on production and consumption scenarios. These scenarios are generated with energy models and are based on data and assumptions about the key factors that are thought to affect oil and gas demand and supply. The problem is that the future may prove part of data and assumptions wrong and no model can capture all the factors of underlying complex reality and human behavior. Different projections based on different assumptions and models but published at the same time often differ significantly from each other and the scenarios from different times differ from each other much more. Scenarios are only certain possible pathways to the future and therefore they should be used together with other relevant information.

The companies are assessed according to four operational criteria: the reserves-to-production ratio, production growth, reserves growth and production costs, and three market and accounting criteria: the company's relative value, profitability and debt intensity. Each market and accounting dimension is measured with three different criteria in order to examine and demonstrate the effects of using different criteria. If it may be difficult to find alternative criteria in the regional analysis, in the market and accounting dimensions only an analyst's imagination sets limits on the number of alternative criteria. Consequently, it cannot be argued that the chosen criteria are the best possible. It can only be argued that they take into account the critical factors, are recommended by many researchers and are used by many companies.

Again, the following question can be asked: why use so many criteria? Why not use only some multiple describing a company's relative value because value depends on the company's share price and in an efficient market all available information should be reflected in the share price? The following counter arguments can be made: different multiples describing company's relative value behave differently as is demonstrated in chapter 6. A multiple alone tells very little about a company's strengths, weaknesses and problems. The efficient market hypothesis may be misguided because of a lack of information, shareholders' ignorance and lemming-like behavior (Steven 2008).

There are many interesting criteria that are not used in this analysis. The quantity of investments in new production could be an interesting criterion both at the regional and company level. Besides difficulties in data availability, the comparison of investments between regions and companies is difficult because of great differences in geology and capital efficiency. It is thought that reserves and production growth correlate with investments. Information and research agencies regularly present estimates of the investments necessary to achieve some projected production level (e.g. IEA 2011a, 2012a). Stable or increasing production, in turn, requires new reserves.

Some research results suggest that a company's size, reputation and ownership structure affect a company's value (Osmundsen et al. 2006, Victor 2007). A company's size cannot be used as a criterion in a relative analysis and reputation and ownership structure are difficult to define and use in this analysis context.

The criterion value function is such that it linearly reflects the actual criterion values compared to the best alternative, which gets a score equal to 100. This means that, e.g., two times greater profitability or reserves are two times more valuable. This seems to be logical, but is not necessarily the only model of value. Presumably, most criteria have optimal ranges depending on the values of other criteria and circumstances. These ranges are difficult to define but it is thought that the use of several different criteria makes the analysis more reliable.

The aggregated value function which combines the criterion scores is additive, i.e., also linear. The aggregated score is the normalized weighted average of the criterion scores. The weighting is done with criterion weights summing up to 1. It is important to understand that criterion weights have two components. In this study, the first component is inherently related to the measurement scale of each criterion, i.e., the greater the difference of the actual criterion values between different alternatives, the greater weight the criterion has in the final rating. This is in line with the principles of decision theory and common sense.

The second component is the psychological weight. One criterion is simply regarded as more important than another. In this study the psychological weights are the same in the base case. This means that the best actual values of the criteria are of the same value. In the regional analysis, different weights are used based on the different reliability, importance and combined reliability and importance of the criteria. The numerical values of reliability and importance are based on the literature and personal judgment. Undoubtedly, there are better ways to define criterion weights such as expert opinion and cooperation with the stakeholders of a problem. Unfortunately, such a resource is not available in this analysis context.

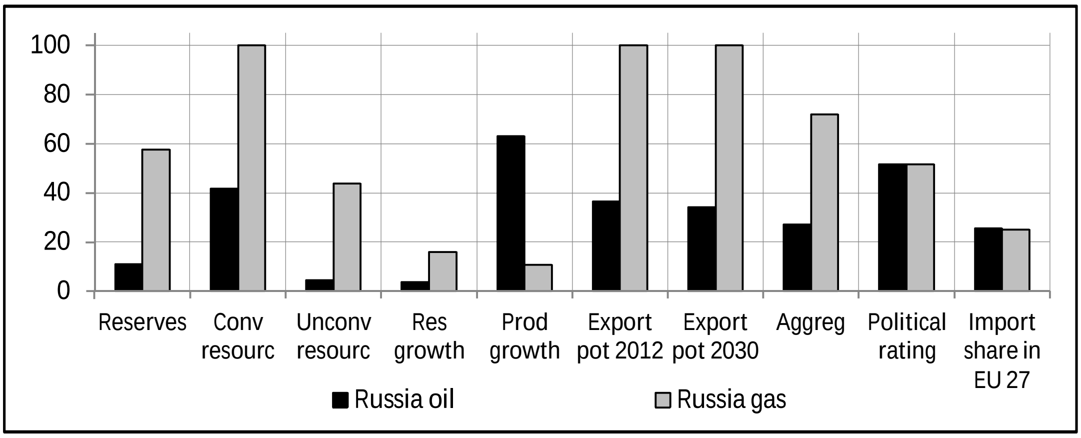
The last key element is the source data. The regional primary data originates mostly from the reports and/or data bases of the BGR (Bundesanstalt für Geowissenschaften und Rohstoffe), BP Statistical Review of World Energy, the EIA (the U.S. Energy Information Administration), the IEA (the International Energy Agency), OPEC (the Organization of the Petroleum Exporting Countries), Eurostat, Bank of Russia and Rosstat (Federal State Statistical Service) and Euromoney Country Risk (ECR). Although there are differences between the data from different organizations, as it is demonstrated in chapter 4, there are only a few, if any, publicly available alternatives to these data sources.

The data for company analysis is mostly from the companies' financial and operational reports. The U.S. companies and some Russian companies use US GAAP financial reporting, the European companies and some Russian companies use IFRS financial reporting. The criterion values based on US GAAP statements may differ from the values obtained if IFRS were applied and *vice versa*. Gazprom reports PRMS reserves and other companies report SEC or both SEC and PRMS reserves. It is impossible to precisely evaluate the effects of different financial or reserves reporting systems. Based on the examples presented in chapter 7, it is suggested that a rule of thumb for the possible differences in both cases could be some 20%. If the purpose is to compare European, Russian and U.S. companies, these uncertainties must be accepted. It is also pointed out that country-specific and regional reserves, resources and production quantities between the earlier mentioned information sources differ from each other in many cases more than 20%.

8.3 Russia, strengths and weaknesses

The second objective of this study was to benchmark Russia's oil and gas sectors against the other strategic oil and gas regions of the world. Figure 8.5 presents the performance profiles of Russia's oil and gas sectors and table 8.1 gives more information of the performance profiles of the other important regions. A performance profile comprises the criterion and aggregated scores of an alternative. The political and economic stability and the share of EU 27 imports are presented on the actual scales and are not included in the aggregated scores. It is thought that the aggregated score tells a region's supply potential and the political and economic stability score and market share tell how rational and acceptable it is to use this supply potential.

Figure 8.5 Russia's performance profiles



In the oil sector, Russia's greatest weaknesses are reserves quantity and reserves growth both compared to the other regions and other criteria. Russia's greatest strengths are the third largest production growth and the second largest recent and future export potentials and moderate conventional resources. In the aggregated scores Russia is the third after the Middle East and America, on approximately the same level as Africa. In the gas sector, Russia's greatest weaknesses are reserves and production growth both compared to the other regions and other criteria. Russia's greatest strengths are the largest conventional resources, recent and future export potential and the second largest gas reserves. In the aggregated scores, Russia is ranked first on approximately the same level as the Middle East. Russia has the third best (or third poorest) country risk score and its share of both the EU 27's oil and gas imports are clearly the largest.

Table 8.1 Oil and gas criterion and aggregated scores

	Russia		Caspian Region		Middle East		Africa		America	
	Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas
Proved reserves	11	58	5	19	100	100	17	18	59	22
Conventional resources	42	100	15	22	62	43	50	33	100	60
Unconventional resources	5	44	4	0	0	7	0	38	100	100
Reserves growth	4	16	9	100	28	54	11	4	100	28
Production growth	63	11	28	12	100	100	35	24	83	66
Recent export potential 2012	37	100	12	38	100	78	34	53	-21	1
Future export potential 2030	34	100	18	37	100	53	37	47	3	21
Aggregated scores base case	*28*	*61*	*13*	*33*	*70*	*62*	*26*	*31*	*61*	*43*
Aggregated scores R+I	*27*	*72*	*12*	*36*	*86*	*73*	*27*	*34*	*34*	*26*
Region's risk score	*52*	*52*	*34*	*34*	*57*	*57*	*37*	*37*	*68*	*68*
Share of EU 27's imports	*26*	*25*	*7*	*0*	*13*	*9*	*12*	*16*	*6*	*1*

The EU 27+ and Rest of World are not presented because they have highly negative export potentials. Aggregated scores are according to the case "combined reliability and importance (R+I)". Political and economic stability is presented on the scale 0-100 where higher is better. The import share in the EU 27 is the region's share of the total oil or gas imports in percents. In principle, the greater the share, the worse the situation.

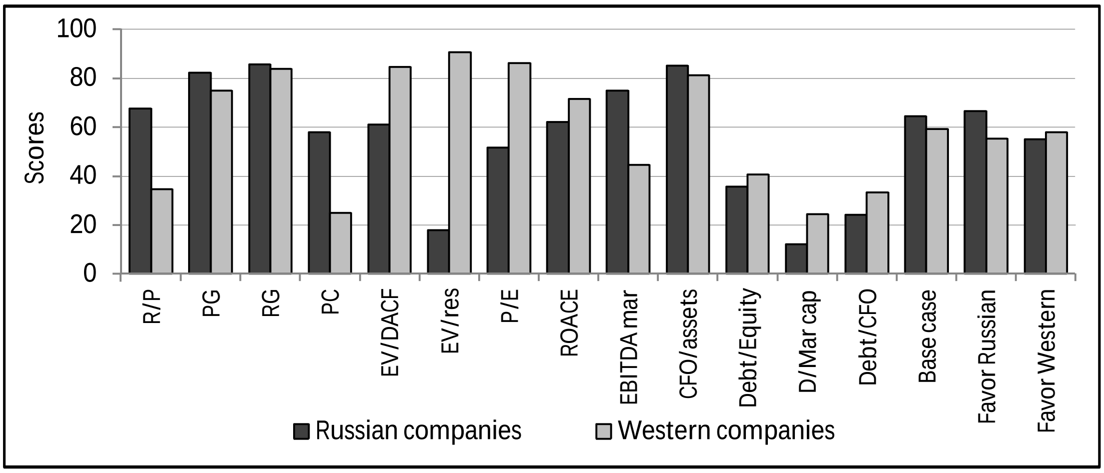
Criterion weights may have a great influence on the final rating if an alternative has a very low or high score with respect to some important criterion that has high weight as the differences between the base case and combined reliability and importance in table 8.1 show.

Compared to the other regions, America is an exception. Its relatively high oil and gas aggregated scores stem mostly from Canada's and Venezuela's unconventional oil and the USA's unconventional gas. Although America's oil export potential is negative and gas export potential low, some American countries are potential oil and/or gas suppliers for Europe. In order to give the right picture of America's precise position in the global oil and gas markets, a country-specific analysis and a deeper evaluation of the costs of unconventional oil and gas production would be needed. Such an approach is outside the scope of this study.

The third objective of this study was to benchmark leading Russian oil and gas companies against the leading oil and gas companies from other countries. In the base case, the best performing company is Exxon with a score of 75, Rosneft has a score of 70, Gazprom, Gazprom Neft and Tatneft have scores of 66, Chevron 65, Lukoil 63, Shell 57 and Total 53. However, it is more interesting to analyze the average performance profiles of the Russian and western companies as presented in figure 8.6. Figure 8.6 also presents the scores of the alternative criteria measuring a company's relative value, profitability and debt intensity and the aggregated scores of the base case and two other cases "favor Russian" and "favor Western" in order to demonstrate the effects of using different criteria.

The strengths of the Russian companies are the high reserves-to-production ratio and low production costs and moderate profitability. The weaknesses of the Russian companies are the low relative company value and high debt intensity. Figure 8.6 shows that using different criteria to measure the same dimensions gives different results. For example, the combination of EV/DACF, the EBITDA margin and Debt to Equity favors Russian companies while the combination EV/reserves, ROACE and Debt to market capitalization favors western companies. Consequently, some interest groups can manipulate the observable performance of companies by using suitable criteria.

Figure 8.6 Average scores of Russian and western companies

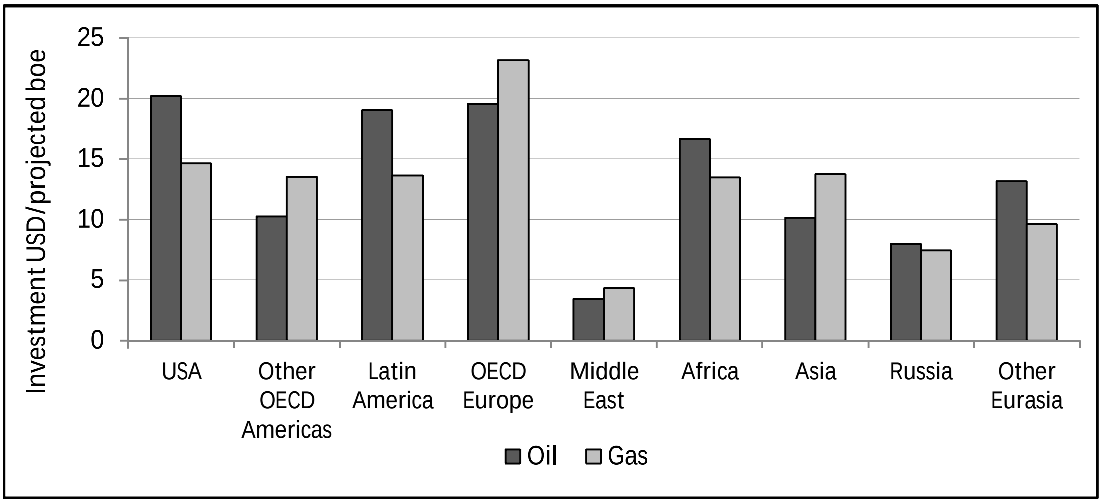


R/P: reserves-to-production ratio; PG: production growth, RG: reserves growth; PC: production costs; relative company value is measured by EV/DACF or EV/reserves or P/E ratio; profitability is measured by ROACE or the EBITDA margin or CFO/; debt intensity is measured by Debt/Equity or D/ Market cap or Debt/CFO.

Because all the necessary data is not available from companies in many interesting regions such as the Middle East and Africa, the good performance of the Russian companies cannot be regarded as globally valid. It suffices to mention that the reserves-to-production ratios of National Iranian Oil Company, Saudi Aramco and Petróleos de Venezuela are 117, 79 and 244 years (NIOC 2012, PDSVA 2012, Saudi Aramco 2012), respectively, and the average ratios of the Russian and western companies are 25 and 13 years, respectively. In order to give some kind of picture of the cost competitiveness of Russian oil and gas, figure 8.7 presents the investments required to produce each projected barrel of oil equivalent (boe) of oil and gas in 2012-2035 in certain regions. Roughly defined, the investments include finding and development costs. Gas investments also include investments in transportation. Figure 8.7 is a rough estimate which is based on the IEA's new policies scenario and cost data. The IEA's new policies scenario takes into account the implementation of certain demand decreasing energy policy programs.

Russia's gas production is projected to increase in the IEA's new policies scenario. This and figure 8.7 can be interpreted to mean that in the future Russia's gas production will be competitive compared to many other regions. Because Russia's oil production is decreasing in the new policies scenario, the situation is more complicated. According to the IEA, Russia's oil production costs, including capital costs, are lower than in Venezuela and approximately on the same level as in the African OPEC countries and lower than the costs of the leading western oil companies (IEA 2011b). Also, according to this analysis, the costs of the leading Russian companies are lower than those of the leading western companies. This means that also Russian oil is competitive compared to many other regions but it is possible that Russia is capable of achieving only relatively flat oil production.

Figure 8.7 Necessary investments in oil and gas infrastructure



Source data: IEA 2012a

Although the aggregated rating of the alternatives could be regarded only as a technical exercise because the criterion weights are the same or based on a subjective assessment of the reliability and/or importance of the criteria, this is not the case. Considering reliability and economic importance of criteria are steps to the right direction when determining criterion weights. Using different criteria to measure the same dimensions in the company analysis shows that determining criterion weights is not a simple task because the alternative criteria give different results.

8.4 Conclusion

The following four field matrix (figure 8.8) presents the risks, strengths and weaknesses of Russia's oil and gas sectors and Russian companies. The risks are divided into controllable and uncontrollable risks. The controllable risks depend mainly on decisions made in Russia. The uncontrollable risks are mostly outside the control of Russian oil and gas companies and authorities.

The matrix presents the strengths and weaknesses both in the qualitative scale: small, moderate and large, and using the superiority coefficients. In the regional analysis, superiority coefficients are calculated by dividing Russia's criterion scores by the corresponding average scores of the Caspian Region, Middle East, Africa and America. The EU 27+ and Rest of World are excluded because they have strongly negative export potential. If the coefficient is greater than 1, Russia is superior to the average of the other regions. In the company analysis, the superiority coefficient is calculated by dividing the average criterion scores of the Russian companies by the average criterion scores of the western companies.

The perspective in the matrix is primarily Russian. The conflicting points between the Russian and European perspectives could be the following: oil and gas prices; competition in the European gas market and Russia's market share in Europe because the EU's goal is to decrease its dependence on Russian oil and gas; diversification of Russia's oil and gas exports because it can decrease the oil and gas available for Europe and increase Russia's bargaining power. It is thought that conflicts with transit countries are detrimental to all parties involved.

Figure 8.8 Risks, strengths and weaknesses of Russian oil and gas

Controllable risks	*Uncontrollable risks*
Russia and Russian companies • Oil sector taxation • Domestic gas prices • Dependence on energy export revenues • Diversification of exports • Problems with transit countries • State ownership, political motives in business • Energy efficiency and increasing consumption • Restriction of foreign investment	Russia and Russian companies • International oil and gas prices • Competition in the European and other gas markets • Ruble inflation and exchange rates • Growing capital intensity of new production
Strengths	*Weaknesses*
Russia • Moderate conventional oil resources (0.7) • Moderate production growth (1.0) • Large recent oil export potential (1.2) • Moderate future export potential (0.9) • Large gas reserves (1.4) • Large conventional gas resources (2.5) • Large recent gas export potential (2.3) • Large future gas export potential (2.5) • Moderate political stability (52) Companies (Rus. average/west. average) • Large reserves to production ratio (1.9) • Small production costs (2.3) • Moderate production growth (1.1) • Moderate reserves growth (1.0)	Russia • Small oil reserves (0.2) • Small oil reserves growth (0.1) • Large share of EU 27's oil imports (26%) • Small gas reserves growth (0.3) • Small gas production growth (0.2) • Large share of EU 27's gas imports (25%) Companies (Rus. average/west. average) • Small company value (0.7) • Moderate profitability (0.9) • Large debt intensity (0.9)

The numbers in parentheses are superiority coefficients. If the value is greater than 1, Russia is superior to the average of the Caspian Region, Middle East, Africa and America or Russian companies are superior to western companies. Political stability is measured with the country (region) risk score, whose scale is 0-100. Greater is better. The share of EU 27's imports is the actual share in percents.

Finally, it is evaluated how justified the criticism presented against Russian oil and gas is and how the objectives of this study were achieved.

The uncontrollable risks: oil and gas prices, growing capital intensity of new production and competition in the European and other gas markets because of increasing unconventional gas production and LNG trade are faced also by most of the other important oil and gas suppliers. Also, relatively high inflation is a problem in many oil and gas producing countries (IMF 2012). Consequently, these uncontrollable risks are not specific only to Russia and in this respect the criticism against Russia is not objective and justified.

On the one hand, the controllable risks stemming from oil sector taxation, domestic gas prices, diversification of exports, risks of conflicts with transit countries and energy efficiency have developed slightly positively. On the other hand, the state ownership in

Russia's oil and gas sectors is increasing and the share of oil and gas exports in the GDP has remained high. It is pointed out that these controllable risks have not been benchmarked or otherwise exactly evaluated. It is argued that the criticism against Russia is partly justified.

The main focus of this study is on the strengths and weaknesses of Russia's oil and gas sectors and Russian oil and gas companies. Although Russia's oil production growth and recent and future oil export potential are high, the small oil reserves and low oil reserves growth give reason to doubt the sustainability of the growth. Regardless of whether the question is one of demand, prices or difficulties in production, Russia's gas reserves and production growth are small compared to other important suppliers. Russia's future oil and gas export potential is higher than the recent export potential but it is reminded that the future export potential is clearly the most uncertain criterion. Consequently, the criticism and concerns about Russia's low renewal of reserves, stagnating production and exports are justified.

Except for the small relative company value, large debt intensity and moderate profitability, the Russian companies get high scores in the other dimensions: reserves to production ratio, reserves and production growth and efficiency. But this holds true only if the benchmarks, i.e. the leading western oil and gas companies, are valid and sufficiently high level benchmarks.

When the results of this study are interpreted, it must be remembered that besides the uncertainty of criterion values stemming from measurement, assessment and conversion errors and different standards, there are also other possible sets of criteria and alternatives and other possible value functions which can give different results. Furthermore, the lengths of assessment periods affect the results. The value tree model is not bound to the criteria, value functions or alternatives used in this analysis. The limiting factors are an analyst's ability to choose proper elements of the model and the availability of relevant information irrespective of whether the question is of expert opinion or recorded data.

If the above key findings are reviewed against the objectives of this study, it seems that the objectives of this study have been achieved. The value tree model suits well for the assessment of oil and gas regions, countries and companies. The assessment chain (information sources, determining criterion values and scores and constructing performance profiles) works well, provided that the key elements of the model are properly chosen. Performance profiles clearly and unambiguously present the strengths and weaknesses of an alternative compared to the other alternatives and criteria and are not dependent on the different units of measurement. The aggregated scoring forces the user of the model to consider the relative importance of different criteria. The analysis also fulfills the requirements of objectivity: benchmarking, quantitative, multidimensional, transparent and updatable.

This study clearly shows that it is misleading to evaluate Russia's or some other region's or company's performance based only on a qualitative assessment or to benchmark them only against their own past performance or a single benchmark like the Middle East using only one or a few criteria. This value tree model provides an opportunity to objectively monitor and assess oil and gas regions, countries and companies compared to the other important actors in the global oil and gas markets.

9 Annex 1 Company data

This annex presents the operational and financial information of the companies included in this analysis. The data is as it is presented in companies' reports with the following exceptions: all oil and gas data is presented using the equivalent unit ton of oil equivalent (toe). The appropriate conversion factors have been used to get the toe values. Production and finding and development costs are calculated from the data presented in the companies' reports. This data is not presented in the following tables. The costs are presented in USD per barrel of oil equivalent (USD/boe). The data in the following tables is chosen so that the tables contain all the information necessary to calculate the values of the criteria used in this analysis. The tables also present the criterion values. The criterion values are calculated according to the formulas presented in chapter 6 and may differ from the values presented by companies if companies have used different calculation rules.

Table 9.1 Chevron Corporation

	2007	2008	2009	2010	2011	2012
Oil reserves million toe	967	1003	951	887	881	884
Gas reserves million toe	503	525	592	551	652	664
Total reserves million toe	1470	1527	1544	1439	1533	1548
Oil production million toe	89	83	93	96	92	88
Gas production million toe	42	43	41	42	41	42
Total production million toe	130	126	135	138	133	130
Refinery throughput million toe	91	93	94	94	89	85
Total revenue	220904	273005	171636	204928	253706	241909
Revenue net of sales based taxes	188517	241856	145936	178146	229993	221523
Depreciation	-8708	-9528	-12110	-13063	-12911	-13413
Interest expense	-166	0	-28	-50	0	0
Interest income	600	340	95	120	145	166
Income before taxes	32274	43057	18528	32055	47634	46332
Income tax expense	-13479	-19026	-7965	-12919	-20626	-19996
Minority interest	-107	-100	-80	-112	-113	-157
Net income	18688	23931	10483	19024	26895	26179
Cash	7362	9347	8716	14060	15864	20939
Short term debt	1162	2818	384	187	340	127
Long term debt	6070	5742	9829	11003	9684	11966
Minority interest	204	469	647	730	799	1308
Equity	77088	86648	91914	105081	121382	136524
Total assets	148786	161165	164621	184769	209474	232982
Cash flow from operations	24977	29632	19373	31359	41098	38812
EBITDA	40441	52145	30491	44936	60287	59422
Market capitalization	193781	147208	153487	181889	209289	208981
Enterprise value	193651	146762	155285	179305	203577	200234
R/P ratio	*11,3*	*12,1*	*11,5*	*10,5*	*11,5*	*11,9*
Reserves growth %	*100,0*	*103,9*	*105,0*	*97,8*	*104,3*	*105,3*
Production growth %	*100,0*	*96,6*	*103,2*	*105,5*	*102,0*	*99,6*
Production costs USD/boe	*8,1*	*9,9*	*9,6*	*10,5*	*13,5*	*15,0*
Finding and develop. costs USD/boe	*60,8*	*101,6*	*47,9*	*54,2*	*29,5*	*43,8*
EV/DACF ratio	*7,7*	*5,0*	*8,0*	*5,7*	*5,0*	*5,2*
EV/reserves ratio USD/boe	*18,0*	*13,1*	*13,7*	*17,0*	*18,1*	*17,6*
P/E ratio	*10,6*	*6,3*	*14,6*	*9,6*	*7,9*	*8,1*
ROACE %	*23,1*	*26,6*	*10,6*	*17,4*	*21,6*	*18,7*
EBITDA margin%	*21,5*	*21,6*	*20,9*	*25,2*	*26,2*	*26,8*
Cash flow to assets %	*16,8*	*18,4*	*11,8*	*17,0*	*19,6*	*16,7*
Debt to equity %	*9,4*	*10,2*	*11,4*	*10,8*	*8,3*	*8,8*
Debt to market capitalization %	*3,7*	*6,0*	*6,9*	*6,3*	*4,9*	*5,8*
Debt to cash flow ratio	*0,29*	*0,30*	*0,54*	*0,37*	*0,25*	*0,31*

Revenues and costs are in million USD. Source data: Chevron 2008, Chevron 2010a, Chevron 2010b, Chevron 2013a, Chevron 2013b

Table 9.2 Exxon Mobile Corporation

	2007	2008	2009	2010	2011	2012
Oil reserves million toe	1511	1638	1589	1592	1668	1748
Gas reserves million toe	1552	1498	1546	1792	1733	1685
Total reserves million toe	3063	3136	3136	3385	3401	3433
Oil production million toe	130	120	119	121	115	109
Gas production million toe	78	75	77	101	109	102
Total production million toe	208	195	196	221	224	211
Refinery throughput million toe	277	270	266	262	260	250
Total revenue	404552	477359	310586	383221	486429	482295
Revenue net of sales based taxes	331871	401132	249831	318556	412953	414328
Depreciation	-12250	-12379	-11917	-14760	-15583	-15888
Interest expense	-400	-673	-548	-259	-247	-327
Interest income	1672	1400	179	118	135	117
Income before taxes	71479	83397	34777	52959	73257	78726
Income tax expense	-29864	-36530	-15119	-21561	-31051	-31045
Minority interest	-1005	-1647	-378	-938	-1146	-2801
Net income	40610	45220	19280	30460	41060	44880
Cash	33981	31437	10693	7825	12664	9582
Short term debt	2383	2400	2476	2787	7711	3653
Long term debt	7183	7025	7129	12227	9322	7928
Minority interest	4282	4558	4823	5840	6348	5797
Equity	121762	112965	110569	146839	154396	165863
Total assets	242082	228052	233323	302510	331052	333795
Cash flow from operations	52002	59725	28438	48413	55345	56170
EBITDA	81452	93402	46685	66922	87806	92023
Market capitalization	504220	397239	322329	364035	401249	389648
Enterprise value	479805	375227	321241	371224	405618	391647
R/P ratio	*14,7*	*16,1*	*16,0*	*15,3*	*15,2*	*16,3*
Reserves growth %	*100,0*	*102,4*	*102,4*	*110,5*	*111,0*	*112,1*
Production growth %	*100,0*	*93,8*	*94,1*	*106,4*	*107,8*	*101,4*
Production costs USD/boe	*6,9*	*8,4*	*9,8*	*10,1*	*11,8*	*12,5*
Finding and develop. costs USD/boe	*28,8*	*34,1*	*29,7*	*44,9*	*32,4*	*31,8*
EV/DACF ratio	*9,2*	*6,2*	*11,2*	*7,6*	*7,3*	*6,9*
EV/reserves ratio USD/boe	*21,4*	*16,3*	*14,0*	*15,0*	*16,3*	*15,6*
P/E ratio	*12,8*	*9,2*	*17,1*	*11,7*	*10,1*	*8,9*
ROACE %	*32,0*	*36,0*	*15,9*	*21,6*	*24,5*	*26,5*
EBITDA margin%	*24,5*	*23,3*	*18,7*	*21,0*	*21,3*	*22,2*
Cash flow to assets %	*21,5*	*26,2*	*12,2*	*16,0*	*16,7*	*16,8*
Debt to equity %	*7,6*	*8,0*	*8,3*	*9,8*	*10,6*	*6,7*
Debt to market capitalization %	*1,9*	*2,4*	*3,0*	*4,1*	*4,2*	*3,0*
Debt to cash flow ratio	*0,2*	*0,2*	*0,3*	*0,3*	*0,3*	*0,2*

Revenues and costs are in million USD. Source data: Exxon 2010, Exxon 2013a, Exxon 2013b

Table 9.3 OAO Gazprom

	2007	2008	2009	2010	2011	2012
Oil reserves million toe	727	713	719	717	724	714
Gas reserves million toe	14693	14614	14953	15260	15427	15347
Condensate reserves million toe	569	588	586	572	605	634
Total reserves million toe	16056	15984	16326	16616	16835	16780
Oil production million toe	34	32	32	32	32	33
Gas production million toe	441	442	371	409	412	391
Condensate prod million toe	11	11	10	11	12	13
Total production million toe	487	486	414	453	458	439
Refinery throughput million toe	38	40	44	50	54	61
Total revenue	2390467	3289707	2999266	3603310	4639881	4767232
Revenue net of sales based taxes	2193474	3026515	2746223	3305342	4218956	4185794
Depreciation	-183577	-195016	-221197	-249693	-275184	-334162
Interest expense	-76975	-59910	-74167	-38714	-31998	-36992
Interest income	75394	46822	36762	20692	18918	26492
Income before taxes	924204	1031632	979435	1273703	1679936	1511955
Income tax expense	-229219	-260252	-185642	-275710	-337494	-301389
Minority interest	-36947	-28452	-14208	-29436	-35424	-27941
Net income	658038	742928	779585	968557	1307018	1182625
Cash	279109	343833	249759	440786	501344	419536
Short term debt	504070	432640	424855	190845	366868	326807
Long term debt	981408	923230	1184457	1124395	1173294	1177934
Minority interest	362308	307984	319431	286610	297420	309363
Equity	3950789	4605115	5326515	6249751	7463571	8391731
Total assets	6792556	7168568	8363215	9235993	10900696	12068139
Cash flow from operations	598508	1016551	897154	1460116	1637450	1445617
EBITDA	1072415	1211284	1223829	1511982	1932776	1828676
Market capitalization	8094711	2567738	4204670	4443773	3932369	3302735
Enterprise value	9304635	3581493	5568815	5318227	4971187	4387940
R/P ratio	*32,9*	*32,9*	*39,5*	*36,7*	*36,7*	*38,2*
Reserves growth %	*100*	*100*	*102*	*103*	*105*	*105*
Production growth %	*100*	*100*	*85*	*93*	*94*	*90*
Production costs USD/boe	*2,79*	*3,33*	*3,06*	*3,25*	*4,02*	*5,93*
Finding and develop. costs USD/boe						
EV/DACF ratio	*14,2*	*3,4*	*5,8*	*3,6*	*3,0*	*3,0*
EV/reserves ratio USD/boe	*3,2*	*1,0*	*1,5*	*1,4*	*1,3*	*1,2*
P/E ratio	*12,2*	*3,4*	*5,5*	*4,6*	*3,0*	*2,8*
ROACE %	*14,9*	*13,5*	*12,6*	*13,6*	*16,0*	*12,7*
EBITDA margin%	*48,9*	*40,0*	*44,6*	*45,7*	*45,8*	*43,7*
Cash flow to assets %	*8,8*	*14,2*	*10,7*	*15,8*	*15,0*	*12,0*
Debt to equity %	*35,0*	*27,8*	*28,8*	*20,1*	*19,8*	*17,3*
Debt to market capitalization %	*18,7*	*53,2*	*38,7*	*29,6*	*39,2*	*45,6*
Debt to cash flow ratio	*2,5*	*1,3*	*1,8*	*0,9*	*0,9*	*1,0*

Revenues and costs are in millions Russian Rubles. Source data: Bank of Russia 2013, Gazprom 2009, Gazprom 2011a, Gazprom 2012, Gazprom 2013d, e, f, MICEX 2013.

Table 9.4 OAO Gazprom Neft

	2007	2008	2009	2010	2011	2012
Oil reserves million toe	809	622	730	721	788	802
Gas reserves million toe	24	52	58	124	185	229
Condensate reserves million toe						
Total reserves million toe	833	674	787	844	973	1031
Oil production million toe	44	47	48	50	50	51
Gas production million toe	2	2	3	3	7	9
Condensate prod million toe						
Total production million toe	46	49	50	53	58	60
Refinery throughput million toe	26	28	33	38	40	43
Total revenue	582178	840315	765579	994958	1291596	1517067
Revenue net of sales based taxes	365370	525699	514356	634554	821607	979138
Depreciation	-23755	-32476	-46728	-49153	-55799	-58461
Interest expense	-3810	-4143	-11690	-10201	-11446	-11160
Interest income	2404	2481	3421	1457	1956	3174
Income before taxes	139561	152854	123457	129850	207665	219991
Income tax expense	-33625	-36322	-25851	-25624	-39996	-35893
Minority interest	0	-968	-2154	-8653	-7307	-78856
Net income	105937	115565	95452	95573	160662	176296
Cash	17701	60964	26248	34930	29435	76012
Short term debt	32872	61257	64956	51633	44330	66195
Long term debt	51138	47243	125859	150632	176979	166417
Minority interest	74	4084	75781	64343	47213	40547
Equity	256130	410174	488406	569580	684957	834884
Total assets	407751	593623	904539	977311	1118159	1300108
Cash flow from operations	130508	161091	105084	164348	180871	231073
EBITDA	164722	186025	176299	179094	265947	278636
Market capitalization	725373	295621	772478	604046	697698	672315
Enterprise value	791683	343158	937044	771381	889572	828915
R/P ratio	*18*	*14*	*16*	*16*	*17*	*17*
Reserves growth %	*100*	*81*	*94*	*101*	*117*	*124*
Production growth %	*100*	*109*	*111*	*117*	*127*	*132*
Production costs USD/boe	*6,28*	*5,53*	*4,87*	*4,77*	*5,53*	*5,72*
Finding and develop. costs USD/boe						
EV/DACF ratio	*5,9*	*2,1*	*8,2*	*4,5*	*4,7*	*3,4*
EV/reserves ratio USD/boe	*5,3*	*2,4*	*5,4*	*4,1*	*3,9*	*3,6*
P/E ratio	*6,9*	*2,6*	*8,1*	*6,3*	*4,4*	*3,8*
ROACE %	*33,7*	*27,7*	*16,7*	*14,1*	*19,8*	*25,7*
EBITDA margin%	*45*	*35*	*34*	*28*	*32*	*28*
Cash flow to assets %	*32*	*27*	*12*	*17*	*16*	*18*
Debt to equity %	*32,8*	*26,2*	*33,8*	*31,9*	*30,2*	*26,6*
Debt to market capitalization %	*11,6*	*36,7*	*24,7*	*33,5*	*31,7*	*34,6*
Debt to cash flow ratio	*0,6*	*0,7*	*1,8*	*1,2*	*1,2*	*1,0*

Revenues and costs are in millions Russian Rubles. Source data: Bank of Russia 2013, Gazprom Neft 2009, Gazprom Neft 2011, Gazprom Neft 2013a, b, c, MICEX 2013.

Table 9.5 OAO Lukoil

	2007	2008	2009	2010	2011	2012
Oil reserves million toe	2129	1959	1856	1805	1816	1813
Gas reserves million toe	631	661	516	533	524	530
Condensate reserves million toe						
Total reserves million toe	2760	2620	2372	2338	2340	2344
Oil production million toe	97	95	98	96	93	92
Gas production million toe	11	14	12	15	15	16
Condensate prod million toe						
Total production million toe	108	109	110	111	108	108
Refinery throughput million toe	52	56	63	66	65	66
Total revenue	81891	107680	81083	104956	133650	139171
Revenue net of sales based taxes	57491	72876	61551	77100	98515	102669
Depreciation	-2172	-2958	-3937	-4154	-4473	-4832
Interest expense	-333	-391	-667	-712	-694	-538
Interest income	135	163	134	174	211	257
Income before taxes	13015	12694	9063	11470	13119	13723
Income tax expense	-3449	-3467	-1994	-2351	-3293	-2798
Minority interest	-55	-83	-58	-113	531	79
Net income	9511	9144	7011	9006	10357	11004
Cash	841	2239	2274	2368	2753	2914
Short term debt	2214	3232	2058	2125	1792	658
Long term debt	4829	6577	9265	9069	7300	5963
Minority interest	577	670	388	411	-172	981
Equity	41213	50340	55991	59197	67638	73207
Total assets	59632	71461	79019	84017	91192	98961
Cash flow from operations	10881	14312	8883	13541	15514	18997
EBITDA	15330	15797	13475	16049	18606	18915
Market cap.	69728	27710	47469	44400	40967	49937
Enterprise value	75930	35280	56518	53226	47306	53644
R/P ratio	*25,6*	*24,1*	*21,7*	*21,1*	*21,8*	*21,8*
Reserves growth %	*116*	*110*	*100*	*99*	*99*	*99*
Production growth %	*100*	*101*	*102*	*103*	*100*	*100*
Production costs USD/boe	*3,5*	*4,0*	*3,5*	*4,0*	*4,6*	*4,9*
Finding and develop. costs USD/boe	*9,1*	*11,8*	*11,2*	*9,7*	*8,8*	*11,3*
EV/DACF ratio	*7,1*	*2,5*	*6,8*	*4,1*	*3,2*	*2,9*
EV/reserves ratio USD/boe	*3,7*	*1,8*	*3,2*	*3,1*	*2,7*	*3,1*
P/E ratio	*7,4*	*3,0*	*6,8*	*5,2*	*4,0*	*4,6*
ROACE %	*22,2*	*17,3*	*11,8*	*14,0*	*14,0*	*14,4*
EBITDA margin%	*26,7*	*21,7*	*21,9*	*20,8*	*18,9*	*18,4*
Cash flow to assets %	*18,2*	*20,0*	*11,2*	*16,1*	*17,0*	*19,2*
Debt to equity %	*16,9*	*19,2*	*20,1*	*18,8*	*13,5*	*8,9*
Debt to market cap %	*10,1*	*35,4*	*23,9*	*25,2*	*22,2*	*13,3*
Debt to cash flow ratio	*0,6*	*0,7*	*1,3*	*0,8*	*0,6*	*0,3*

Revenues and costs are in millions of USD. Lukoil reported earlier PRMS reserves. Since January 1, 2010 Lukoil has reported SEC reserves. Source data: Lukoil 2009, Lukoil 2011, Lukoil 2013a, b, c, MICEX 2013

Table 9.6 OAO NOVATEK

	2007	2008	2009	2010	2011	2012
Liquid reserves million toe	49	55	63	73	91	106
Gas reserves million toe	583	616	863	1021	1179	1569
Condensate reserves million toe						
Total reserves million toe	638	677	935	1103	1281	1691
Oil production million toe	3	3	3	4	4	4
Gas production million toe	25	28	29	34	48	53
Condensate prod million toe						
Total production million toe	28	30	33	38	52	55
Refinery throughput million toe	0	0	0	0	0	0
Total revenue	62431	79272	89954	117024	175273	210973
Revenue net of sales based taxes	56052	72086	81912	106947	157716	194127
Depreciation	-3668	-4478	-5588	-6616	-9277	-11185
Net gain on disposal of interests	*95*	*8*	*52*	*1329*	*62948*	*-60*
Interest expense	-263	-222	-819	-437	-2150	-3236
Interest income	376	407	527	598	3392	1731
Income before taxes	25489	28589	32500	51082	135025	86215
Income tax expense	-6761	-5662	-6778	-10804	-15734	-16774
Minority interest	-8	28	-321	255	364	17
Net income	18736	22927	26043	40533	119655	69458
Cash	3982	10992	10532	10238	23831	18420
Short term debt	6560	6342	13827	25152	20298	34682
Long term debt	42	19935	23876	47074	75180	97805
Minority interest	477	571	19139	20667	669	1251
Equity	81335	96069	114301	147119	241013	290050
Total assets	103975	139907	193639	285173	383432	463133
Cash flow from operations	21383	31514	36454	44863	71907	75825
EBITDA	29052	32882	38701	57792	143424	98922
Market cap.	573223	170595	605161	1104795	1223275	1103655
Enterprise value	575843	185880	632332	1166783	1294922	1217722
R/P ratio	*23*	*22*	*29*	*29*	*25*	*31*
Reserves growth %	*100*	*106*	*147*	*173*	*201*	*266*
Production growth %	*100*	*108*	*116*	*134*	*184*	*196*
Production costs USD/boe	*0,6*	*0,7*	*0,5*	*0,6*	*0,5*	*0,61*
Finding and develop. costs USD/boe	*3,8*	*4,2*	*1,8*	*1,3*	*1,0*	*1,5*
EV/DACF ratio	*26,7*	*5,9*	*17,0*	*25,8*	*17,5*	*15,5*
EV/reserves ratio USD/boe	*4,5*	*1,1*	*2,7*	*4,2*	*3,8*	*2,9*
P/E ratio	*30,6*	*7,5*	*23,2*	*27,2*	*10,2*	*15,9*
ROACE %	*23,6*	*21,8*	*18,4*	*19,8*	*42,0*	*18,9*
EBITDA margin%	*51,8*	*45,6*	*47,2*	*54,0*	*90,9*	*51,0*
Cash flow to assets %	*20,6*	*22,5*	*18,8*	*15,7*	*18,8*	*16,4*
Debt to equity %	*8,1*	*27,2*	*28,3*	*43,0*	*39,5*	*45,5*
Debt to market cap %	*1,2*	*15,4*	*6,2*	*6,5*	*7,8*	*12,0*
Debt to cash flow ratio	*0,3*	*0,8*	*1,0*	*1,6*	*1,3*	*1,7*

Revenues and costs are in millions of rubles USD. Source data: Bank of Russia 2013, Novatek 2009, Novatek 2011, Novatek 2013c

Table 9.7 Rosneft Oil Company

	2007	2008	2009	2010	2011	2012
Oil reserves million toe	1827	1815	1904	1879	1953	1995
Gas reserves million toe	155	160	166	198	456	606
Condensate reserves million toe						
Total reserves million toe	1982	1975	2071	2078	2409	2601
Oil production million toe	101	106	109	116	119	121
Gas production million toe	13	10	10	10	10	13
Condensate production						
Total production million toe	114	116	119	126	129	135
Refinery throughput million toe	40	49	50	50	58	62
Total revenue	1258	1712	1472	1919	2718	3078
Revenue net of sales based taxes	647	798	839	1079	1430	1532
Depreciation	-84	-99	-168	-202	-213	-227
Interest expense	-38	-28	-24	-21	-19	-15
Interest income	5	9	16	20	20	24
Income before taxes	455	325	212	359	405	437
Income tax expense	-125	-47	-57	-58	-86	-95
Minority interest	-1	-2	0	-8	-3	-1
Net income	329	276	155	293	316	341
Cash	25	40	60	127	166	296
Short term debt	382	414	237	167	152	126
Long term debt	288	296	472	549	596	837
Minority interest	7	20	24	32	34	36
Equity	698	1143	1491	1759	2035	2230
Total assets	1836	2277	2725	3015	3377	3858
Cash flow from operations	438	357	355	478	487	516
EBITDA	570	440	388	554	614	654
Market cap.	2224	1064	2419	2101	2057	2490
Enterprise value	2873	1737	3072	2694	2645	3168
R/P ratio	*17,4*	*17,1*	*17,4*	*16,5*	*18,7*	*19,3*
Reserves growth %	*100*	*100*	*104*	*105*	*122*	*131*
Production growth %	*100*	*102*	*105*	*111*	*113*	*118*
Production costs USD/boe	*3,3*	*2,6*	*2,3*	*2,7*	*2,8*	*2,7*
Finding and develop. costs USD/boe	*13,8*	*10,2*	*8,7*	*9,6*	*9,9*	*11,3*
EV/DACF ratio	*6,2*	*4,6*	*8,2*	*5,4*	*5,3*	*6,0*
EV/reserves ratio USD/boe	*8,1*	*4,1*	*6,7*	*5,8*	*4,7*	*5,5*
P/E ratio	*7,0*	*4,0*	*15,6*	*7,2*	*6,5*	*7,4*
ROACE %	*30,7*	*18,6*	*8,4*	*13,4*	*12,5*	*11,7*
EBITDA margin%	*88,2*	*55,1*	*46,2*	*51,3*	*42,9*	*42,7*
Cash flow to assets %	*23,8*	*15,7*	*13,0*	*15,9*	*14,4*	*13,4*
Debt to equity %	*95,5*	*61,2*	*47,1*	*40,2*	*36,4*	*43,0*
Debt to market cap %	*30,1*	*67,0*	*29,4*	*34,3*	*36,6*	*38,9*
Debt to cash flow ratio	*1,5*	*2,0*	*2,0*	*1,5*	*1,5*	*1,9*

Revenues and costs are in billions of rubles. Source data: MICEX 2013, Rosneft 2008, Rosneft 2010, Rosneft 2012, Rosneft 2013a, b, d.

Table 9.8 Royal Dutch Shell plc

	2007	2008	2009	2010	2011	2012
Oil reserves million toe	664	603	772	834	821	843
Gas reserves million toe	959	1016	1150	1105	1118	1004
Condensate reserves						
Total reserves million toe	1622	1619	1923	1939	1939	1847
Oil production million toe	95	88	84	85	83	81
Gas production million toe	70	73	73	80	77	81
Condensate production million toe						
Total production million toe	165	162	156	165	160	162
Refinery throughput million toe	174	155	139	146	132	130
Total revenue	369776	470940	285129	378152	484489	481700
Revenue net of sales based taxes	369776	470940	285129	378152	484489	481700
Depreciation	-13180	-13656	-14458	-15595	-13228	-14615
Interest expense	-1108	-1181	-542	-996	-1373	-1757
Interest income	1436	1507	654	552	1039	1013
Income before taxes	50576	50820	21020	35344	55660	50289
Income tax expense	-18650	-24344	-8302	-14870	-24475	-23449
Minority interest	-595	-199	-200	-347	-267	-248
Net income	31331	26277	12518	20127	30918	26592
Cash	9656	15188	9719	13444	11292	18550
Short term debt	5736	9497	4171	9951	6712	7833
Long term debt	12363	13772	30862	34381	30463	29921
Minority interest	2008	1581	1704	1767	1486	1433
Equity	123960	127285	136431	148013	169517	188494
Total assets	269470	282401	292181	322560	345257	360325
Cash flow from operations	34461	43918	21488	27350	36771	46140
EBITDA	62833	63951	35166	51036	68955	65400
Market cap.	259822	160030	181366	205342	231166	219916
Enterprise value	268265	168111	206680	236230	257049	239120
R/P ratio	*9,8*	*10,0*	*12,3*	*11,7*	*12,1*	*11,4*
Reserves growth %	*100,0*	*99,8*	*118,6*	*119,5*	*119,5*	*113,9*
Production growth %	*100,0*	*98,0*	*94,8*	*100,0*	*97,0*	*98,4*
Production costs USD/boe	*8,2*	*8,6*	*10,6*	*10,2*	*12,6*	*13,8*
Finding and develop. costs USD/boe	*17,1*	*28,8*	*32,8*	*37,0*	*25,1*	*54,3*
EV/DACF ratio	*7,6*	*3,8*	*9,5*	*8,5*	*6,8*	*5,1*
EV/reserves ratio USD/boe	*22,5*	*14,1*	*14,6*	*16,6*	*18,0*	*17,6*
P/E ratio	*8,4*	*6,1*	*14,5*	*10,2*	*7,5*	*8,2*
ROACE %	*23,7*	*18,3*	*8,0*	*11,5*	*15,9*	*12,7*
EBITDA margin%	*17,0*	*13,6*	*12,3*	*13,5*	*14,2*	*13,6*
Cash flow to assets %	*12,8*	*15,6*	*7,4*	*8,5*	*10,7*	*12,8*
Debt to equity %	*14,4*	*18,1*	*25,4*	*29,6*	*21,7*	*19,9*
Debt to market cap %	*7,0*	*14,5*	*19,3*	*21,6*	*16,1*	*17,2*
Debt to cash flow ratio	*0,5*	*0,5*	*1,6*	*1,6*	*1,0*	*0,8*

Revenues and costs are in millions of USD. Source data: Shell 2009, Shell 2010, Shell 2011, Shell 2013a, b.

Table 9.9 OAO Tatneft

	2007	2008	2009	2010	2011	2012
Oil reserves million toe	862	790	862	840	870	869
Gas reserves million toe						29
Condensate reserves million toe						
Total reserves million toe	862	790	862	840	870	897
Oil production million toe	26	26	26	26	26	26
Gas production million toe	1	1	1	1	1	1
Condensate production million toe						
Total production million toe	27	27	27	27	27	27
Refinery throughput million toe	1	1	1	1	3	8
Total revenue	356276	444332	380648	468032	417586	444099
Revenue net of sales based taxes	209977	227061	226851	251967	317151	337806
Depreciation	-10379	-10139	-11917	-12483	-12223	-17770
Interest expense	-60	-580	-626	-483	-5842	-6978
Interest income	2779	3753	4216	3761	2656	3872
Income before taxes	62609	18154	74526	64470	86117	101818
Income tax expense	-18254	-9342	-17556	-13822	-21907	-23370
Minority interest	-1076	-399	-2598	-3975	-2106	-4975
Net income	43279	8413	54372	46673	62167	73473
Cash	13010	13418	12841	8080	16901	13083
Short term debt	4332	5790	71228	34333	41997	32096
Long term debt	9182	44813	16588	75021	59747	37991
Minority interest	4499	4583	7984	11939	11602	16279
Equity	264059	260276	305523	338607	373825	429954
Total assets	370219	392980	495742	567179	607385	630607
Cash flow from operations	48033	47852	66603	55877	77576	90637
EBITDA	69193	24721	80255	69700	99483	117719
Market cap.	308986	115071	294836	311664	332589	462103
Enterprise value	310307	152845	369996	412972	417432	519107
R/P ratio	*33*	*30*	*32*	*31*	*32*	*33*
Reserves growth %	*100*	*92*	*100*	*97*	*101*	*104*
Production growth %	*100*	*101*	*101*	*101*	*102*	*102*
Production costs USD/boe	*4,7*	*6,3*	*4,8*	*5,7*	*6,8*	*7,1*
Finding and develop. costs USD/boe						
EV/DACF ratio	*6,5*	*3,2*	*5,5*	*7,3*	*5,1*	*5,4*
EV/reserves ratio	2,1	0,9	2,0	2,3	2,1	2,7
P/E ratio	*7,6*	*14,6*	*5,8*	*7,1*	*5,7*	*6,7*
ROACE %	*17,0*	*3,0*	*16,0*	*11,8*	*14,5*	*16,7*
EBITDA margin%	*33,0*	*10,9*	*35,4*	*27,7*	*31,4*	*34,8*
Cash flow to assets %	*13,0*	*12,2*	*13,4*	*9,9*	*12,8*	*14,4*
Debt to equity %	*5,3*	*19,3*	*28,1*	*31,2*	*26,4*	*15,7*
Debt to market cap %	*4,6*	*44,5*	*29,8*	*35,1*	*30,6*	*15,2*
Debt to cash flow ratio	*0,3*	*1,1*	*1,3*	*2,0*	*1,3*	*0,8*

Revenues and costs are in millions of Russian rubles. Source data: Bank of Russia 2013, MICEX 2013, Tatneft 2010, Tatneft 2012a, b, Tatneft 2013a, b, c.

Table 9.10 Total S.A.

	2007	2008	2009	2010	2011	2012
Oil reserves million toe	788	777	776	817	789	776
Gas reserves million toe	641	653	655	642	765	769
Condensate reserves						
Total reserves million toe	1426	1427	1430	1459	1558	1551
Oil production million toe	75	73	69	67	61	61
Gas production million toe	44	44	45	51	55	53
Condensate prod million toe						
Total production million toe	119	116	114	118	116	114
Refinery throughput million toe	120	118	107	100	93	89
Total revenue	217554	264709	183175	211143	257093	257038
Revenue net of sales based taxes	187504	235815	156431	186229	231838	234218
Depreciation	-7434	-8464	-9320	-11164	-10448	-12238
Interest expense	-2818	-1949	-1220	-1157	-1589	-1503
Interest income	2586	1767	1081	760	1228	845
Income before taxes	37151	36916	22847	27886	37103	30716
Income tax expense	-18603	-20806	-10811	-13559	-19590	-16787
Minority interest	-485	-534	-254	-313	-425	-189
Net income	18063	15576	11782	14014	17088	13740
Cash	8815	17147	16800	19360	18147	20410
Short term debt	6791	10747	10075	12898	12519	14535
Long term debt	21899	22533	28001	27770	29187	29388
Minority interest	1240	1333	1422	1145	1749	1690
Equity	66035	68182	75706	80725	88033	96200
Total assets	167144	164652	184041	192036	212263	226711
Cash flow from operations	24239	27458	17240	24516	27194	28859
EBITDA	44332	45028	32052	39134	47487	43423
Market capitalization	197871	131161	150393	125659	120812	123052
Enterprise value	217746	147294	171669	146967	144371	146565
R/P ratio	*12,0*	*12,2*	*12,6*	*12,4*	*13,4*	*13,6*
Reserves growth %	*100*	*100*	*100*	*102*	*109*	*109*
Production growth %	*100*	*98*	*95*	*99*	*98*	*96*
Production costs USD/boe	*4,9*	*6,3*	*5,8*	*6,1*	*7,0*	*7,9*
Finding and develop. costs USD/boe	*59,8*	*56,6*	*44,6*	*41,8*	*33,7*	*40,3*
EV/DACF ratio	*8,5*	*5,2*	*9,6*	*5,9*	*5,2*	*5,0*
EV/reserves ratio	*20,8*	*14,1*	*16,4*	*13,7*	*12,6*	*12,9*
P/E ratio	*10,3*	*7,9*	*12,1*	*8,5*	*6,7*	*8,5*
ROACE %	*22,6*	*17,1*	*11,6*	*12,6*	*14,4*	*10,7*
EBITDA margin%	*23,6*	*19,1*	*20,5*	*21,0*	*20,5*	*18,5*
Cash flow to assets %	*14,5*	*16,7*	*9,4*	*12,8*	*12,8*	*12,7*
Debt to equity %	*42,6*	*47,9*	*49,4*	*49,7*	*46,5*	*44,9*
Debt to market cap %	*14,5*	*25,4*	*25,3*	*32,4*	*34,5*	*35,7*
Debt to cash flow ratio	*1,2*	*1,2*	*2,2*	*1,7*	*1,5*	*1,5*

Source data: Bank of Finland 2013, Total 2011, Total 2013a, b.

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