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DIPLOMARBEIT

Titel der Diplomarbeit

Gas export from Russia to the E.U. and Ukraine and its pricing dynamics

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I) Eidesstattliche Erklärung

„Ich erkläre hiermit an Eides Statt, dass ich die vorliegende Arbeit selbständig und ohne Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe. Die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sind als solche kenntlich gemacht. Die Arbeit wurde bisher in gleicher oder ähnlicher Form keiner anderen Prüfungsbehörde vorgelegt und auch nicht veröffentlicht.“

II) Kurzfassung

Jonathan Stern vom *Oxford Institute for Energy Studies* hat in mehreren Publikationen eine Änderung der an den Ölpreis gebundenen Gaspreise hin zu einem Marktpreismechanismus propagiert. Meine Diplomarbeit nimmt diese Vorschläge als Ausgangspunkt für weitere Forschung und Analyse auf diesem Gebiet.

Meine Forschungsfragen lauten:

1. **Darstellung eines konsolidierten Überblicks der russischen Gas-Exporte nach Europa, speziell über die Transitroute durch die Ukraine, und der Preisdynamiken der europäischen und ukrainischen Gasimporte aus Russland sowie der Preisdynamik im russischen Heimmarkt.**
2. **Welche Auswirkungen könnte eine Änderung des ölgebundenen Gaspreises unter Langzeitverträgen für russische Lieferungen nach Europa hin zu einem Marktpreismechanismus haben? Wie würden die Dynamiken der europäischen Importpreise und der Ukrainischen Netback-Preise beeinflusst werden?**
3. **Welche Vorteile und Nachteile könnte der Einsatz des European Gas Index (EGIX), als Mechanismus um europäische Marktpreise von Gas in Verträgen mit Russland zu signalisieren, haben?**

Um diesen Fragen nachzugehen werde ich eingangs den notwendigen politischen und makroökonomischen Hintergrund darstellen. Dazu werde ich zum einen auf die Rolle Russlands als Gasexporteur eingehen. Zum anderen werde ich auf die Rolle von Gazprom als politisches Instrument sowie auf den Einfluss der russischen Heimmarktpreispolitik auf die Bepreisung von Exporten nach Europa referenzieren. Hier ist auch die Rolle der Ukraine als Transitland von Bedeutung sowie der Drang Russlands die Exportpreise in die CIS Länder an die Preise der Lieferungen nach Europa anzugleichen. Dieser makroökonomische Teil wird übergehen in die Darstellung der Entwicklung von Gaspreismechanismen, der theoretischen Aspekte von Gaspreisen, der Rolle von LNG und europäischen Hubs und der Idee von alternativen Preismechanismen basierend auf Marktpreisen.

Der quantitative Teil meiner Diplomarbeit wird eine Analyse von drei primären Datensets und Preisdynamiken sein um die Forschungsfragen zwei und drei zu beantworten und zu diskutieren.

- Zeitserie der russischen Gaspreise für ölindexierte Lieferungen nach Europa an der deutschen Grenze, Langzeitverträge
- Zeitserie des EGIX als Marktpreisvariante
- Zeitserie der Rohölpreise basierend auf Tagesreferenzpreisen der Marke Brent

III) Abstract

Jonathan Stern, from the Oxford Institute for Energy Studies, proposes in several of his papers s shift away form oil-linked natural gas pricing to market-based pricing mechanisms. My thesis takes these ideas as a starting point for further investigation.

My main research questions are:

1. **Consolidated overview of Russian gas exports to Europe, especially via transit through the Ukraine and the gas price dynamics of European and Ukraine natural gas imports from Russia and of Russian domestic supply.**
2. **What could be outcomes to expect from a shift from oil-linked to market-linked natural gas prices for long-term Russian natural gas supply to Europe? How would the dynamics of European import prices and Ukraine netback prices be influenced?**
3. **What can be advantages and disadvantages of using the European Gas Index (EGIX) to signal European market prices for natural gas in supply contracts for Russian natural gas?**

To examine these questions I first of all provide the necessary political and macro economical background. For this matter I will on the one hand deal with Russia's role as a gas exporting country, focusing especially on the role of Gazprom as a political tool and on the influence of Russia's domestic gas price policy on its foreign pricing policy directed towards the E.U. Here the role of Ukraine as a transit country to the E.U. and the Russian thrive towards European netback pricing in the CIS, exemplified by the Ukraine, will be taken under consideration. This macro economical part will lead to a brief survey of the development of gas pricing mechanisms, the theoretical aspects of gas pricing, the role of LNG and Continental European gas hubs to the ideas of alternative gas pricing mechanisms, especially a shift to market based pricing as we see it in Stern's work.

The quantitative part of the thesis contains an examination of three primary sets of data in order to answer the research questions two and three:

- The time series of Russian natural gas border prices to Germany: oil-linked price
- The time series of the EGIX (European Gas Index) Gaspool and NCG area in Germany): market price
- The time series of Brent crude oil (petroleum) as a reference price for crude oil in Europe

IV) Acknowledgment

I hereby wish to thank first and furthermost of all my wife Natalia for inspiring me each and every day.
Also I want to give a massive thanks to Dr. Yuri Yegorov, who, with a perfect mixture of strictness and support, kept me focused and showed me the way.
Finally my gratefulness belongs to Univ. Prof. Dr. Franz Wirl, who gave me the possibility to write on this topic via his department, the Chair of Industry, Energy and Environment at the University of Vienna.

V) Table of Contents

VI) List of Abbrevations

ANOVA: Analysis of Variance

bcm: Billion Cubic Meters

CIS: Commonwealth of Independent States

EGIX: European Gas Index

EEX: European Energy Exchange

EU: European Union

FDI: Foreign Direct Investment

GDP: Gross Domestic Product

IEA: International Energy Agency

LNG: Liquefied Natural Gas

mcm: Million Cubic Meters

NATO: North Atlantic Treaty Organization

NBP: National Balancing Point

NCG: NetConnect Germany

OECD: Organisation for Economic Co-operation and Development

OPEC: Organization of the Petroleum Exporting Countries

TTF: Title Transfer Facility

USSR: Union of Soviet Socialist Republics

VII) List of Graphs, Boxes and Tables

Graphs

Boxes

Tables

1. Research Questions

1.1. Problem Statement

> "Russia is the world's second largest producer and exporter of oil. It also is the largest producer and exporter of natural gas. At times of low world market prices for oil and natural gas, such as 1986-88 (for natural gas 1987-89) and 1998, it experiences economical crises."[1]

This statement introduces us to the significance of the commodities oil and gas for the largest country in the world, the Russian Federation. In my thesis I will deal with the gas market. The deliveries of natural gas from the Russian Federation to Europe are on a constant basis a hot topic in a political as well as in an economical sense. Russia is the biggest single exporter of natural gas to Europe and the European Union (EU). This import-export relationship is on the one hand heavily influenced by the fact of transit, especially through the Ukraine, and in this case subject of geopolitical games. In order to secure supplies from a European point of view and in order to justify and to hedge investments from the Russian point of view the gas deliveries from Russia to Europe are mostly carried out under the regime of long-term contracts. The pricing mechanism of these long-term contracts is based on the idea of the replacement value leading to a pricing formula of oil-indexation. Several commentators, furthermost of all Jonathan Stern (2009), see this pricing mechanism as out-dated and suggest market driven pricing tools via indexation based on prices at European hubs. This does not necessarily indicate a certain advantage for the buyer or the seller side but it could mean a more direct reflection of factual market situations.

Additionally domestic Russian gas prices are heavily influenced by politics leading to low prices as a form of subsidy for the local industry and the Russian people. This results in negative revenues in the home market for the Russian state-owned company Gazprom and the need for Gazprom to make positive revenues via the exports to Europe and also via the exports to the countries of the Commonwealth of independent Nations (CIS), for example to the Ukraine. In this case rising prices lead to political disputes resulting in gas wars like we faced it in January 2009.

[1] Ellmann, Michael (2006), p. 3

So we have a climate of oil-indexed, non-market long-term contracts of European imports, the thrive for European netback prices for the Ukraine and very low domestic prices in Russia.

1.2. Objective

Within my thesis I want to closely examine the situation of Russian natural gas exports to Europe and its pricing dynamics. This shall be broadened by the dimension of transit via the Ukraine and the implication that European gas pricing dynamics have on the Ukraine import price, because here we face a massive externality on European and Russian gas import-export strategies due to political and geopolitical games.

My main research questions are:

1. **Consolidated overview of Russian gas exports to Europe, especially via transit through the Ukraine and the gas price dynamics of European and Ukraine natural gas imports from Russia and of Russian domestic supply.**
2. **What could be outcomes to expect form a shift from oil-linked to market-linked natural gas prices for long-term Russian natural gas supply to Europe? How would the dynamics of European import prices and Ukraine netback prices be influenced?**
3. **What can be advantages and disadvantages of using the European Gas Index (EGIX) to signal market prices for natural gas in supply contracts for Russian natural gas?**

1.3. Methodology

My thesis consists of two major parts. On the one hand a descriptive part based on literature research and the discussion of the findings. This research will be based on acclaimed authors on the topic. It covers the role of Russia as a gas exporting country, especially to Europe, the role of Gazprom as a political tool, Europe as gas importer, Ukraine as a gas importer and a transit country, gas pricing on the oil-indexed basis, theoretical aspects of gas pricing, the role of European hubs an LNG and the discussion about a market price mechanism. The goal is to give a consolidated picture on the topic.
Part two will be a statistical analysis of different oil and gas price series via graphs and SPSS in order to answer research question two an three.

1.4. Structure of the thesis

The general structure of the thesis will be as follows:

1. Descriptive analysis of Russia as gas exporting country to Europe and the Ukraine
2. Descriptive analysis of Europe as a gas importer
3. Descriptive analysis of the Ukraine as a gas importer and a transit country
4. Descriptive analysis of existing gas pricing mechanisms on the oil-indexed replacement value basis, the role of European hubs, the role of LNG and the discussion on market-based gas pricing
5. Statistical analysis of different oil and gas price series in order to answer research question two and three
6. Conclusion: Summary and discussion of the findings

2. Russia's Role as a Gas Exporting Country

2.1. Russia's transition period in the aftermath oft he fall of the Soviet-Union

> „After the CIS was formed in 1991, the former Soviet countries entered a very tough transition period that brought fundamental changes in their economic systems, institutional collapse, a substantial decline in GDP and lower living standards. (...) Non-payment became a huge problem in the gas sector in particular, because suppliers of gas – unlike coal and fuel oil – had no advance payment, and no legal right to cut off non-paying consumers.“[2]

I chose this statement by Tatiana Mitrova (2009) as the opener for the first chapter because it illustrates the juvenile economical background that the young market economy of the Russian Federation provides as a breeding ground of the topics we are dealing with. To fully understand the natural gas sector and the price dynamics of Russian natural gas exports to the European Union and to Ukraine, including transit tariff issues concerning the latter, I wish to provide an overview on the role of the Russian Federation as a gas exporting country. I will start by outlining the period of economical transition in the aftermath of the fall of the Soviet Union, the organisation of the post-soviet gas industry, the role of Gazprom and Russia's natural gas balance. This will be followed by an outline of Russia's natural gas export activities, the challenges of post-soviet CIS trade, projections of future natural gas production in Russia and a brief overview on the gas price reform with a focus on Ukraine.

The prime role concerning scientific research on the topic of natural gas from an economical perspective is being taken by *The Oxford Institute for Energy Studies*. The institute was founded in 1982 and functions as a recognized independent centre of the University of Oxford. Per self-definition it has the following function:

> “Its unique multidisciplinary expertise allows it to examine the economics, the politics and the sociology of energy with a focus on oil and natural gas. Its research spans the international relations between producers and consumers

[2] Mitrova, Tatiana (2009), p. 13

> of energy; the economic development of producing nations and the geo-political aspects of all these issues alongside the economics and politics of the environment in relation to energy, including climate change. The Institute's intellectual independence places it firmly at the centre of the dialogue between consumers and producers, government and industry, academics and policy makers. The Institute serves a worldwide audience with its research and continues to inform understanding of all major energy issues today."[3]

The now following explanations are mainly based on Tatiana Mitrova (2009), Jonathan Stern (2009b) and Simon Pirani (2009a).

> "Many concerned with the natural gas industry – as political decision makers, academics, or because they work in it – think of the former Soviet Union in the first place as a producer and exporter. Reserves in Russia and central Asia are among the world's largest; Russia's exports to Europe, and the disputes over getting them there, are a theme of constant discussion."[4]

This statement by Simon Pirani highlights the key issues, which have to be understood when discussing the Russian Federation and its gas exports. On the one hand you have to have at least a brief understanding of Russia as a gas exporter, its structure, challenges, prospects and also its market power. On the other hand, from the European point of view that this thesis takes, the issue of transport of the product has to be included. For that reason a part of this work will deal with the main export corridor from the Russian Federation to Europe, namely Ukraine.

As already mentioned in the opening statement Russia had a major problem in the beginning of the 1990s after the fall of the Soviet-Union due to high accumulated gas debts, both domestic and inter-state, which could not be met. These inter-stat debts where mostly located within the members of the Commonwealth of Independent States (CIS). Mitrova (2009) points out that official GDP fell by at least 20% in all the transition countries and even more then 40 % in many of them including Russia and Ukraine. As especially Ukraine is interesting for the further investigations I will focus

[3] http://www.oxfordenergy.org/, 16.4.2012

[4] Pirani, Simon (2009a), p. 1

on the numbers Mitrova (2009) states in this concern. Ukraine already accumulated $4-4.5 billion in debts for gas just between 1991 and 1994. Till July 1999 Ukraine owed an additional $1 billion to Russia and a substantial amount of $111 million to Turkmenistan. The first inter-state cut off due to non-payment already occurred in 1993, it was already Ukraine which was not able to pay a debt of $ 238 million and threatened Russia to shut down the transit pipeline to Europe. At the times of the Soviet-Union the Soviet ministry of the gas industry dealt with the gas agenda. This ministry was broken up into independent ministries after the collapse of the Soviet-Union. In Russia the company Gazprom was set up to deal first of all with the complete gas sector. Gazprom can be described as a state-owned, centralised company. Since 1993 it is a joint-stock company. Similar to Russia also other gas producing and gas-exporting members of the CIS set up centralised, state owned companies. The result was a very strong influence of politics in the gas business and a market of regulated prices that the companies had to deal with.[5]

2.1.1. 1990-2000: The time of barter

Many of the CIS countries were not able to live up to their debts, so the Russian Federation, as much as many other CIS countries, allowed barter agreements to settle the debts.

> "In the 1990s almost all CIS countries allowed gas transactions to be settled by barter, which they sometimes saw as the only way to get any payment at all. In 1994-96 the share the share of barter settlements in some CIS gas markets was more than 90 per cent."[6]

What as a barter agreement? In modern Western society we are used to make regular transactions of a product or service being exchanged against a monetary value, usually money. One of the legacies of the communistic system of the former USSR to the Russian Federation and the CIS countries was a form of product for product exchange called barter. Tatiana Mitrova (2009) finds to following explanation:

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[5] cf. Mitrova, Tatiana (2009), pp. 13-15

[6] Mitrova, Tatiana (2009), p. 14

> "Barter arrangements, or "bilateral clearing", also entered into inter-state gas trade: Belarus paid Russia for gas with food, electrical and electronical equipment, construction materials, trucks, tractors and other goods; Ukraine paid Russia and Turkmenistan with food, chemical and engineering products, grain, light industrial goods, diesel locomotives, pipes and metals; Armenia and Georgia paid Russia with food and chemical products, pharmaceuticals, electric power, car tyres, and paint and varnish products. Other assets besides manufactured products were bartered: for example, Ukraine has paid Turkmenistan with ships and factories. On the other hand goods supplied under barter arrangements were often of low quality and overpriced; some were completely useless. (…) Barter continued to figure in Ukrainian-Turkmen transactions until their trading relationship ended in 2006".[7]

This intense explanation by Mitrova (2009) is for the case of this paper from relevance when we have a closer look on the gas trade between the Russian Federation and Ukraine. Ukraine was until several years ago using the way of barter agreements to get parts of its gas debts settled.
Mitrova (2009) also points out that the most important type of barter was the gas for transit barter. Also up until 2006, so quite shortly before the recent impactful gas crisis between Ukraine and Russia, which resulted in a temporary stop of gas supplies in January 2009, evolved, Russia paid the transit to Europe via Ukraine through the supply of very cheap gas to Ukraine. Mitrova considers this as the largest gas-for-transit deal.[8]

Another important issue when it comes to barter agreements is the politically important fact, that the gas supply was in many cases linked to some completely different issue.

> "Another common phenomenon in the 1990s was the linking of payment for gas supplies with a wide range of issues not associated with the gas industry. For example, under the Russo-Ukrainian agreements of 1997, Russia wrote

[7] Mitrova, Tatiana (2009), p. 14

[8] cf. Mitrova, Tatiana (2009), p. 14

> off $521 million of Ukrainian gas debts in exchange for 31% of the Black Sea fleet."[9]

Jonathan P. Stern (2005) however argues that barter agreements and the on going use of those agreements might have its roots not just an a communistic country on the path of transition to a market economy and the legacy of its habits but also in the domestic support of a kind of virtual economy. This would mean, that the Russian government used Gazprom as a tool for subsidizing a weak economy with cheap gas supply in order to keep unprofitable businesses alive and maintain employment.[10]

> "The specific gas-related argument is that Gazprom was a willing party to non-payment in return for being allowed to keep revenues from exports. But it is important to ask whether the problems in the domestic market were the creation of Gazprom or successive governments struggling through an economic transition. Viewed by this author over the past decade, Russian governments bore overwhelming responsibility for the non-payment crisis."[11]

Stern (2005) explains, that this form of subsidy to an unhealthy domestic economy made Gazprom fully dependent on the revenues of gas exports, especially to the European Union. From a point of view of the Russian governments it might also be argued that those actions were a necessity in order to keep a certain level of stability within the domestic Russian economy. Nevertheless I would like to follow Stern (2005) when he points out, that a shift of Gazprom's domestic price structure to marginal cost pricing and strict payment discipline would of course have resulted in sharp decline of gas demand due to a cooling off within the industry. On the other hand Gazprom would have had more time to establish a profitable network in its home market rather than being forced to rapidly build up a new and expensive export infrastructure.[12]

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[9] Mitrova, Tatiana (2009), p. 14

[10] cf. Stern, Jonathan P. (2005), pp. 198-199

[11] Stern, Jonathan P. (2005), p. 199

[12] cf. Stern, Jonathan P. (2005), p. 199

The most important facts that should be kept in mind from this sections are the significant size and therefore the importance of gas-for-transit barter between the Russian Federation and Ukraine and the use of gas supply as a political asset to settle all kinds of political issues and to keep the domestic economy stable. Exactly those practices will be important concerning the gas price dynamics in the Ukraine, which will be discussed later on and will also serve as an explanatory for the deep natural gas import-export bond and dependencies between the Russian Federation and Europe.

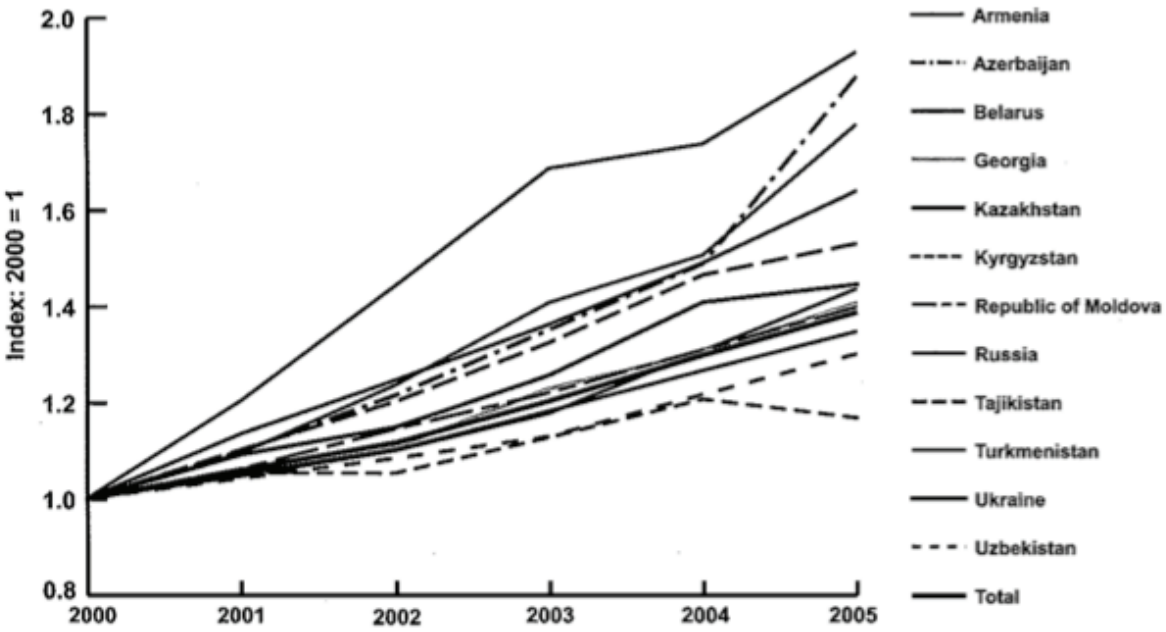
2.1.2. 2000-2007: Stabilisation

While the period of economic transition from the planned economy of the former USSR to a market economy brought habits like barter agreements along in the 1990s, it has to be mentioned, that the century concluded with the Russian financial crisis of 1998. The causes and effects of this crisis are not major subject of this thesis, important is, that it lead to a massive cooling down of the economies of not just the Russian Federation but also of other interrelated CIS countries. Of significance for this authors explanation is the period after the crisis of 1998, which marked a massive economic recovery in the years from 2000 until 2007, before the global financial and economical crisis of 2008 hit the Russian economy as well.

> "Between 2000 and 2006, all CIS countries pulled out of the economic crisis of the 1990s and achieved stable GDP growth. (…) For the gas sector, the first significant result of the improved economical situation was a reduction in non-payments and barter."[13]

This is an important statement to keep in mind. As the economies, especially the economy of the Russian Federation, were in a state of recovery, a more market driven dynamic resulting in a thrive for reduction of barter and non-payment occurred. The significant GDP growth in Russia and the CIS countries is being highlighted in graph 2.1.

[13] Mitrova, Tatiana (2009), p. 18

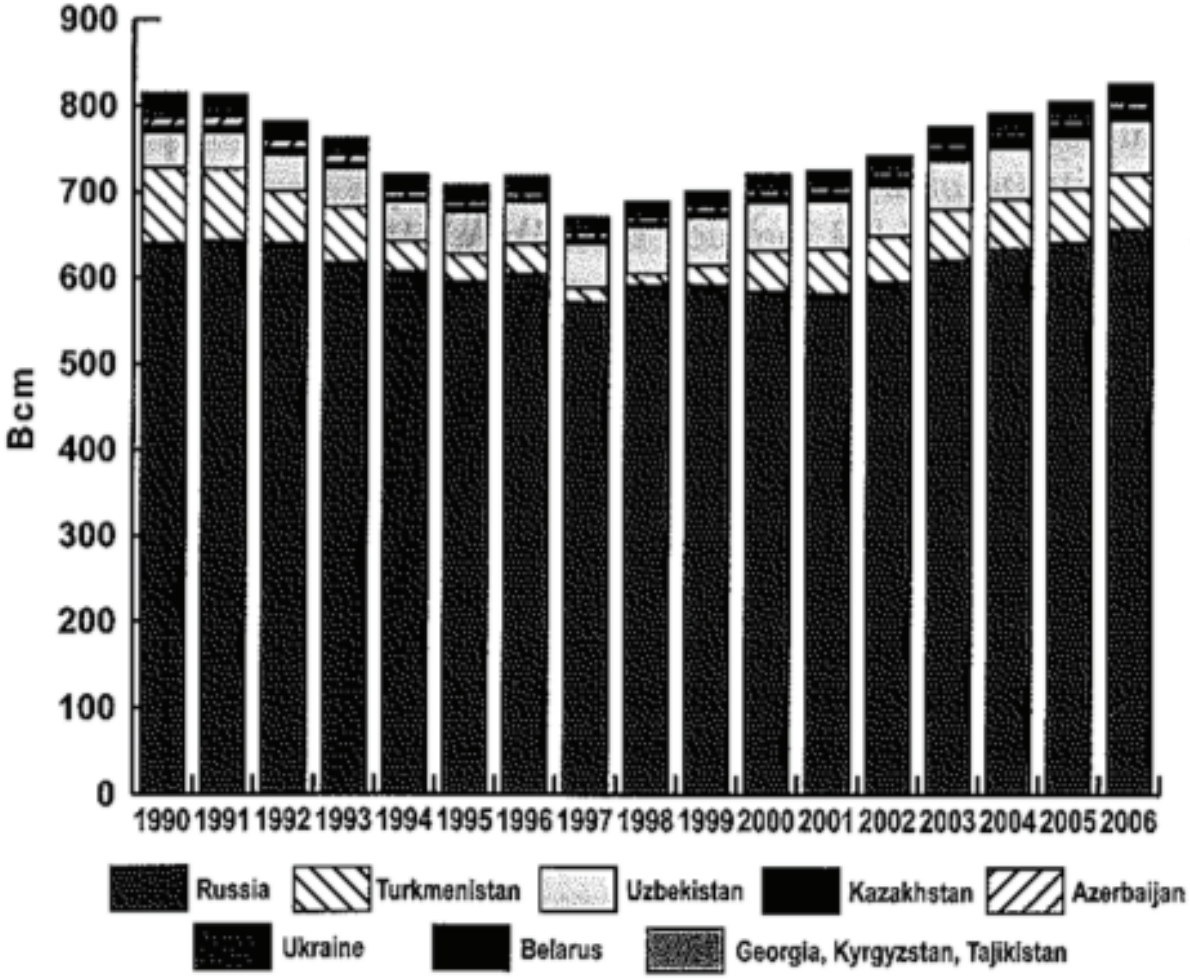


Graph 2.1: GDP dynamics in CIS countries, 2000-05 (Mitrova, Tatiana (2009), p. 19)
Source used by Mitrova (2009): Mezhgosudarstvennyi statisticheskii komitet SNG, *Osnovnye makroekonomicheskie pokazateli stran SNG. 1995-2004* (Moscow, 2005)

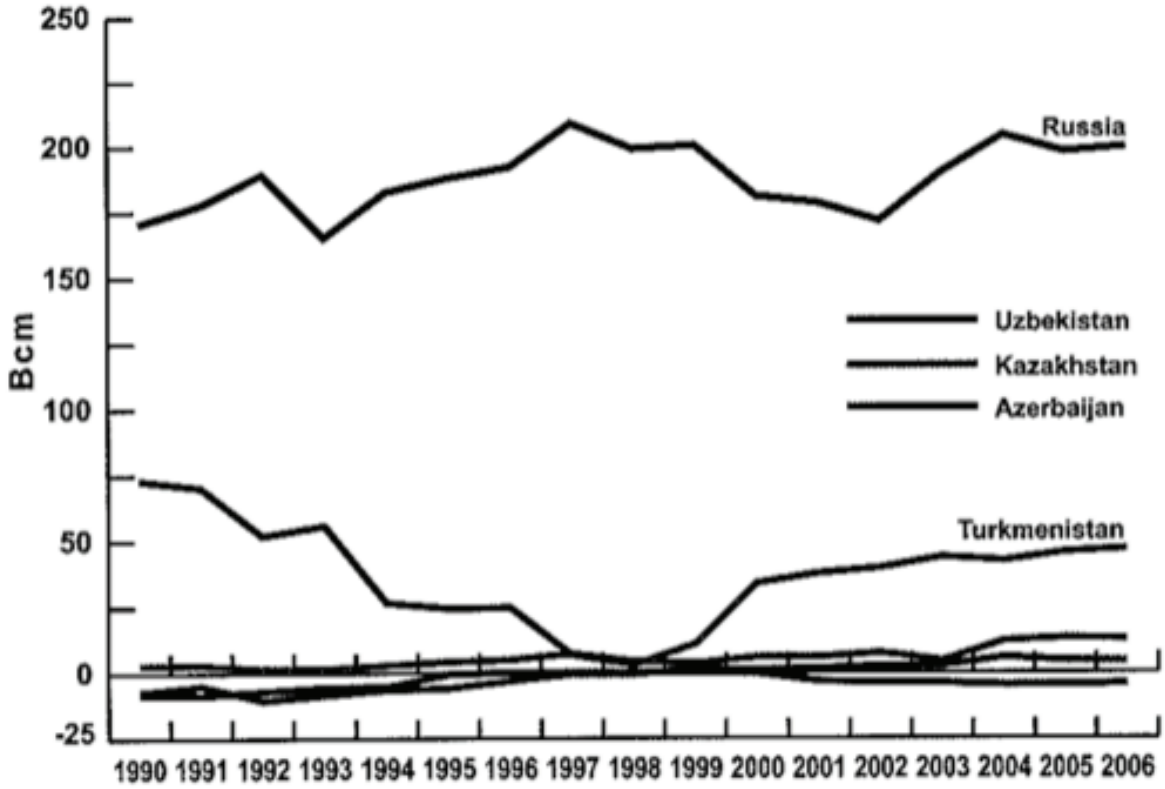
Those years did not just bring a stabilisation for the natural gas industry in Russia, but due to investments into exploration, production and transportation of gas also a substantial growth of the industry. Mitrova (2009) regards this as the main achievement within that period.[14]

Graph 2.2 highlights the substantial growth in production volumes between 2000 and 2006 and graph 2.3 shows the growth in net gas exports since 2000.

[14] cf. Mitrova, Tatiana (2009), p. 20



Graph 2.2: Gas production in CIS countries, 1990-2006 (bcm) (Mitrova, Tatiana (2009), p. 20)
Source used by Mitrova (2009): Mezhgosudarstvennyi statisticheskii komitet SNG, *Osnovnye makroekonomicheskie pokazateli stran SNG. 1995-2004* (Moscow, 2005)



Graph 2.3: Net gas exports of CIS countries, 1990-2006 (bcm) (Mitrova, Tatiana (2009), p. 21)
Source used by Mitrova (2009): Mezhgosudarstvennyi statisticheskii komitet SNG, *Osnovnye makroekonomicheskie pokazateli stran SNG. 1995-2004* (Moscow, 2005)

Despite all these important achievements, the natural gas industry was still the least major sector of the Russian Federation functioning on the basis of free markets. It has become clear that the gas sector's particular political and economical role will produce specific CIS gas sector regulation regimes lead by Russia and being unlike European models. The principles being set by Russia include:

- Vertically integrated, state-owned companies
- Favourable production conditions for foreign direct investment (FDI) and private investors, with dominant state-owned companies
- State control over transportation networks
- Strict distribution regulations[15]

[15] cf. Mitrova, Tatiana (2009), pp. 21-22

2.2. Organisation of the post-soviet gas industry in Russia

As we already know the post-Soviet gas industry is mainly controlled by integrated state-controlled companies, which are in many cases 100 per cent state owned. These companies were mainly formed around 1992 and include names like *Gazprom*, *Turkmengas*, *Ukrgazprom*, *Uzbekneftegas* and many more. Integration in terms of gas companies means owning more or less the complete value chain, starting from exploration and production but also including activities like distribution, transmission and engineering. These state-controlled companies can be interpreted as 'quasi-ministries'. Their role goes beyond market driven parameters, there is a broad strategic and political context involved.[16]

> "Gazprom is the best example of a post-Soviet vertically integrated state-controlled company, which dominates both upstream and downstream activities. It has roughly a 60 % share of Russia's proven gas reserves and 84.7 % in total productions, it owns all the main gas-processing facilities; owns and operates Russia's high-pressure pipelines; is sole owner of gas storage capacity; and has a legal export monopoly. Further downstream, Gazprom owns 'blocking stakes' in more than 70% of gas-distribution organisations, and controls many of the larger ones."[17]

For this paper it is important to keep this illustration of Gazprom's substantial market power and strategically important political role in mind. One of the major outcomes of Gazprom's role as a political tool results in the companies export dynamics. As we already understand domestic gas supply is carried out by Gazprom with major losses in order to subsidize the domestic industry and also the private sector.
Also the Russian Federation knows certain bodies of regulation. There are no regulatory bodies in charge, which are exclusively dealing with the natural gas industry, but there are at least two bodies to be mentioned: *The Federal Tariff Service* and *the Federal Antimonopoly Service*. Their main issues are:

- Anti-monopoly issues
- Establishing gas tariffs for consumers and gas transportation tariffs

[16] cf. Mitrova, Tatiana (2009), p. 22

[17] Mitrova, Tatiana (2009), p. 23

- Development of regulatory documents
- Creation of methods of tariff calculation
- Treatment of cases related to the violation of legislation[18]

2.3. The role of Gazprom

In the context of my thesis I would like to have a brief look at the role of Gazprom especially when it comes to an entity of gas pricing and also on the current self-definition of the company in order to get a feeling of what to think of Gazprom as a player in gas exporting.

> "In the post-Soviet period, CIS domestic gas markets have been markets in the name only. In reality they were rationing mechanisms with market-based activity at the fringes."[19]

This statement highlights the fact that the domestic Russian and CIS post-Soviet gas market was not a market at all.
The industry was dominated by one player, state-owned Gazprom.

> "This company, newly-formed from the Soviet Ministry of Gas, produced 94% of Russia's total annual output of 643 bcm, and as the country's remaining gas was merely being generated as a by-product by Russia's oil companies and transferred into the gas system at very low cost, Gazprom was the only significant seller of gas in the Russian market. As a result, it was by far the largest player not only in Russia's energy industry but also in the country's economy. Consequently, while other commodity prices were liberalised during the first reform period of the early 1990s, it was decided that gas prices charged by Gazprom needed to remain under strict government control." [20]

[18] cf. Mitrova, Tatiana (2009), p. 25

[19] Mitrova, Tatiana (2009), p. 26

[20] Henderson, James (2011), p. 5

The main domestic target for Gazprom was more or less providing a subsidy to the domestic industrial and private sector via regulated gas, which was and is being sold substantially under market price.

There are two interesting streams, which may or may not impact on a possible redefinition of Gazprom and its pricing strategies.

On the one hand there is a changing structure of the domestic gas market by the emergence of independent gas producers such as *Novatek* and *Itera*. Those independent producers are not legally bound to the regulated price restrictions and can effectively sell at a proper market price. As a result a two-tier market exists with Gazprom selling at a very low regulated price and independent producers at market prices.[21]

Why would anyone buy for a higher market price? The answer lies in the 'Gas Balance'. Gazprom and the Russian government negotiate on an annually basis which volumes of gas to sell at regulated prices domestically. This is being followed by a bidding process to allocate the volumes. But usually there is extra gas needed on top of those volumes and this is, where the independent producers enter the stage.[22]

On the other hand, and most probably also interrelated with the existence of this two-tier market, there is a political thrive to transfer Gazprom into a global player in the gas and oil business. On Gazprom's website the following statement can be found.

> "Gazprom is a global energy company. Its major business lines are geological exploration, production, transportation, storage, processing and sales of gas, gas condensate and oil, as well as generation and marketing of heat and electric power. (…) Gazprom is a reliable supplier of gas to Russian and foreign consumers. The Company owns the world's largest gas transmission network – the Unified Gas Supply System of Russia with the total length of over 161 thousand kilometres."[23]

According to this statement and the use of vocabulary like global, reliable and largest point out the willingness for a global self-definition. These indicators taken from

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[21] cf. Henderson, James (2011), pp. 8-9

[22] cf. Henderson, James (2011), p. 9

[23] http://www.gazprom.com/about/, 17.4.2012

Gazprom's self-definition combined with the threat of the political influence on the domestic level, which leads to unprofitable business in the Russian domestic market, partly explain on the one hand Gazprom's focus and motivation on the E.U. as an importing partner of Russian gas on netback market price levels. On the other Gazprom's relationship with the Ukraine, amongst other CIS countries like White Russia, and the recent focus on raising the price levels of exports to the Ukraine might be interconnected with this current status of the company.
Jonathan Stern summed those ideas up by mentioning two major risks that Gazprom is facing already in 2005. He stated that Gazprom's future strategy concerning supply and target markets will based on the willingness and ability to pay.[24]
Stern draws a general scenario for possible Gazprom supply and export strategies based on pricing and willingness to pay, which is shown in table 2.1.

[24] cf. Stern, Jonathan (2005), p. 206

EUROPEAN BORDER PRICES[25]	**RUSSIAN REGULATED INDUSTRIAL PRICES**[26]	
	HIGH	LOW
HIGH	Demand in both Europe and Russia is low but revenue and profitability is high allowing for domestic new large scale supply to be developed (eg Yamal) or imported form Central Asia. In this scenario the major risk for Gazprom is that volume growth in both domestic and export markets may be uncertain. In that situation, flexible, i.e. non-Gazprom, supply sources would be preferable.	Close to the situation in 2003-04. Expansion of Russian exports to Europe with strongly increased revenue earnings. Market expansion prospects are uncertain at these price levels. Developing new large-scale supply or imports for the domestic market, where demand is still expanding due to low prices, is impossible, as both would incur significant losses.
LOW	Additional exports to Europe become unattractive, especially through new infrastructure, such as NEP. Sales to the domestic market become extremely profitable. Investment in large-scale new supply and imports is problematic because of uncertain domestic demand at high prices. If low European gas prices continue into the 2010s renewal of some long-term contracts may be questioned.	Close to the situation Gazprom faced in the period 1997-2000 (except that the domestic price was much lower). Very difficult to make a case for more than marginal investments or new infrastructure, domestic or imported.

Table 2.1: Gas Price Scenarios for Russia and Europe in the 2010s – Consequences for Gazprom (Stern, Jonathan (2005), p. 207)

[25] Explanation by Stern (2005): High European border prices – above $120/mcm; low border prices = below $80/mcm; prices in 2004 dollars at the German border; 1 Euro = $1,15;

[26] Explanation by Stern (2005): High regulated domestic prices = above $60/mcm; low regulated domestic prices = below $30/mcm. Prices for industrial customers in 2004 dollars in the zone which includes the city of Moscow; $1 = RR30

These scheme for possible Gazprom strategies dates back to 2005, so way before the 2008 financial and economical crisis, yet it still contains an interesting and useful general nutshell point of view of the company functions and in which environment it functions.
I would like to conclude this subchapter with the two major risks Gazprom has to deal with according to Stern's table.

1. Prices Risk: This includes the risk that the domestic market does not become sufficiently profitable to warrant the development of higher-cost gas sources, for example the Yamal Peninsula field. In terms of domestic price levels and this would implicate a substantial increase in prices and may lead to acceptance problems within the domestic market due to a more or less loss of the political subsidy which is carried out via cheap gas sales.
2. Market risk: If prices are not being accepted demand might decrease and Gazprom may suddenly be unable to sell to supply in which it invested at a profitable price.[27]

In general it is important to keep in mind form this subchapter, that Gazprom is challenged by the use of natural gas as a mechanism for subsidizing the domestic industry and the people of Russia with cheap gas and that the company has to seek for routes to be nevertheless profitable. The relationship with the EU as an importing country and the Ukraine as an importer and transit country will be influenced by this challenge and reflect it.

[27] cf. Stern, Jonathan (2005), pp. 206-208

2.4. The Russian natural gas balance

The Russian gas balance needs to be viewed as a matrix. This matrix includes on the one hand three major supply sources:

- Gazprom production
- Non-Gazprom production
- Central Asian imports

On the other hand it includes three major markets:

- Russian demand
- Exports to CIS countries
- Exports to Europe[28]

Jonathan Stern (2009a) sets up the Russian gas matrix based on 2008 data the following way:

SUPPLY SOURCES	Bcm/year	MARKETS	Bcm/year
Gazprom Production	550	Russian Gas Demand (Unified Gas Supply System UGSS)	353[29]
Non-Gazprom Production	114	Exports to CIS Countries	92
Central Asian Imports	61	Exports to Europe	159[30]

Table 2.2: The Russian Gas Matrix: major building blocks (2008 data)[31] (Stern, Jonathan (2009a), p. 4)

[28] cf. Stern, Jonathan (2009a), p. 3

[29] Based on Stern (2009a): Gazprom figure of sales delivered to customers in Russia via the UGSS

[30] Based on Stern (2009a): Long-term contract sales only, total European sales were 189 bcm

[31] Based on Stern (2009a): Major building blocks only, total supply is very different to total markets principally because of: gas used for transportation, net changes in storage, gas used outside the UGSS in Siberia and in the Far East

> „The gas industry is vital to the Russian economy, accounting for more than half of all the energy consumed in the country and contributing 13% of total export revenues.“[32]

It is relevant to mention that the contribution oft he gas industry tot he Russian GDP is according to 2006 date around 8-9 per cent.[33]
This contribution is significantly less than for example the contribution of the oil industry, which also does not have a counterpart company to Gazprom in terms of dominance and centrality.[34]
Therefore revenues and profits from Gazprom sales are crucial for the stability of Russia's economy. As we have already learned, the usage of cheap gas taken from Gazprom's supply as a subsidy for the domestic industry and for the Russian people is still a common political method. Therefore export revenues to CIS and non-CIS markets are the main caretakers for Gazprom's profits. In order to keep those costumers, especially the European costumers, Gazprom has to be able to full fill the supply contracts. As we will see later on the companies' route of exploration in terms of exploiting new gas fields is vague at best.
Nevertheless Stern argues that in case of a supply shortage it would not be the European costumers that would suffer from reduced availability because the long term delivery contracts provide, as one of their major advantages form a European point of view, international arbitrage clauses providing for financial damages in the event of non-delivery. The only consequence might be a disappearance of short-term sales.[35]
Table 2.3 shows the export volumes to Western Europe, Eastern Europe and to the Baltic States, table 2.4 shows the exports to Ukraine. Both tables include data up to 2007.

[32] Stern, Jonathan (2009b), p. 54

[33] cf. Hanson, Philipp (2008), pp- 8-11

[34] cf. Stern, Jonathan (2009b), pp. 54-55

[35] cf. Stern, Jonathan (2009a), p. 4

	1995	2000	2005	2006	2007
Western Europe	75,1	90,4	113,3	117,8	113,8
Eastern Europe	42,3	39,7	42,9	43,3	39,6
Baltic States	4,4	4,7	5,0	4,9	5,3
Total Europe	121,8	133,7	158,2	166,4	158,3

Table 2.3: Russian gas exports to Europe and Baltic countries 1995-2007 (bcm)[36] (Stern, Jonathan (2009b), p. 79)

	2000	2001	2002	2003 [37]	2004	2005	2006	2007
Gazprom supply[38]	27,2	21,9	25,9	26	34,34	37,6	59,0	59,2

Table 2.4: Russian gas exports to Ukraine 2000-2007 (bcm)[39], based on: (Stern, Jonathan (2009b), p. 78)

[36] Stern (2009b) mentions the following sources: Gazprom in Figures 2001-05; Gazprom, Annual Report 2006, pp. 49-50; 2007, p. 63. Gazprom Export at 35

[37] Interpreted by Stern (2009b) based on a chart in Gazprom, *Annual Report 2003*, p. 67.

[38] Based on Stern (2009b): Data for 2006 and 2007 include gas purchased form Central Asia and resold by Rosukrenergo

[39] Stern (2009b) mentions the following sources;
Gazprom: data for 2000-02 from Stern, The future of Russian Gas, Table 2.2, p. 69; More recent date from Gazprom Annual Reports: 2007, p. 63; 2006, p. 49; 2005, p. 55; 2004; p. 47; 2003, p. 67
Rosstat: date for 2000-06: Rosstat, Rossiiskii statischeskii ezhegodnik, 2007, Table 25.17, p. 768; 2005, table 23.17, p. 716; 2004, table 25.17, p. 666; 2003, Table 25.17, p. 647; 2002, table 24.17, p. 627; Interstate Statistical Committee oft he CIS, External Trade of the Countries of the Commonwealth of Independent States in 2005, p. 154; 2008, pp. 143-144

I would like to conclude this subchapter with table 2.5. It includes a projection of the Russian gas balance for 2015.

SUPPLY SOURCES	Bcm/year	MARKETS	Bcm/year
Gazprom Production	480-580	Russian Gas Demand (Unified Gas Supply System UGSS)	385-440
Non-Gazprom Production	150-200	Exports to CIS Countries	75-85
Central Asian Imports	70-100	Exports to Europe	180-200

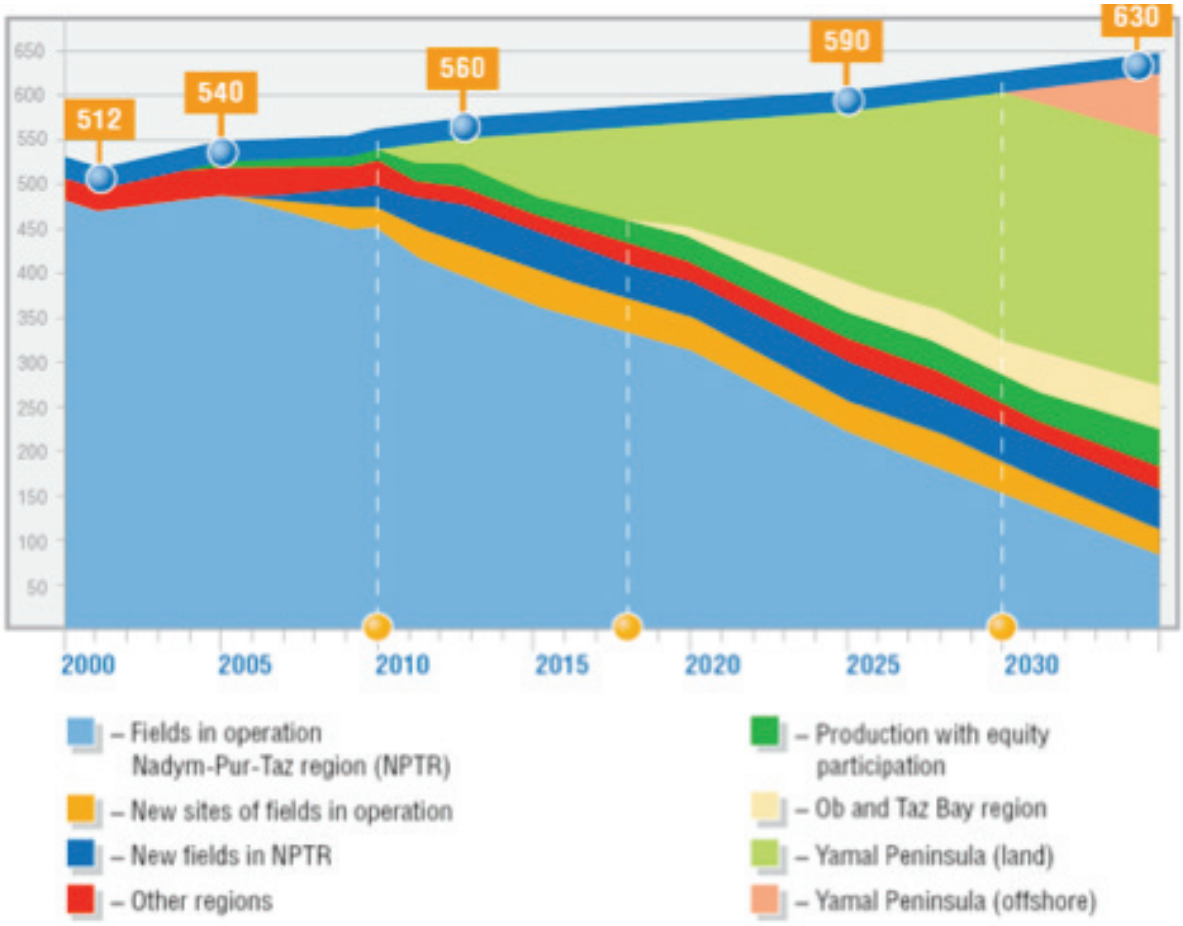
Table 2.5: The Russian Gas Matrix projection for 2012[40]

The projection for 2015 is based on Jonathan Stern (2009b). He derived this projection according to his research. What we can see is a likely increase in non-Gazprom production and Central Asian imports on the supply side and a rise in domestic demand and European demand on the demand side. If Gazprom supply stagnates or even falls as the projection implies at least as a possibility, the gas matrix might be in danger of being unbalanced, especially as the gas supply need for the transportation network is not even considered in this matrix. As supply is clearly influencing pricing dynamics, especially when we discuss spot market based pricing in the following chapters, I would like to have a brief look at the Gazprom investment and exploration projections.

2.5. Future prospects for natural gas production in Russia

Up to 2030 Gazprom itself has very positive projections for its gas supply. According to graph 2.4 Gazprom would reach the upper level of Stern's projection for 2015 that we got to know in chapter 2.4 and reach around 630 bcm/year around 2030.

[40] cf. Stern, Jonathan (2009b), p. 82



Graph 2.4: Gazprom's production projections until 2030[41]

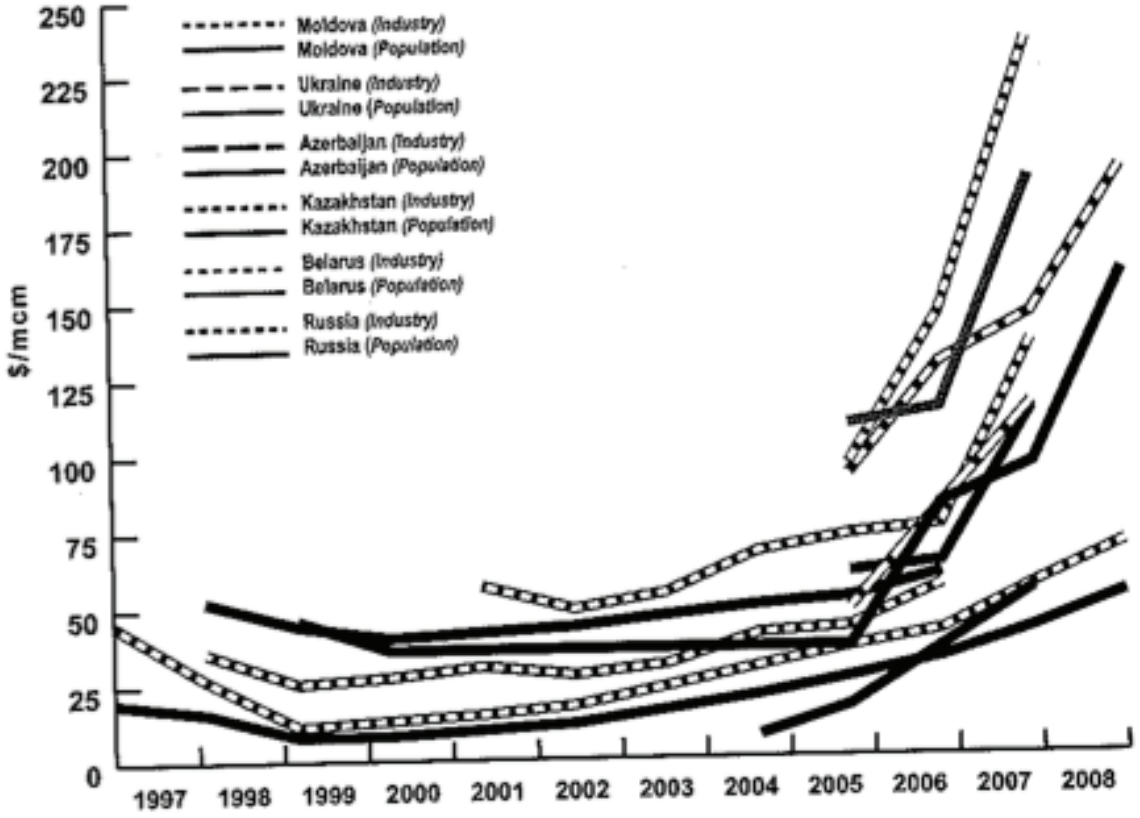
Gazprom's roadmap for gas supply development over the next several decades in order to reach the projections might look like this:
Gazprom will be heavily dependent on how quickly they can bring the supergiant on the Yamal Peninsula and the smaller Ob-Taz Bay field on stream. All Western and Northern Yamal Peninsula gas will be evacuated via high pressure transportation across Baidarat to Uktha. The south-western part of Peninsula and also Ob-Taz Bay gas will use the usual corridor through Yamburg. Building up a new pipeline network is nevertheless seen as a very high-risk strategy.[42]

[41] *Gazprom in Questions and Answers 2007*, p.28. http://eng.gazpromquestions.ru/index.php?id=7, 25.4.2012

[42] Stern, Jonathan (2009a), pp. 7-8

2.6. The gas price reform

As we already know Russia as a post Soviet-state has a habit of treating gas supply and in a broader sense energy supply as a basic human right. Several circumstances within the last years created a surrounding that makes it economically impossible to deal with prices the way it was. As an introduction to this topic graph 2.5 illustrates the increase of gas prices in Russia and also in some CIS countries including Moldova, Azerbaijan, Kazakhstan, Belarus and most important Ukraine.



Graph 2.5: CIS gas prices in nominal $/mcm (Mitrova, Tatjana (2009), p. 37)
Sources used by Mitrova (2009): regulators, energy ministries, published official information

There are several reasons for a necessary increase in gas prices in general and especially within CIS and the domestic market in Russia. On the one hand the steadily rising global oil prices. As gas pricing is widely linked to oil prices this rises the price of gas on the one hand. On the other hand it makes gas more attractive as an energy source. In combination with GDP growth and growing industries this has an impact on the demand side. Rising demand finally implies exploration of new

sources of gas supply and new technical networks. So as a final result the levels of CIS and domestic Russian prices move closer to European netback prices. This development, which Gazprom managers refer to as market-linked pricing, but they actually mean a link to European netback prices, leads to CIS prices, which are being closely linked to European prices, of course under the consideration of lower transportation and transit costs in the case of most CIS countries.[43]

> „The use of the European pricing scheme as the basis to determine CIS gas prices means that, as long as European prices are themselves linked to those of oil, CIS prices will fluctuate in accordance with oil price dynamics, adjusted for the time gap between the date of the contract and the real date of delivery. If European countries were to choose not to index gas prices with oil prices, and to reduce the influence of that pricing structure with long-term contracts, then prices in former Soviet countries would also be affected.“[44]

This close link between CIS pricing and European pricing when it comes to Russian natural gas exports is the reason for me to closely examine in the following chapters not just the influence and dynamics of a switch form the oil link to spot market linked pricing on European pricing but also on the interrelated CIS pricing, exemplified but the also in terms of gas transit relevant country Ukraine.

[43] cf. Mitrova, Tatiana (2009), pp- 33-37

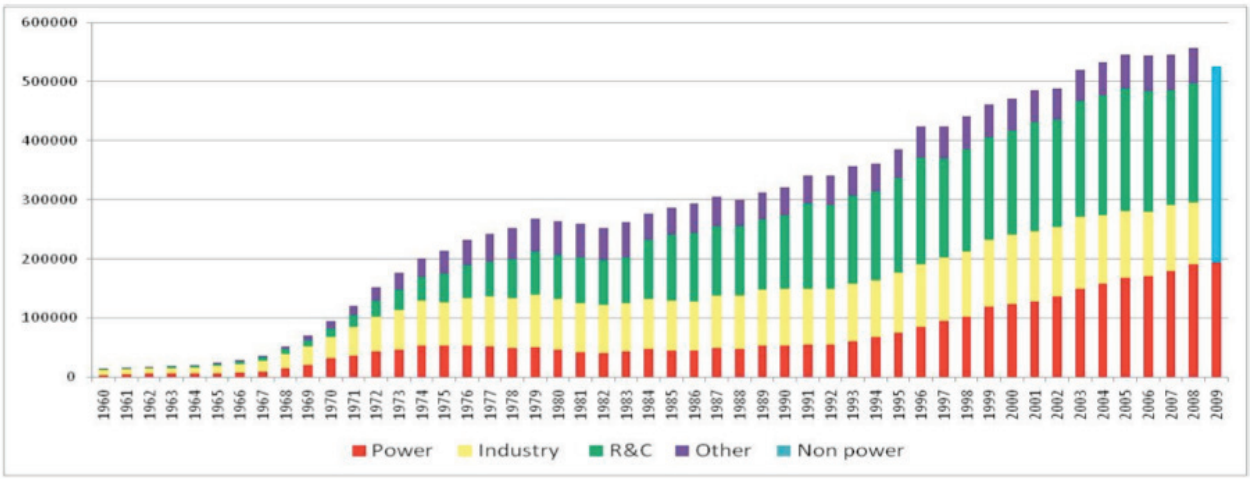
[44] Mitrova, Tatiana (2009), pp- 37-38

3. Europe's Role as an Importer if Russian Natural Gas

It is a well-known fact that concerning natural gas Europe is heavily interconnected and dependent on deliveries from Russia. In the following chapter I will give a brief overview and relevant data to illustrate the interconnection between Russia and Europe, respectively the European Union and OECD Europe, when it comes to gas deliveries. This overview is based on three major sources: Honoré (2011), Stern (2005) and Mitrova, Pirani et al. (2009).

3.1. The OECD Europe natural gas demand

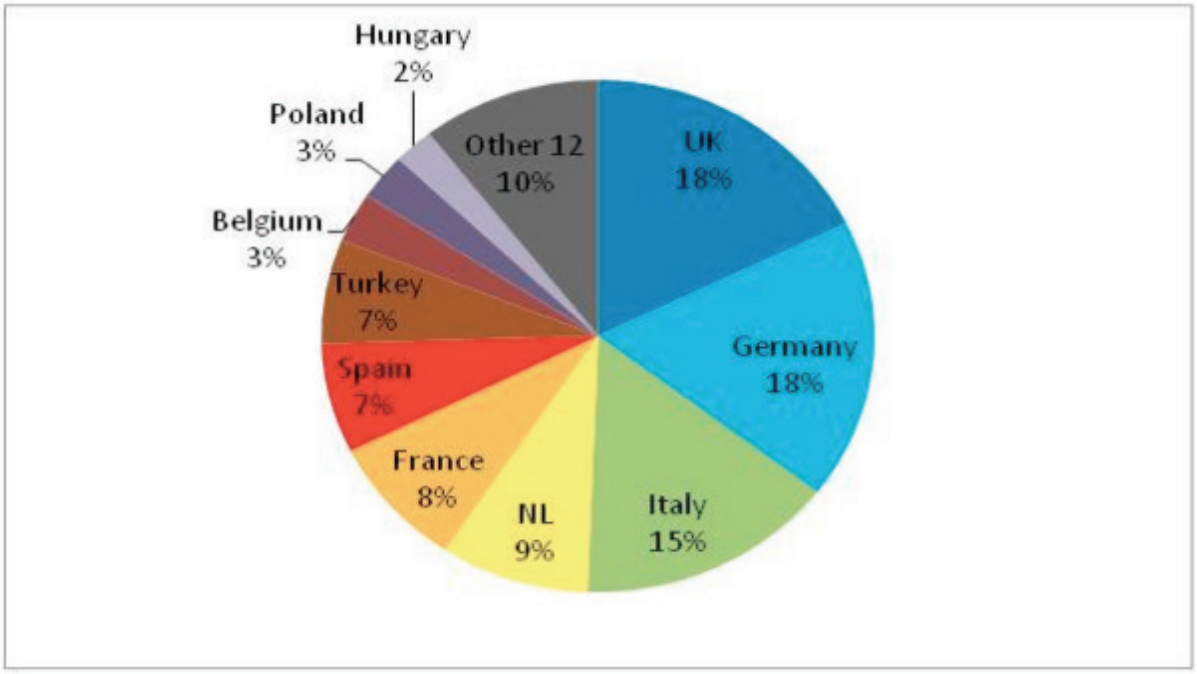
In this subchapter I will have a look on the demand side when it comes to natural gas in Europe. Honorè (2011) introduces a general graph, which shows the development of natural gas demand in OECD Europe form 1960 till 2010.



Graph 3.1: Natural gas demand in OECD Europe, 1960-2010 (mcm) (Honorè, Anouk (2011a), p. 24)
Sources used by Honorè (2011a): IEA (annual), Natural Gas Information, part IV, table 3A (several issues); EA (monthly); Natural Gas Survey, table 1 (various issues), and author's analysis

This graph introduces us to the steady increase in natural gas demand in the OECD countries within the last 50 years. The graph represents power (red), industry (yellow), green (R&C) and other (purple).
The main implication that we can draw from this graph is on the one hand the steady growth over the last 20 years until 2008 by an annual average of 4,2 per cent in the

1990s and a slowdown in growth form 2000-2008 on a level of around 2 per cent. In 2009 there was for the first time plunging demand mostly due to the economic slowdown and also due to the Russia-Ukraine dispute in 2009. Demand in OECD Europa basically fell back to 2003 levels.[45]
Graph 3.2 gives an overview on the biggest natural gas markets in OECD Europe by demand.



Graph 3.2: Natural gas markets in OECD Europe in 2008 (Honorè, Anouk (2011a), p. 12)
Sources used by Honorè (2011a): IEA, Natural Gas Information 2010, part II, page 8, table 3

Graph 3.2 points out that the United Kingdom and Germany, followed by Italy, are the biggest markets when it comes to natural gas demand within the OECD Europe countries. For the topic of this thesis it is interesting to keep it in mind, as especially Germany and the UK are possible positions for a natural gas hub in order to derive market prices.
As we now have a general idea of the importance and the historical development of natural gas demand in OECD Europe I would like to introduce in table 3.1 a more detailed look on the natural gas cross consumption in the major European markets in order to create an idea of the size of the European gas market.

[45] Honorè, Anouk (2011a), pp- 23-24

	Demand in 2008 (mcm)*	Share of European demand in 2008 (%)*	Average growth rate per year (%)				January-September 2008-2009-2010 (%) **		
			1960-2008*	1990-2008*	2000-2008*	2008-2009*	2009 vs 2008	2010 vs 2008	2010 vs 2009
OECD Europe	555800	93.5	7.9	2.4	2	-5.6	-8.2	-1.6	7.3
Austria	8650	1.47	3.59	1.97	1.48	1.3	2.8	14.6	11.5
Belgium	17330	2.95	12.41	3.31	1.26	-2.0	9	9.4	0.4
Czech Republic	8719	1.49	4.8	1.58	-0.72	-5.8	-8.6	7.3	17.4
Denmark	4590	0.78	Na	4.56	-0.8	-4.2	-4.7	6.2	11.4
Finland	4735	0.81	Na	3.21	1.51	-9.6	-14.2	-6.3	9.2
France	45901	7.82	5.79	2.74	1.81	-3.4	-3.4	8.2	12
Germany	95793	16.32	9.91	1.78	1.11	-5.5	2.9	4	1.1
Greece	4206	0.72	Na	21.68	9.39	-16.2	-27.1	-15.6	15.7
Hungary	13167	2.24	Na	0.92	1.13	-13.8	-20.3	-14.5	7.3
Ireland	5217	0.89	Na	4.61	3.33	-3.1	-5.3	5	10.8
Italy	84883	14.46	5.52	3.29	2.3	-8.0	-12.6	-6.1	7.4
Luxembourg	1255	0.21	Na	5.33	6.56	1.1	1.4	10	8.5
Netherlands	48346	8.23	10.53	0.59	-0.13	0.6	-7.4	1.7	9.8
Norway	6707	1.14	Na	6.22	6.07	3.1	Na	Na	Na
Poland	16549	2.82	6.47	1.76	2.73	0.2	-3.6	0.3	4
Portugal	4754	0.81	Na	Na	9.62	2.7	-4.6	-0.9	3.9
Slovakia	6308	1.07	Na	-0.05	-1.53	-2.6	3.5	10.8	7.1
Spain	38183	6.5	Na	11.43	10.92	-11.4	-11.3	-13.7	-2.8
Sweden	913	0.16	Na	2.21	1.59	34.6	21.5	69.7	39.6
Switzerland	3429	0.58	Na	3.06	1.8	-4.0	0.4	9.4	9
Turkey	37178	6.33	Na	14.09	12.17	-4.3	-13.3	-2.3	12.7
UK	98990	16.86	16.12	2.98	-0.35	-8.3	-14.4	-5.4	10.4

Table 3.1: Natural gas gross consumption in the European major markets (Honorè, Anouk (2011a), p. 26)

Sources:

*Calculated by Honorè (2011a) from IEA (annual), Natural Gas Information, Part II.8, table 3

**Calculated by Honorè (2011a) from IEA (monthly), Natural Gas Survey, various issues, table 1

What we can take from table 3.1 is first of all the approximate size of the natural gas demand in OECD Europe, which was around 555.800 mcm in the year 2008 accounting for 93,5 per cent of total European demand. Another important fact to derive from table 3.1 is the general slowdown of demand since 2000 and especially a decline in demand by 2008.

However the demand for 2010 already showed positive signs with consumption above 2009, at least for the first three quarters. Additionally it can be stated that some of the major markets, such as France, Germany and the Netherlands show clear signs of recovery. But on the other hand major drivers of growth in demand

since 2000, such as Greece, Hungary, Spain, Finland, Italy, UK and Portugal fell behind 2008 at levels, slowing down overall gas demand in OECD Europe for 2010.[46]

3.2. The European natural gas imports from Russia

A significant share of Europe's gas demand is supplied by long-term deliveries from the Russian Federation, especially via Gazprom. As we know from table 3.1 total natural gas demand in the OECD Europe area is an approximated 555.800 mcm which equals 555,8 bcm. Now we can recall the following table:

	1995	2000	2005	2006	2007
Western Europe	75,1	90,4	113,3	117,8	113,8
Eastern Europe	42,3	39,7	42,9	43,3	39,6
Baltic States	4,4	4,7	5,0	4,9	5,3
Total Europe	121,8	133,7	158,2	166,4	158,3

Table 3.2: Russian gas exports to Europe and Baltic countries 1995-2007 (bcm)[47] (Stern, Jonathan (2009b), p. 79)

The OECD Europe area includes: Belgium, Denmark, Germany, France, Ireland Island, Italy, Luxemburg, Netherlands, Norway, Austria, Portugal, Sweden, Spain, Switzerland, Turkey, Check Republic, Finland, Slovenia, Hungary, Poland and the United Kingdom. Table 3.3 additionally includes all the Baltic States, so it includes additionally Estonia, Lithuania and Latvia. If we subtract the demand for the Baltic States we are left with OECD Europe supply for 2007 of 153 bcm via gas exports form the Russian Federation. To have an approximate idea of the impact of Russian gas exports to Europe we can compare this figure roughly with the estimated OECD Europe gas demand for 2008 which is 555 bcm. The Russian supply share estimates in this case roughly around 27,5 per cent.

[46] Honorè, Anouk (2011a), pp- 26-27

[47] Sources used by Stern (2009b): Gazprom in Figures 2001-05; Gazprom, Annual Report 2006, pp. 49-50; 2007, p. 63. Gazprom Export at 35

3.3. The European gas balance

Chapter 3.1 as well as chapter 3.2 showed mostly data before the economic and financial crisis of 2008. To have an additional point of view on the pattern of the European gas balance I would like to additionally mention Mellling (2010). His work is basically dealing with gas pricing but we can also find an interesting approximation of the pattern of the European gas balance.

GAS BALANCE (EU 27, TURKEY, SWITZERLAND)	2008	Estimated 2009
Consumption	561.9	522.1
LNG Supply	55.3	68.2
Pipeline Supplies		
Norway	99.2	100.0
Russia	156.6	133.0
Algeria	35.8	32.5
Other	19.7	17.0
Indigenous	196.4	179.2
Total Supply	**563.0**	**529.9**

Table 3.3: European gas balances 2008 and 2009 (bcm estimated) (Melling, Anthony J. (2010), p. 41)

What we should keep in mind from this table is on the one hand, that the total demand projections that Mellling gives for 2008 are similar to what we saw in the work by Anouk Honorè. Additionally the rise of LNG supply by roughly 23 per cent is remarkable. This means that more volumes were traded on the markets, for example via the European Energy Exchange. Most of the supply, which is traded on spot markets, is delivered via LNG. The role of Russia as the biggest single supplier is also pointed out very clearly by this table. For 2009 we can observe a sharp decline in consumption mostly due to the recession. Most of the decline hit Russia and therefore mostly Gazprom.

3.4. The European dependence on Russian natural gas

> „For Gazprom, the crucial element of exports to Europe is not the volume of gas – important as these have become – but the value of these sales, which earned the company $40-50 billion/year in 2006-07.“[48]

As we already know from previous chapters the Russian federation has a very high domestic natural gas demand and sells domestically way under market price.
On the other hand European exports account for about 27-29 per cent of sales volumes but for 57-65 per cent of revenues. This share of revenues is lower than in the 1990s when Gazprom sold natural gas domestically for a disastrously low price including non-cash instruments. But it still relatively steady as prices have been raised domestically and within the CIS region but also export prices to Europe increased.[49]
These facts illustrate the importance of exports to Europe for Russia and therefore indicate a thrive for the Russian Federation to bind Europe and to make it to a certain degree dependent. This is carried out on the one hand by long-term contracts, which of course from a European point of view also imply a certain degree of supply security. On the other hand Russia and Europe would move closer and are dependent on each other by various infrastructural projects such as North Stream or South Stream.
To finalize this section I would like to refer one more time to Stern. He derived a table illustrating the total dependence of Europe on Russian gas supplies. This table is a little bit out dated as it refers back to 2003 but it still gives a rough idea of how crucial Russian gas deliveries are to many European countries.

[48] Stern, Jonathan (2009b), p. 79

[49] cf. Stern, Jonathan (2009b), p. 79

	% of Total Imports	% of Total Consumption
Austria	77	65
Finland	100	100
France	24	23
Germany	37	33
Greece	76	76
Italy	32	26
Netherlands	17	6
EU15	28	18
Czech Republic	74	73
Hungary	86	66
Poland	85	58
Romania	91	29
Slovakia	100	97
Slovenia	60	60
Central/Eastern Europe	87	60
Turkey	61	60
TOTAL EUROPE	**38**	**26**

Table 3.4: European dependence on Russian gas supplies, 2003 (Stern, Jonathan (2005), p. 143)[50]

As we can see from the fact that the E.U. is here referred to as the EU15, this table is not state of the art but it illustrates roughly that European countries are heavily dependent on Russian gas supply. Austria for example imports two third from Russia, Germany one third and total Europe around 38 per cent in 2003.Significant is of course also the fact that Central and Eastern imports more or less everything from Russia while Western Europe has a share slightly more than 25 per cent. Anyway, the fact of dependence shall be taken under consideration within the following chapters dealing with the field of gas pricing.

[50] Stern (2005) mentions the following source: Calculated from Cedigaz, Trends and Figures in 2003, from Natural Gas in the World 2003

4. Ukraine's Role as an Importer of Russian Natural Gas

The Ukraine is historically the most important transit country for gas deliveries from Russia to Europe. The transit infrastructure built up during the times of the Soviet Union is still a major strategic and political asset for Ukraine. In this context it is important to bring in the Ukrainian side, as the most important transit country from Russia to Europe. Especially I will take under consideration that Russia and Gazprom are forcing the move of delivery prices to Ukraine close to European netback prices and the recent instabilities resulting especially in the gas war of 2009 and the 2010 gas agreement.
In this chapter I will give a brief overview and insight on the gas balance and the gas dependence of Ukraine as well as its role as a transit country, This is important in order to understand the main implications of the Russia-Ukrainian disputes over gas for Europe.

4.1. The Ukraine-Russia gas relationship

> „Ukraine's energy sector, and its economy, are characterized by overdependence on imported gas. Ukraine has in recent years consumed 69-78 bcm/year of natural gas, producing 18-20 bcm/year and importing the balance form central Asia and Russia. This imbalance originates in Soviet times, hen Ukraine's industry, power sector and housing were geared to cheap gas provided first from its own onshore fields and then from Siberia."[51]

Based on these insights presented by Simon Pirani (2009b) we can on the one hand state, that Ukraine has a historical dependence on natural gas combined with the problem of lacking supply, which generates a dependence on deliveries from abroad. As we have seen it many times in the CIS area Moscow moved also the gas relationship with Ukraine to a barter relationship. This implies that after the fall of the Soviet Union a non-market barter regime evolved trading mostly gas for transit. Russia paid for the use of the transit pipelines running through Ukraine via gas supply to the Ukraine.

[51] Pirani, Simon (2009b), p. 93

Since 2000 rising oil prices triggered higher oil-indexed European gas prices and Moscow decided the end the barter cycle and to end sales to Ukraine at discounted prices. Moscow's prime goals for the gas relationship with Ukraine are four folded:

- Deliver central Asian gas rather than Russian gas
- Raise prices to European netback levels
- Replace barter swaps with cash relationships between corporate entities
- Gain ownership of the transit system and a position in the domestic market of Ukraine via these entities

These goals have been intensified since the cooling off of political relationships based on the "Orange Revolution".[52]

Taken these points together under the light of the fact that Ukraine is well know as the most energy-inefficient country worldwide[53] with little progress on energy savings, we have a basic idea on the given issues and can now have a closer look at the Ukraine gas balance.

4.2. The Ukraine gas balance

> "Ukraine is by far the largest CIS gas importer. Although most imports are contractually labelled as central Asian, the only transit route is through Russia, and it is Ukraine's relationship with Russia on which volumes, prices and contractual arrangements mainly depend."[54]

Table 4.1 gives a general overview on the Ukraine gas balance.

[52] cf. Pirani, Simon (2009b), p. 93

[53] Pirani, Simon (2009b), p. 94

[54] Pirani, Simon (2009b), p. 97

	2003	*2004*	*2005*	*2006*	*2007*
Total gas inputs	**224.3**	**229.6**	**228.3**	**220.8**	**203.4**
Ukraine production	19.4	20.3	20.5	20.7	20.7
Ukraine, pumped from storage	17.2	17.3	17.6	15.3	13.5
Soiuzprominvest*	0.4	0	0	0.1	-
Total import	187.1	191.6	189.9	184.5	168.9
incl. (for Ukraine, from C. Asia)	(34.4)	(25.6)	-		
(for Ukr., from Turkmenistan)	-	-	-	(36.5)	(35.5)
(for Ukr., from Uzbekistan)	-	-	-	(2.8)	(2.8)
(for Ukr., from Kazakhstan)	-	-	-	(6.5)	(7.7)
(for Ukraine, from Itera)	(0.3)	(0)	-	(0)	(0)
(for Ukraine, from Rus)	(26.0)	(34.1)	-	(9.1)	(4.6)
(for Rosukrenergo)	-	-	(1.5)	-	-
(for Naftogaz, from C. Asia)	-	-	(37.0)	-	-
(for Naftogaz, from Rus)	-	-	(20.4)	-	-
Gas for pumping into storage (excluded from balance)	-	-	-	-	**5.4**
Total gas outputs	**224.3**	**229.6**	**228.3**	**220.8**	**203.4**
Ukraine, consumption	68.7	68.1	68.9	65.9	62.8
Ukraine, technical requirements	7.6	7.6	7.4	8.1	7.0
Ukraine, prod'n of LPG	-	-	0.1	0.2	0.1
Transit to CIS countries	16.8	16.7	14.9	14.7	3.1
Transit to Europe	112.4	120.4	121.5	113.8	112.1
Transit by other suppliers**	0	10.1	8.8	-	-
Exports of Ukrainian gas	0	3.9	2.7	0	0
Ukraine, pumped into storage	18.2	16.3	15.3	18.1	18.0

Table 4.1: Ukraine's gas balance (bcm) (Pirani, Simon (2009b), p. 98)
Sources used by Pirani (2009b): Pirani's table is based on data published by the Ukrainian fuel and energy ministry, published in Energobiznes

What can be derived from table 4.1 is on the one hand that Ukraine's total natural gas import fell from 2004 to 2007 significantly coming hand-to-hand with a decline in domestic gas consumption within the same period. Also the total gas outputs fell within this time including a decline of transit volumes to Europe on a 2003 level and diminishing transit to CIS Europe.

4.3. The Ukraine-Russian relationship since the mid 2000s

Chapter 4.1 already introduced the main goals from a Russian point of view when it comes to the natural gas relationship with the Ukraine: Delivery of Central Asian gas, European netback pricing, replacement of barter swaps and establishing a domestic position in the Ukraine.[55]
Since the mid 2000s several political and economical factors supported these developments. The most important economic driver was raising oil prices. Due to the oil-link prices in Russian-European long-term gas delivery contracts, prices more than doubled from 1998 to 2006. This resulted in a major gap between European and CIS prices including first of all the deliveries to the Ukraine. This implicit loss on western CIS sales triggered lobbying for the principle of European netback pricing by Russian gas managers. The political factor on the other hand has to do with the so-called *"Orange Revolution"* of December 2004. In the aftermath of 2004 the Yushchenko administration urged stronger ties with the E.U. and NATO and tried to distance the country from Russia. Yushchenko's first Prime Minister Yulia Timoshenko determined a disruption of the energy regime, which was being installed by Yushchenko's forerunner Leonid Kuchma and Gazprom. So Russia had both: A set of fresh economical goals and also the political opponents to put on the back foot.[56]

4.4. The 2006 gas crisis

As a result Moscow decided to raise import prices to the Ukraine much more rapidly than in countries such as Belarus that decided to share ownership of its pipeline systems with Russia. This erupted in the January 2006 crisis, which was one of two occasions when Russian supplies to European countries were significantly disrupted due to a dispute with the transit country Ukraine. The 2006 crisis concerned prices as much as import terms and resulted in the following outcomes:

- End of barter deals: the gas for transit regime was being dismissed, instead the transit fees were henceforth to be paid cash

[55] cf. Pirani, Simon (2009b), p. 93

[56] cf. Pirani, Simon (2009b), p. 99

- Separation of transit and supply contracts
- No future negotiations between the Ukraine and Turkmenistan, all Turkmen exports were to be bought directly by Gazprom and resold
- The joint venture wholesale trader Ukrgaz-Energo was built up and given a dominant position in the Ukrainian domestic market

The set up of European netback prices was not possible at this stage due to the fact that the Ukrainian government proved that they were not afraid to use their almost transit monopoly as an ultimate bargaining tool.[57]

4.5. The 2009 gas crisis

In this subchapter I will give a brief overview on the 2009 gas war between Russia and the Ukraine in order to understand the current relationship between the two countries as a political and economical background for my further discussion on the crisis. This section will just mention the basic outlines of the topic as an in-deep assessment has been done by the *Oxford Institute of Energy Studies* already.
To start up it is crucial to have an idea of the development of transit prices and import prices in comparison to European netback pricing.

	$/mcm European border (est)	Transit (est.)	Netback (est.)	Actual import prices	Differential
2004	143.05	27.00	116.05	50	66.05
2005	189.31	31.58	157.73	50–80	77.73–107.73
2006	246.51	36.53	209.98	95	114.98
2007	254.48	38.35	216.13	130	86.13
2008	368.32	41.13	327.19	179.50	147.69

Table 4.2: Illustrative European border prices, transit charges, Ukrainian netback and actual import prices in $/mcm (Pirani, Stern et al. (2009), p. 10)

[57] cf. Pirani, Stern et al. (2009), pp. 7-9

According to the estimates by Pirani, Stern et al. (2009) European border prices increased massively between 2004 and 2008, mostly due to the steady rise of oil prices. Import prices to the Ukraine increased substantially as well but the most important an interesting fact is, that the delta between the actual Ukrainian import prices and the European netback prices rose as well.

In 2007 European gas prices briefly rose to 500 $/mcm. But as Russia was at that time in a conflict with Belarus, Ukraine's import prices for 2007 were settled without any dispute. Political changes in the Ukraine occurred. Former Prime Minister Yulia Timoshenko took over the power again and immediately started to work against Russian interests. As a result Ukrgaz-Energo was being dismissed and therefore a major vehicle for Russia to establish its position in the domestic market of the Ukraine did not exist any longer.[58]

The direct reason for the massive gas crisis of January 2009 are widespread but the trigger appears to be economical.

A big part of the problem was that the Ukrainian gas company Naftogaz failed in clearing their debts to Gazprom. In mid December 2008 Gazprom already stated that Naftogaz had accumulated a debt of $2,195 billion. Gazprom's CEO Miller and also the Russian Prime Minister Putin warned Ukraine publicly that in order of non-payment consequences might appear. These warnings were also a hint for the European Commission in order to remind the Ukraine of its obligations coming with the ratification of the *Energy Charter Treaty*. Naftogaz after all paid $1,52 billion to Russia on the 30th of December 2008 leaving an outstanding debt delta of $614 million. The question that has to be asked is of course why Russia and Gazprom allowed the debt of Ukraine to rise to those enormous proportions. Ukraine should have been cut off earlier. Russia should have had an interest in sending a positive signal to the European costumers assuring them that problems like witnessed in 2006 would not occur again. On the other hand the financial crisis of 2008 and an interconnected sharp decline in oil prices started to translate negatively in Gazprom's revenue outlook for 2009. Under those circumstances Gazprom had to start to collect all possible revenues and use the situation to establish a contract moving the prices closer to European netback.[59]

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[58] cf. Pirani, Stern et al. (2009), pp. 7-9

[59] cf. Pirani, Stern et al. (2009), pp. 15-17

Year	Total	To Europe	To CIS
2000	123.6	109.3	11.3
2001	124.4	105.3	19.1
2002	121.6	106.1	15.1
2003	129.2	112.4	16.8
2004	137.1	120.3	16.8
2005	136.4	121.5	14.9
2006	128.5	113.8	14.7
2007	115.2	112.1	3.1

Table 4.3: Gas transported through Ukraine (bcm), (Pirani, Simon (2009b), p. 110)
Sources used by Pirani (2009b): Naftogaz web site; Naftogaz, Offering Circular 2004, p. 69

Table 4.3 shows the figures for gas transit through Ukraine from 2000 until 2007. It does not include the volumes for domestic use in the Ukraine. What we can see is a steady decline of transported volumes since 2004 going along with a decline of transports to Europe over the same period. In 2007 the Russian diversification strategy made a first significant impact. Transit to the CIS fell massively from 14,7 bcm/year to 3,1 bcm/year. The main reason was that the gas, which used to be transported via Eastern Ukraine to Southern Russia was now being transported by a new Russian bypass pipeline on domestic soil.[60]
In general gas problems may occur out of three different variations of middleman countries:

- There are either one or several paths for pipelines between producer and consumer countries (in the case of Russia this can be Ukrainian vs. Belarus transit);
- The transit country is either a net gas exporter, a net gas importer (in the case of Ukraine), or neither a producer nor a consumer of natural gas.
- The transit country is potentially a member of a political block, in which case political interest of a fourth country could impose externalities.[61]

[60] cf. Pirani, Simon (2009b), p. 110

[61] Yegorov, Wirl (2009), p. 147

- **1 January:** Gazprom cuts all supplies for Ukrainian consumption, while supplies to Europe continue
- **5 January:** Gazprom alleges that 65.3 mmcm of gas has been 'stolen' during the first four days of the year; Ukraine responds that in the absence of a supply and transit contract it is entitled to take this 'technical' (fuel) gas
- **6 January:** Deliveries to Europe drastically reduced
- **7 January:** Deliveries to Europe completely cut off
- **11 January:** EU monitors deployed
- **13–17 January:** Gazprom cites daily attempts to resume flows 'blocked by Ukraine'
- **14 January:** Letter from Naftogaz to Gazprom cites lack of a 'technical agreement' preventing resumption of flows
- **19 January:** Ten year supply and transit contracts signed
- **20 January:** Gas flows to Ukraine and Europe restart
- **22 January:** Gas flows to all European customers returning to normal levels

Box 4.1: The Russia-Ukraine crisis of 1-22 January 2009: major milestones (Pirani, Stern et al. (2009), p. 19)

Box 4.1 illustrates the culmination of the political and economical dispute between Russia and the Ukraine at the beginning of the year 2009. After all deliveries to Europe were cut off completely for several days until the flows were restarted around the 20th of January 2009. The important outcome of the crisis was a ten year supply and transit contract, which I will have a closer look on now.
Table 4.4 illustrates the sharp cut off of supply during the 2009 crisis. Within just a week Russia reduced the flow of gas to Europe to a minimum.

Date	Supplies from Russia	Volumes of transit to Europe and Moldova	Difference between supplies and transit volumes
01/01/2009	318.2	318.4	–0.2
02/01/2009	300.0	295.2	+4.8
03/01/2009	293.2	269.8	+23.3
04/01/2009	303.1	269.1	+34.0
05/01/2009	214.0	228.0	–14.0
06/01/2009	59.7	55.4	+4.3
Total	**1488.2**	**1435.9**	**+52.2**

Table 4.4: Supply of Russian natural gas to Ukraine and transit for the period 1-6 January, 2009, according to Naftogaz Ukrainy in Miillion cubic meters (mmcm), (Pirani, Stern et al. (2009), p. 21) Sources used by Pirani, Stern et al. (2009): NJSC Naftogaz of Ukraine is indigant at OJSC Gazprom's statements, Naftogaz Ukrainy website, 7 January, 2009

4.6. The 10 year supply and transit contract as the result of the 2009 crisis

The Russian Prime Minister Vladimir Putin and the Ukraine Prime Minister Yulia Timoshenko finally signed an agreement on gas supply and transit to covert he long-term period of 2009 until 2019.[62]
The contract has been analyzed into deep by Pirani, Stern et al. Based on their analysis I will give a brief overview on their findings:

- The supply contract (Article 2) provides for 40 bcm of gas to be delivered to Ukraine in 2009 and 52 bcm annually (the annual contract quantity) from 2010 to the end of the contract period
- Prices will be 80 per cent of a "European price" in 2009 and 100 per cent from 2010 (Article 4)
- There are strict rules on taking extra gas, and strict payment terms, for Naftogaz Ukrainy

[62] cf. Pirani, Stern et al. (2009), p. 26

- Sales will be made directly by Gazprom to Naftogaz Ukrainy on Ukraine's borders with Russia and Belarus (Article 2)
- Gazprom's wholly-owned Ukrainian trading subsidiary, Gazprom-Sbyt, will market at least 25 per cent of the imported gas
- The annual transit volumes for the ten year period will be not less than 110 bcm
- The transit tariff will be $1,7/mcm/00km in 2009 although the revenue, which Ukraine will receive should take into account an advance payment of $250m which Gazprom made under amendment to the previous transit contract
- Gazprom will make and advance payment for transit services of $1,7 billion, under an annex to the contract[63]

In general we are facing a very strict new gas relationship between Russia and Ukraine and facing the fact of European netback pricing the possibility is given, that the Ukraine will have payment problems again which may result in another disconnection of European supply. The most important impact that we have to keep in mind form the major points of this contract is the fact that the payment methodology changed drastically. Before the prices charged to the Ukraine were netted forward from Central Asia including transportation and a profit margin for Russia. Now the prices will be netted backwards from European prices, which might be even an advantage for Ukraine, as it anyway does not have any power over the prices arranged between Russia and Central Asia. This might result in a risk reduction due to uncertainty reduction.[64]

[63] cf. Pirani, Stern et al. (2009), pp. 26-28

[64] cf. Pirani, Stern et al. (2009), pp. 29-30

4.7. The impact of the 2009 gas crisis on Europe

Within this subchapter I will briefly focus on the role of Europe within the January 2009 gas conflict and especially on the impacts that it might have on Europe. Besides several official statements that were given by the European Commission on their leading role in the settlement of the crisis Pirani, Stern et al. (2009) seem to comment very plausible on the facts.
They state that the European Commission played a rather minor role. The role was more or less reduced to a diplomatic one urging both parties to cooperate. Overall the Commission hat little monitoring capability from a technical point of view, it had little credibility and political leverage and it also was unwilling to provide financial resources in order to at least end the crisis quickly considering that it was the middle of winter in Europe and the Ukraine.[65]
Before I move on to summarize the consequences for all the three involved parties Europe, Ukraine and Russia I would like to diversify the outcomes and have a look on Eastern Europe, which was affected the harshest way.

Country	Bulgaria	Serbia	Bosnia	Macedonia	Croatia	Moldova	Romania	Greece
Shortfall	100%	100%	100%	100%	40%	100%	34%	80%
Diversification	0%	12%	0%	0%	Some	0%	0%	LNG

Table 4.5: South Eastern European Countries' Positions and Responses on 7 January 2009 (cf. Kovacevic (2009), p. 11)
Sources used by Kovacevic (2009): European Commission, news articles

As we can see from table 4.5 especially Eastern Europe was hit massively by the 2009 crisis. Most of the countries are solely dependent on Russian gas deliveries having no diversification strategy. Also most of the countries had a massive shortfall within the crisis period, many even 100 per cent. This combined with little stored gas due to little storage capacities can trigger serious issues. Western European countries on the contrary suffered little inconvenience when it comes to end-users. As we can especially see from table 4.5, no Western or Middle European country

[65] Pirani, Stern et al. (2009), pp. 46-49

was cut off completely from supply during the crisis. All the countries seem to have a diversification strategy as wee. When it comes to the diversification strategies it is interesting to observe that the countries seem to thrive for partial supply security inside of Europe with little transit issues using the supplies from Norway for example. Also African gas supply does not appear too much in the portfolios, only Italy has a clear increase in being supplied via Libya, at least before the *"Islamic Spring".* In our further thinking about pricing scenarios this form of risk hedging being conducted by Middle and Western European countries will be interesting as well.

Country	**Austria**	**Czech Rep.**	**Poland**	**Germany**	**France**	**Italy**
Shortfall	66%	71%	33%	10%	25%	15%
Diversi-fication	Norway, Germ-any	Norway, Yamal/ Germ-any	Norway	Norway, Netherlands	In-dustry co-vered	Increasing (Libya, Norway, Netherlands)

Table 4.6. Middle and Western European Countries' Positions and Responses on 7 January 2009 (cf. Pirani, Stern et al. (2009), pp. 54-55)
Source used by Pirani, Stern et al. (2009): Gas Coordination Group, *Member State General Situation According to Significance of Impact,* Memo 09/3, Brussels, 9 January 2009

My next step now is to go more in detail when it comes to the direct outcomes that the 2009 gas crisis had on Russia, Europe (especially Western Europe in this context) and the Ukraine as we have here several implications which will be interesting for our further look at pricing.
On the one hand it can be stated that the 2009 crisis was a massive damage for Gazprom's image especially when it comes to security of supplies.

> „Gazprom's reputation for reliability of supply has been damaged, perhaps irreparably. This is not just because many were always predisposed, for ideological reasons, to believe that Gazprom was not a secure supplier, but because the majority of ordinary European citizens and politicians will not be interested in detailed legal/commercial arguments about which side was to blame for this crisis."[66]

For the Ukraine the problem should be two-folded. On the one hand it will have problems with the high import prices due to major economic and fiscal problems. On the other hand Russia might choose to diversify the transit network and run less and less via Ukraine. This strategy is a powerful threat to use when it comes to negotiations if transit tariffs and import prices. Ukraine anyway chose a more pro-Russian path since 2010 which also resulted in a new agreement that we I will discuss shortly within the next subchapter. Anyway the Ukraine is heavily gas dependent and heavily dependent on Russian imports, so in order to reduce this dependence the most powerful tools would be a reduction of energy inefficiency and increasing domestic production.[67]
This suggestion by Pirani, Stern et al. (2009) however does not include an idea of how to increase domestic production of natural gas in the Ukraine. I believe that the problem can be tackled of course on the one hand by decreasing inefficiencies but on the other hand natural gas deliveries from Russia can just by a very small percentage be replaced by domestic production. A much more feasible way might be to think of alternatives. Coal might be an interesting alternative to take into consideration. This however shall be the topic of a different paper.

Europe on the other hand is dealing with short, medium and long term impacts.

- Short-run: Interconnection between Western-Middle Europe and South-Eastern Europe in order to reduce the risk in case of shortages
- Medium-run (2011-2015): Pipeline diversification like Nord Stream and South stream, bypassing the Ukraine, will reduce the transit risk due to Russia-Ukraine disputes, also LNG terminals will be interesting in this concern

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[66] Pirani, Stern et al. (2009), p. 57

[67] cf. Pirani, Stern et al. (2009), pp. 57-58

- Long-run (post 2020): Large scale Caspian and Middle East pipelines such as Nabucco

Anyway it is also important to keep in mind that Europe has long-term contracts with Russia and that the economies have to stabilize in order to live up to the contracts and then think of diversification issues.[68]

4.8. The implications of the 2010 gas agreement

As Timoshenko and Viktor Janukowitsch could not reach a coalition agreement in 2009 they met as opponents at the presidential election of 2010. Yanukovich won and Timoshenko resigned which triggered a dramatic change in the political climate. Timoshenko is meanwhile imprisoned due to irregularities in the gas deals with Russia. At the time of writing this paper many commentators suggest that she as more of a political prisoner and that the new president Yanukovich wants to keep the opposition down.

Yanukovich changed the political path of his country to a pro Russia course. Under president Viktor Yushchenko the relations with Russia reached their lowest ebbs. With the newly elected president both sides signalled willingness to move closer and increase the relations. Yanukovich replaced key positions in Naftogaz Ukrainy with new managers who had a loyal relationship to him and his political party, the Party of Regions. In the aftermath of 2008 financial crisis Ukraine is in a heavy recession which has to be met centrally also with a reform of the energy sector. Especially Ukraine's gas import bill is e serious economic problem for the country. Russia's thrive for European netback pricing lies heavily on the Ukraine and also on other CIS countries such as Belarus.[69]

As we can see in table 4.7 all the CIS import prices are being moved closer to European netback but the Ukrainian price is rising faster than the price in Belarus or Moldavia. So the interesting question for the Ukraine is: How to find a deal with Russia to reach discounts like for example Belarus in order to reduce gas bills?

[68] cf. Pirani, Stern et al. (2009), pp. 58-59

[69] cf. Pirani, Stern et al. (2010), pp. 5-9

„The effect of the 2009 “gas war” and the economic crisis on Naftogaz Ukrainy, was the collapse of the cross-subsidization scheme it had been operating in its gas business. It had been using income from industrial customers, and state subsidies, to offset both the effect of non-payment, mainly by district heating companies, and prices both for those district heating companies and residential customers that were far below cost recovery.“ [70]

$/mcm	2005	2006	2007	2008	2009 (est.)	2010 (proj.)
Russia industry	35.5	40.6	53	65.9	70	89
Russia households	25.6	31.7	41.6	52	51	63
Ukraine import prices	**77**	**95**	**130**	**179.5**	**232.54**	**255.15**
Ukraine industry (state regulated)	69.1	107.3	142.6	192.4	306.8	299.6
Ukraine households	30.5	67.2	87.5	79.3	67.2	66.4
Belarus import prices	**55.1**	**55.1**	**118**	**126.5**	**151**	**171.5**
Belarus wholesale (Beltransgaz)	59.54	58.87	n/a	n/a	n/a	n/a
Belarus industry (Beltopgaz)	72.3	75.16	141.7	171.3	205.5	261.3
Belarus households	82.7	84.4	101.7	214.9	174.5	159.0
Moldova import prices	**80**	**160**	**170**	**232**	**245**	**242**
European border price	**213.7**	**285.2**	**294.1**	**418.9**	**307.8**	**323.7**

Table 4.7. Some comparative CIS gas prices (Pirani, Stern et al. (2010), p. 7)

[70] Pirani, Stern et al. (2010), p. 8

	2005	2006	2007	2008	2009	2010 (proj.)
Imports						
Volume imported, bcm	55.8	53.3	50.1	48	26.8	36.5
Price ($/mcm)	44-80	95	130	179.5	232.54	255.15
Value of imports, $ billion	**3.2**	**5.1**	**6.5**	**8.6**	**6.24**	**9.3**
Transit						
Volume transited to Europe, bcm	121.5	113.8	112.1	116.9	92.8	113.9
Volume transited to CIS, bcm	14.9	14.7	3.1	2.7	3	3
Cost of transit ($/mcm/100km)	1.09	1.6	1.6	1.7	1.7	2.75
Value of transit services, $ billion	**1.5**	**2.2**	**2.1**	**2.34**	**1.88**	**3.62**

Table 4.8. Outline of Ukraine's gas and transit trade with Russia (Pirani, Stern et al. (2010), p. 9) Sources used by Pirani, Stern et al. (2010): Energy Charter Secretariat information, government and company statements, energy ministry statements (for volumes and prices)

Table 4.8 gives us some figures that we are already aware of but also gives projections on 2010 form a 2009 point of view based on a 2010 agreement between Moscow and Kiev in as a result of the Ukraine's need to get a discount. We see much higher transit prices with $/mcm/100km 2,75 and a milder increase on import prices to $255,15 per mcm.
What did the Ukraine offer for the discount?

> "The agreement signed between presidents Medvedev and Yanukovich on 21 April14 provides for discounts on gas imports worth up to $40 billion under current contracts that expire in 2019. In return, Ukraine will extend the lease on the Sevastopol base used by Russia‟s Black Sea fleet from 2017 to 2042, with a further five-year option."[71]

In the opinion of this author this agreement marks the comeback of the political and strategically use of gas exports and imports rather than using market mechanisms. Form this point of view this development has to be kept in mind for the discussion of possible market pricing in further chapters.

[71] Pirani, Stern et al. (2010), p. 12

4.9. Natural gas transit to Europe via Ukraine: General figures

In order to close this chapter I would like to bring in some additional figures to have a concrete idea of the Ukrainian transit and import balance of natural gas.
Table 4.9 gives a general overview on the topic. We can see that Ukraine had to deal with a massive increase in import prices since 2003, rising from $50 per mcm to at least $175 per mcm in a 2009 projection. As we already know from other sources transit to CIS countries has been reduces to a minimum due to a Russian bypass strategy while the volumes transported to Europe are quite steady. Costs of transit tariffs also increased leading to a total transit value of $2,2 bn in 2008, which accounts for more than 25 per cent of the value of gas imports to the Ukraine. Considering just this fact it is clear what a crucial part the transit network plays in keeping the Ukraine's gas balance at least somehow stable. Table 4.10 also supports this fact.

	2003	2004	2005	2006	2007	2008	2009 (projected)
Ukraine gas balance							
Ukraine, consumption	68,7	68,1	68,9	65,9	62,8	59,3	58
Ukraine, technical requ.	7,6	7,6	7,4	8,1	7,0	7,0	7,0
Ukraine, imports (pres.)	56,9	55,4	55,8	53,3	49,1	54,4	40
Ukraine production	19,4	20,3	20,5	20,7	20,7	20	20
Import price ($/mcm)	$50	$50	$44-80	$95	$130	$179,5	$175-360
Total value of imports, $ bn nest.	$2,84bn	$2,77bn	$3,2bn	$5,06bn	$6,38bn	$8,44bn	$7,0-14,4bn
Transit							
Volumes transported (bcm/year)							
To Europe	112,4	120,3	121,5	113,8	112,1	116,9	117
To the CIS	16,8	16,8	14,9	14,7	3,1	2,7	3
Cost of transit ($/100km/mcm)	barter	barter	$1,09	$1,6	$1,6	$1,7	$1,7
Value of transit services, $ bn, est.	$1,48bn	n/a	$1,5bn	$2,2bn	$2,1bn	$2,2bn	$2,35bn

Table 4.9. Ukraine's gas trade and transit: an outline (cf. Pirani, Stern et al. (2009), p. 6)

Year	Amount	Method of payment
2001	$1430,0m	Cash+kind
2002	$1647,2m	Cash+kind
2003	$1482,5m	Cash+kind
2004	n/a	
2005	$1550m	Cash, incl. $250m paid in adv.+kind
2006	$2200m	Cash, incl. $250m paid in adv
2007	$2200m	Cash, incl. $250m paid in adv

Table 4.10. Naftogaz Ukrainy income from gas transit (Pirani, Simon (2009b), p. 113)
Source used by Pirani (2009b): Naftogaz Ukrainy, *Offering Circular,* p. 46 (2001-03); East European Gas Analysis (2005); Ukrsibbank, *Naftogaz: company research* (2006-07)

The Ukrainian gas transport network is generally one of the largest networks (37.800 km) worldwide. It has an input capacity of 175 bcm and an output capacity of 175 bcm. Russia is interested in gaining possession of this transport system but so far it failed. This also an important strategically and political implication when it comes to pricing and the strategic use of pricing the Russian exports to Ukraine. As we know from table 4.3 transit volumes peaked in 2004 at a level of 137,1 bcm/year. There are four scenarios for the future use of the network:

- Management by a consortium with 50% or greater Russian participation. This would be a pro Russian course which is conducted by the present president Viktor Janukowitsch
- Management by a consortium with less than 50% Russian participation. This solution is more pro European
- Privatisation
- Continued management by Ukratransgaz. Here the problem will be a financial one implying the necessity of raising money whether from Russia or Europe.

Generally the pipeline is getting older and older without proper maintenance, so a proper scenario should be chosen within a short time horizon.[72]

[72] cf. Pirani, Simon (2009b), pp. 109-116

5. Gas Pricing Mechanisms

Within the former chapters I was dealing mainly with political and macro economical implications on the gas sector and on the co-dependent relations between Russia, Europe and the Ukraine. Politics, geopolitics and macroeconomics are one side of implications in order to derive and explain gas price developments. Another implication should be given by market economical thoughts as well.
As we have already observed natural gas markets, as important as they are, do not function optimal. Otherwise occasions like the 2009 gas war should not be possible. In the United States for example there is spatial pricing that correctly reflects substantial delivery and infrastructure costs. Europe's markets tend to be more and more liberalized but neglect spatial differences and the thrive of global market integration due to LNG technologies. Pure market economical arguments on gas pricing not always work. It becomes important to think interdisciplinary. Economics, politics and geopolitics should be thought as an integrated framework of inputs on the development of natural gas prices.[73]
The externalities politics and geopolitics we have discussed so far already. In my further steps within this paper I would like to test pure market structures and then discuss my outcomes in the light of the externalities. Therefore I will first of all briefly describe and summarize the current pricing situation of European long-term delivery contracts. This will be followed by Jonathan Stern's discussion about changing the oil-linked scheme to a more market driven framework such as hub pricing. Having introduced the framework I will put a data set consisting mainly of Russian long-term border prices at the German border, the European Gas Index and oil prices to the test in chapter 6. I will use data from the European Gas Index and compare it with given historical data of Russian border prices as well as the oil price volatility in order to be able to comment on the outcomes that a market driven pricing framework might have. These outcomes will be furthermore discussed with additional implications from politics and geopolitics.

[73] cf. Yegorov, Wirl (2010), pp. 2-3

5.1. The general context of gas pricing

There are three general categories of natural gas prices, depending on the degree of regulation, competitiveness of the market and market liquidity:

- Government-regulated prices
- Price indexation to competing fuels
- Spot market pricing in competitive gas markets

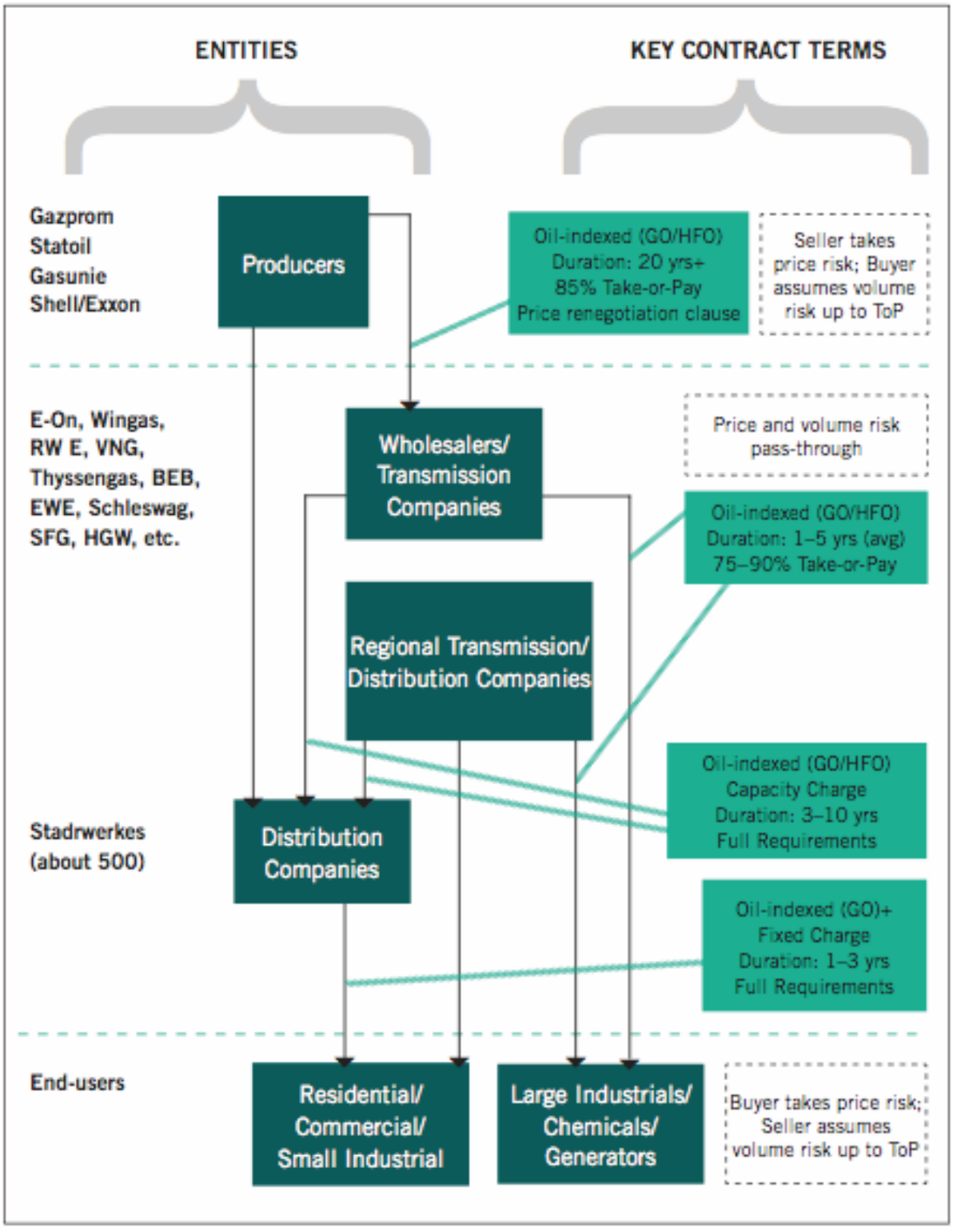
Russian long-term contracts to Europe fall under the regime of oil-index prices, which basically means that the underlying principle is price competition with alternative fuels. For example gas used to home heating is relative to gasoil and gas used for industrial purposes is priced relatively to heavy fuel oil.[74]

Within this paper I will not describe the historical development of European gas contracts in detail, as many commentators have covered this issue already. I will rather focus on the present situation.

Generally the concept market value pricing goes back to early European pricing traditions following the early Dutch contracts in the 1960s. Central was the market value at the point of sale with an overhead of transportation cost and profit margin. The principal competing fuel was agreed to be gasoil in order to derive the market value or the so-called replacement value. Another important implication of those contracts was the possibility of price review. The netback value would change over time due to changing prices of competing fuels, changes in technology and the market shares of alternative fuels. In order to cover these changes dates were specified, for example once every three years, at which each party could request renegotiation of the contract terms. The Dutch contract's key features where afterwards introduced into potential supplies from more distant countries such as Russia. As here distance and the needed supply network become huge cost factors the contracts included less upward volume flexibility as it was with the Dutch contracts. *'Minimum Bill',* or *'Take or Pay'* clauses were introduced, which means that typically 80 to 90 per cent of the agreed quantity had to be taken and paid.[75]

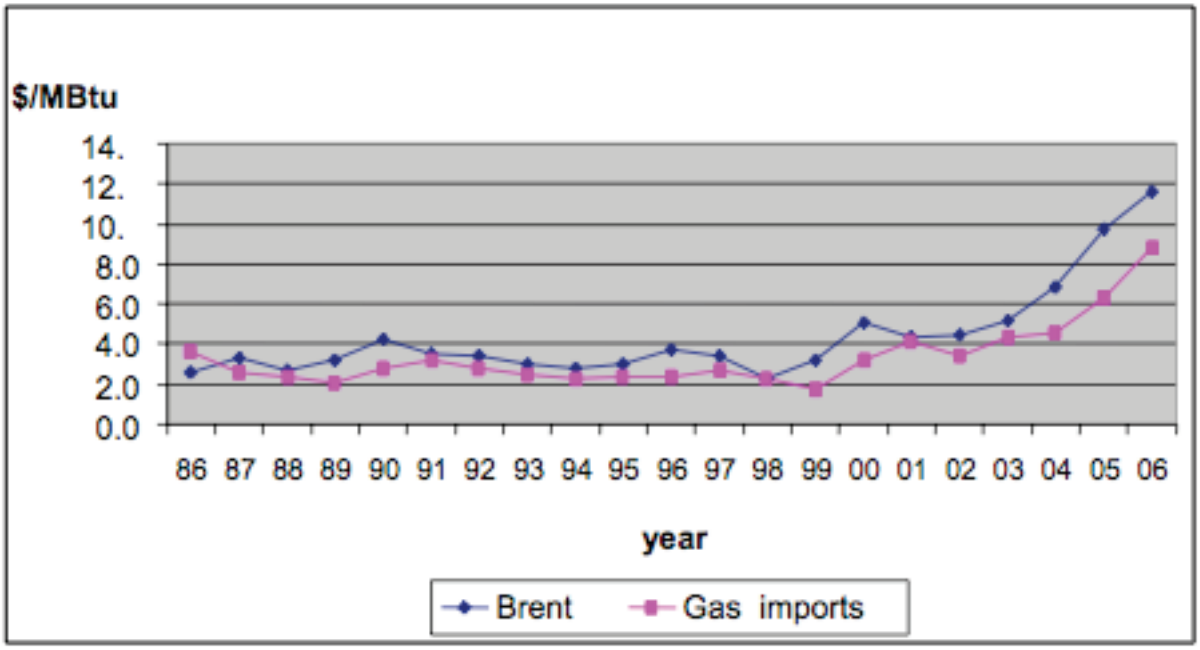
[74] cf. Melling, Anthony J. (2010), p. 15

[75] cf. Melling, Anthony J. (2010), pp. 16-22



Graph 5.1. Traditional German gas market/contracting structure (Melling, Anthony J. (2010), p. 18)

Graph 5.1 shows the traditional German gas market based on its contractual structure. Within this paper part one is the most crucial one, which defines the contract structure between the producing companies and the distribution companies and the wholesalers. Most of the Russian deliveries come via Gazprom. As we can see the key contract terms include oil-indexation, which would be based on the Dutch contracting scheme that was introduced earlier within this chapter. The contracts are defined as long-term contracts with a duration of 20 years and more, the '*Take or Pay'* clause is on a level of around 85 per cent and contracts include price renegotiation clauses. As we can see the contracts stay oil-indexed until they reach the end-users such as large industry and small industry, but the contractual running times are much lower than the long-term contracts with the producers.
An interesting side-fact that I would like to mention at this point is since the creation of the Interconnector between the UK and the continent also gas-to-gas competition as been referred to the indices in order to generate gas prices. Anyway the price of gas remains to be mainly linked to oil products and oil derivatives.[76]
Graph 5.2 shows the average import price of natural gas to the EU compared with the Brent oil price. It makes clear that at least till 2006 a clear oil-link with a lag of about half a year is visible.



Graph 5.2. Average import price of natural gas in EU (Davoust, Romain (2008), p. 12)
Sources used by Davoust (2008): BP, Energy P&T

[76] cf. Davoust, Romain (2008), p. 11

5.2. Theoretical aspects of gas pricing

This subchapter is based on Dickel, Kanai et al. (2007) in a publication of the Energy Charter Secretariat: *Putting a price on Energy-International Pricing Mechanisms for Oil and Gas.*

Oil and gas are commodities, which distinguish themselves heavily from regular products and form other commodities. They are not standard textbook case when it comes to the functioning of markets. Here are some special characteristics:

- High uncertainty linked to resource development
- High specificity of investment
- Character of natural resource
- Involvement of two decision makers
- Inelastic demand for energy
- Market imperfections (unavoidable externalities)[77]

All of these points find their background in theoretical aspects. In order to have a better understanding of the market that we are dealing with and as an environment for the further discussion of the data analysis within this paper I will give in subchapter 5.2.1-5.2.6 a brief link to those theoretical aspects based on Dickel, Kanai et al. (2007).

5.2.1. High uncertainty and high specificity: Transaction cost theory

The development of energy resources such as gas fields and the transport of the product to the final costumer and the end-users are clearly risky because it involves high specific investments in infrastructure. The specificity is especially true for gas transportation as gas has a much lower energy density than oil. Consequently storage and transportation costs are higher. Typically just few parties or companies are involved in a transaction.
Transaction cost theory states that there are three instruments to govern transactions: Markets, organised firms or long-term contracts. In the case of the gas

[77] cf. Dickel. Kanai et al. (2007), p. 42

industry this is typically long-term contracts and not markets, leading to transaction costs such as negotiation and enforcement of the contracts.[78]

5.2.2. Character of natural resource: Ricardian rent

As gas is a natural resource the costs of exploration and the quality of the production site are dependent on the location. There are for example different techniques when it comes to onshore and offshore drilling. There are differences between small fields and let's say super-giant fields. A regular manufactured good does not have this implication of location on costs. As a result different locations have different costs and therefore imply different rents. This rent is called a *Ricardian Rent*.

5.2.3. Finitness of resources: Hotelling theorem

It is a common fact that natural gas is a finite resource and that one day all stocks will be used. Anyway for some time to come the question of finite resources is not a question of a completely depleted planet but a question of willingness to invest in exploration of existing resources. The Ricardian approach already explained us the fact that different location qualities imply different costs and therefore different rents. This can bee contrasted by the *Hotelling Theorem*.

> „This approach provides the conceptual basis for an energy-pricing system based on replacement value. All further development of the economic theory on finite resources is based on Hotelling's theorem. It claims that the depletion path for a finite resource will be such that the annual revenue follows the interest rate, and that the resulting price path is such that an alternative (backstop technology) will be an economic substitute when the finite resource is depleted.“[79]

This implies that on the one hand there are companies who make decisions on the depletion of gas field based on some kind of discounted cash-flow analysis. The Hotelling rent shows what a resource owner gets for the depletion and what a

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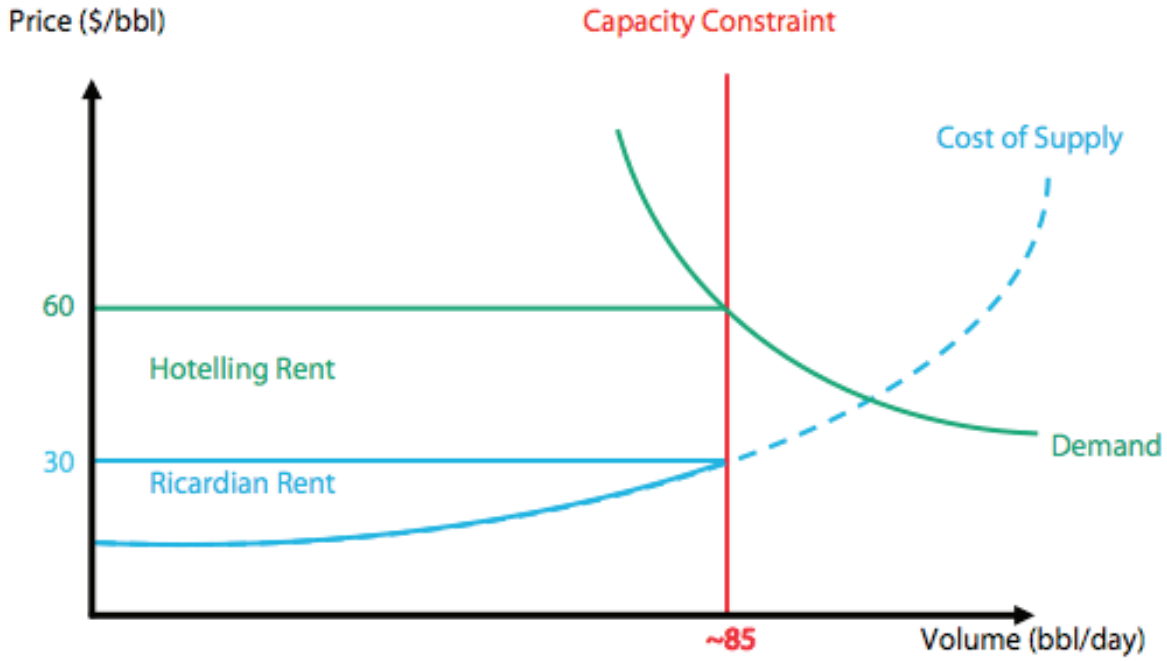
[78] Dickel, Kanai et al. (2007) refer to Coase, R. H., *The nature of the firm,* accessible at http://www.cerna.ensmp.fr/Enseignement/CoursEcoIndus/SupportsdeCours/COASE.pdf, 24 January 2007

[79] Dickel. Kanai et al. (2007), p. 45

consumer would pay beyond the marginal cost of production. Graph 5.3 illustrates based on oil production the difference between *Ricardian Rent*, which is derived by the cost side and *Hotelling Rent*, which is derived by the supply side.



Graph 5.3. Rents of oil production (Dickel, Kanai et al. (2007), p. 46)
Source used by Dickel, Kanai et al. (2007): Energy Charter Secretariat

5.2.4. Involvement of two decision makers: Principal-Agent theory

The right to natural resources is usually a state right, so the state represented by its government is usually the resource owner. On the other side there is the production company. The time horizons of the two players differ. Governments have to account also for future generations while companies have to satisfy present shareholder needs. Risks and rewards are to be split by the two parties. This scenario is addressed by principal-agent theory. It deals with technological knowledge owned by the agent production company and later on the resource risk sharing, risk of marketing, risk of price development and the sharing of the income. The principal's decision lies on the development speed and the volume. Domestic pricing policy is often based on social grounds but export prices reflect a rent maximizing behaviour by the principal. This can also lead to restrictions of volumes in order to influence prices. This is true for OPEC members for example. Gas exporting countries will

export to attractive countries in terms of volumes and prices as much as they will focus on premium segments of the import country's market.

5.2.5. Inelastic demand for energy

Gas is an essential good within the industrialised world. Demand for gas itself is a function of many factors. It includes the price of the commodity, the income levels of the import country, the pattern of the technologies used in the import country and also individual preference. On a short-term basis the demand for gas is more or less completely inelastic because the economy cannot immediately adjust to a different technology. The long-term demand gets more elastic. As we are talking about a finite resource the demand curve also faces a constraint on capacity. The closer the curve gets to the constraint the less elastic is demand. The impact of price of a highly inelastic demand combined with high concentration on the side of the producer is given by the Cournot/Nash formula.

(Price-Marginal cost)/Price = HHI/ε **(equ.1)**[80]

ε implies the demand elasticity whereas HHI stands for the Hirschmann-Herfindahl index, which expresses market concentration. What we can see in this formula is that high market concentration has little effect on price as long as demand is elastic and vice verca. That would also mean that in a market with just few players on the supple side, like it is the case with the gas market, and very inelastic demand at least short-term, this market structure has an impact on price.

5.2.6. Market imperfections: Unavoidable externalities

In a market like the gas market allocation by the market doe not always work according to the textbook, market imperfections occur. In energy markets the following market imperfections are typical:

- Imperfect competition
- Externalities
- Presence of public goods

[80] Nash, J. (1951), pp. 286-295

A way to deal with externalities is *Pigou Taxes*, which charge a tax on a player who causes a negative externality.[81]

5.3. Contracting practice within Russian long-term contracts

This subchapter is based on Melling (2010), pp. 77-84.

It is well know that Gazprom retains absolute control over Russian gas exports and that this situation is a major bargaining advantage for Russia. Some major principles of Russian gas exports are:

- Long-term contracts by 'Take or pay' principles
- One channel of gas exports to European countries (Gazprom Export LLC)
- Setting gas prices on the basis of the market value of petroleum products using an appropriate formula
- Monopoly of gas purchases from Central Asia
- Investments in new gas development just on the basis of existing sales contracts on a long-term basis
- Diversification of transport routes (for example Nord Stream and South Stream)

The exports to Europe are conducted via *Gazprom Export*, the sales to CIS countries remain under more politically driven business units. Spot sales into continental Europe function via subsidiaries. Gazprom is keen on not upsetting long-term costumers who could demand renegotiations of prices as a result of the market price influence of spot market volumes. Gazprom is very careful when it comes to that. Most of Russian deliveries to Western Europe are under long-term agreements and indexed primarily to gasoil and secondarily to heavy fuel oil. As sales to Western Europe are very defined since the fall of the Soviet Union the relationship with CIS is yet to be defined and subject of discussion and negotiation. Anyway also the European contracts feature some anomalies.

[81] chapter 5.2 cf. Dickel, Kanai (2007), pp. 41-51

- Spot sales into Continental Europe: As mentioned above this could be problematic when it comes to renegotiation clauses in long-term contracts. When spot prices are higher than oil-indexed prices long-term costumers will by at the upper limit of their contract. If they are lower it will be difficult for Gazprom to release volumes directly to European spot markets, undercutting long-term costumers.
- Sales by intermediaries: A non-transparent schema of entities exists to buy gas in CIS countries such as Turkmenistan and resell in Europe.
- Distance discounts: Gazprom has little competition at the Eastern German border. This enables Gazprom to charge slightly higher prices in Eastern Europe.

Russian sellers state the wish to maintain oil-indexed contracts over market-based pricing mechanisms in order to secure their future investments. The goal is to bring all contracts to a comparable price level without favoured nations and increase the Brent crude parity, which is at present times around 65 to 80 per cent. Gazprom's recent goals include:

- Expand Russian gas production
- Expand sales to Europe to 220 bcm/year by 2020
- Enhance access to European gas markets by acquiring gas distribution assets
- Alliances with key transit states
- Expand spot market deliveries
- Invest in LNG business
- Raise Russian domestic prices to European netback levels[82]

5.4. Price Formula for long-term contracts

As we already know from chapter 5.1 European long-term gas supply contracts mostly depend following the Dutch contract structure. Important to note is that contracts that followed the Dutch structure included less flexibility. The main major elements, which will be afterwards reflected in a stylized formula, are:

[82] chapter 5.3 cf. Melling, Anthony J. (2010), pp. 77-84

- Long-term supply obligations ensured by the minimum pay concept
- Pricing based on the concept of netback value calculated on the basis of competing energies
- Regular recalculation of the gas price
- Delivery point and price reference point can differ
- Regular review of price conditions (mostly three year intervals)

Nowadays more than 250 bcm/year are imported to the EU countries under this concept.[83]

Pm = Po + 0,6*0,8*0,0078*(LFOm-LFOo) + 0,4*0,9*0,0076*(HFOm-HFOo) (equ.2)[84]

Formula 2 shows a stylized price formula under the netback concept. The formula consist of the following parts:

(i) Pm: Gas price during the month m, it as a function of
- Po: Starting gas price
- Price development of competing fuel (LFO: Light fuel oil, HFO: heavy fuel oil)

(ii) 0,6 and 0,4: Shares of gas market segments of competing with respective fuel

(iii) 0,8 and 0,9: Pass through factors (sharing of risk and reward of the price development between buyer and seller)

(iv) 0,0078 and 0,0076: Technical equivalence factors to convert the units of prices for fuel into units of gas prices

(v) LFO: Price of light fuel oil, reflecting smaller costumers

(vi) LFOo: Price of light fuel oil for starting month o

(vii) LFOm: Price of light fuel oil resulting for month m

(viii) HFO: Price of heavy fuel oil, reflecting larger costumers

(ix) HFOo: Price of heavy fuel oil for starting month o

(x) HFOm: Price of heavy fuel oil resulting for month m

The starting price is negotiated on the basis of currency and determined minus delivery costs and minus marketing incentives. Price review clauses include the right for each party to suggest the reflection of external changes in the formula, which

[83] cf. Dickel, Konoplaynik et al. (2007), pp. 152-153

[84] Dickel, Konoplaynik et al. (2007), p. 154

cannot be controlled, by the party. The claim has to be substantiated by prove of the claim. Usually renegotiations are held every three years at a fixed date. When it comes to the relationship of Europe with Gazprom it can be stated that Russia prolonged its main delivery contracts with costumers like *OMV, ENI, E.On-Ruhrgas or Gaz de France* in 2006 with expiry dates between 2027 and 2036.[85]

5.5. European netback formula for the Ukraine import price

Based on the long-term contracts and the resulting prices the Russian Federal Tariff Service used a formula in order to derive netback prices for CIS countries such as Ukraine. The formula shown here is the one used for the third quarter of 2007.[86]

$$P_i = \left(P_E \times \left(\frac{100\% - D}{100\%}\right) - \frac{\sum_{r=1}^{3} Tar_r}{\sum_{j=1}^{9} V_{Ej}} - TC - \Delta TC_{Russia}^{average}\right) \times C_i$$

(equ.3)[87]

(i) P_i: European netback price for zone i

(ii) P_E: Realised export gas price in the European market (RUR/mcm)

(iii) D: Export duty (%)

(iv) Tar_r: Tariffs in quarter r of base period (RUR)

(v) r: Current quarter of base period

(vi) j: Current month of base period

(vii) V_{Ej}: Gas volume exported to the European market in month (mcm)

(viii) TC: Transportation costs outside of the Russian border

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[85] cf. Dickel, Konoplaynik et al. (2007), pp. 154-158

The authors also refer tot he following sources: Information provided on these contract extensions comes from the monthly edition of *Gas Matters:* OMV (34 Gas Matters, October 2006), ENI (24 Gas Matters, November 2006), E.ON Ruhrgas (26 Gas Matters, September 2006), GdF (20 Gas Matters, December 2006)

[86] cf. Mitrova, Pirani et al. (2009), pp. 434-435

[87] Mitrova, Pirani et al. (2009), p. 435, Sources: Russian Federal Tariffs Services

(ix) $\Delta TC^{averageRussia}$: Difference between average transportation costs from the production site to the Russian border and the average transportation costs from the production site to the Russian consumer (RUR/mcm)

(x) C_i: Price zone coefficient[88]

In general we have here a price netted back from average European sales excluding transportation costs and adjusted by a prize zone coefficient. The author of this paper assumes that the coefficient functions as a reflector of Russia's relationship with the respective CIS country. In this matter via the formula Ukraine faces relatively higher netback prices as a closer Russian ally like Belarus.

Based on the 2009 agreements between Yulia Timoshenko and Vladimir Putin there is also a revision formula for the Ukraine gas price available.

$$\mathbf{P_{gas}(t) = 26{,}2 + 1{,}69 * p_{oil}(t) + 3{,}75 * p_{oil}(t-9)} \qquad \textbf{(equ.4)}^{89}$$

(i) p_{gas}: Gas price in $/tcm

(ii) p_{oil}: Oil price in $/barrel

5.6. LNG and hubs

So far I have discussed the structure of long-term contracted gas pricing, which is mostly based on the netback value idea. If one wants to think about a different, more market driven concept when it comes to natural gas pricing the existence of spot markets has to be taken under consideration as a reference point.
When it comes to thinking about the gas markets itself there are also commentators who think of a completely integrated world market for natural gas. Siliverstovs, Neumann et al. (2004) put this to the test. Their conclusion was that et least in the 1990s up to 2004 there was no significant co-integration between European, Japanese and North American markets. The authors state that this situation might

[88] Mitrova, Pirani et al. (2009), p. 435

[89] Yegorov, Wirl (2009), p. 154

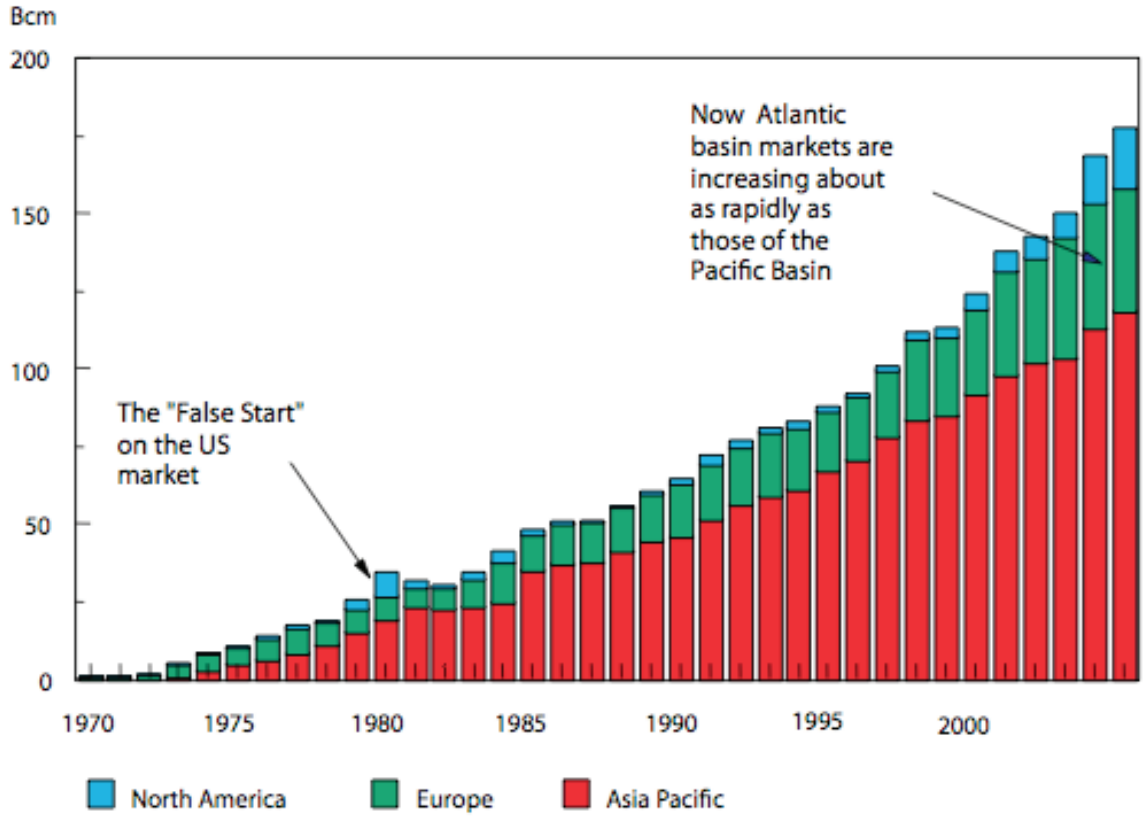
Source: www.expert.ru/articles/2009/01/22/itogi-gazovoy-voyny

change as a result of emerging global LNG markets with spot trading and physical arbitrage between for example European and North American markets.[90]
This movement would be interesting for further research but within this paper I will think the European market separate from other world markets. Before we think about spot markets it is crucial to think about how they are actually served. Most of the gas, which is traded on spot markets, is LNG (liquefied natural gas).
Europe and North America are nowadays the dominating markets when it comes to interest in LNG deliveries. The Atlantic Basin and the Middle East are growing markets. Long-term contracts have remained to be the dominating contracting method in order to manage risk and divide it on the two sides of the partnership. But there is also a certain need for flexibility, the flexibility of markets, the flexibility of buying a commodity like gas on different way than via pipeline gas. Flexibility has come in two ways:

- Small, but growing short-term market
- Self-contracting: Partners in the LNG plant contract with one or more of their own partners which act as wholesalers to the market[91]

[90] cf. Siliverstovs, Neumann et al. (2004), pp. 15-16

[91] cf. Jensen, Jim (2007), p. 175

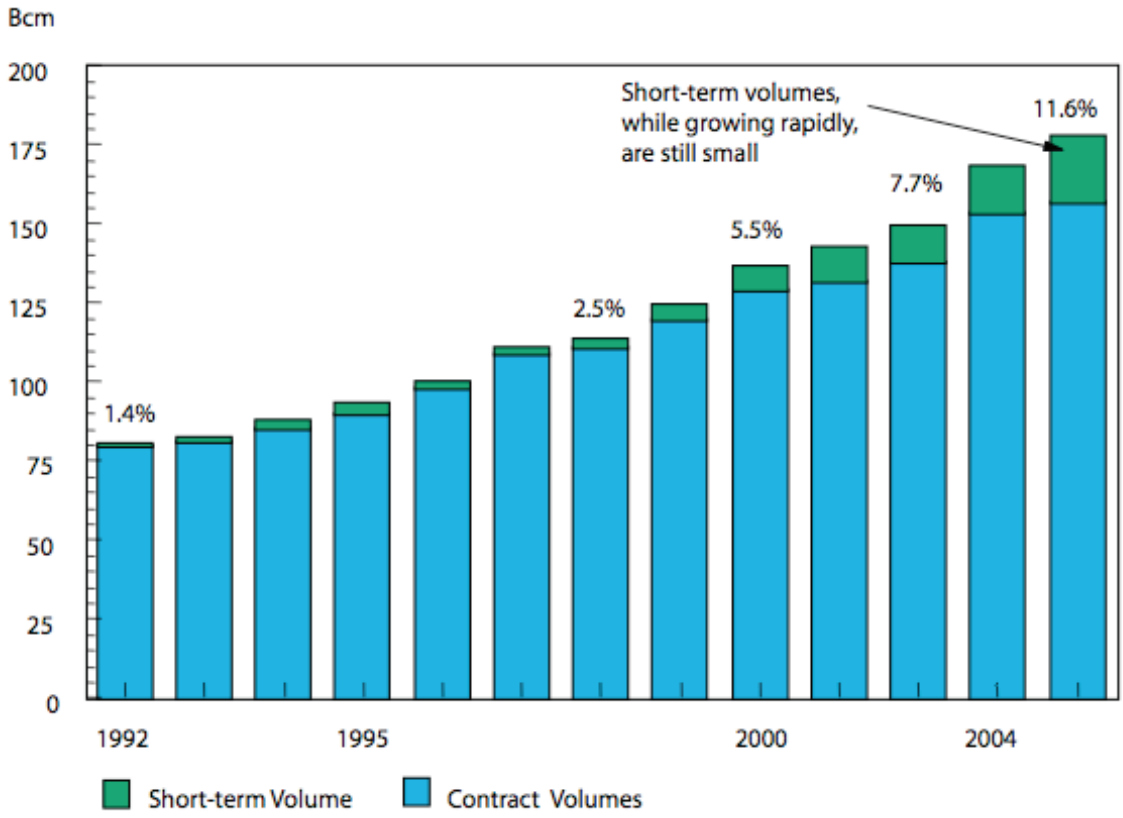


Graph 5.4. Growth of LNG imports by market region (bcm) (Jensen, Jim (2007), p. 177)

Graph 5.4 shows the growth of LNG imports by market regions. From a European point of view it can be stated that it is globally the second biggest importer but compared to pipeline imports under the regime of long-term oil linked contracts LNG plays a rather small role.

In general LNG projects are very cost intensive. The chain of investments consist of field development, pipeline to the coast, liquefaction facilities, tanker transportation and regasification. The risk-sharing logic of LNG contracts mostly embodies that the buyer takes the volume risk via a take-or-pay clause and the seller takes the price risk via a price escalation clause.[92]

[92] cf. Jensen, Jim (2007), p. 179



Graph 5.5. LNG trade showing the growing role of short-term sales (bcm) (Jensen, Jim (2007), p. 183)

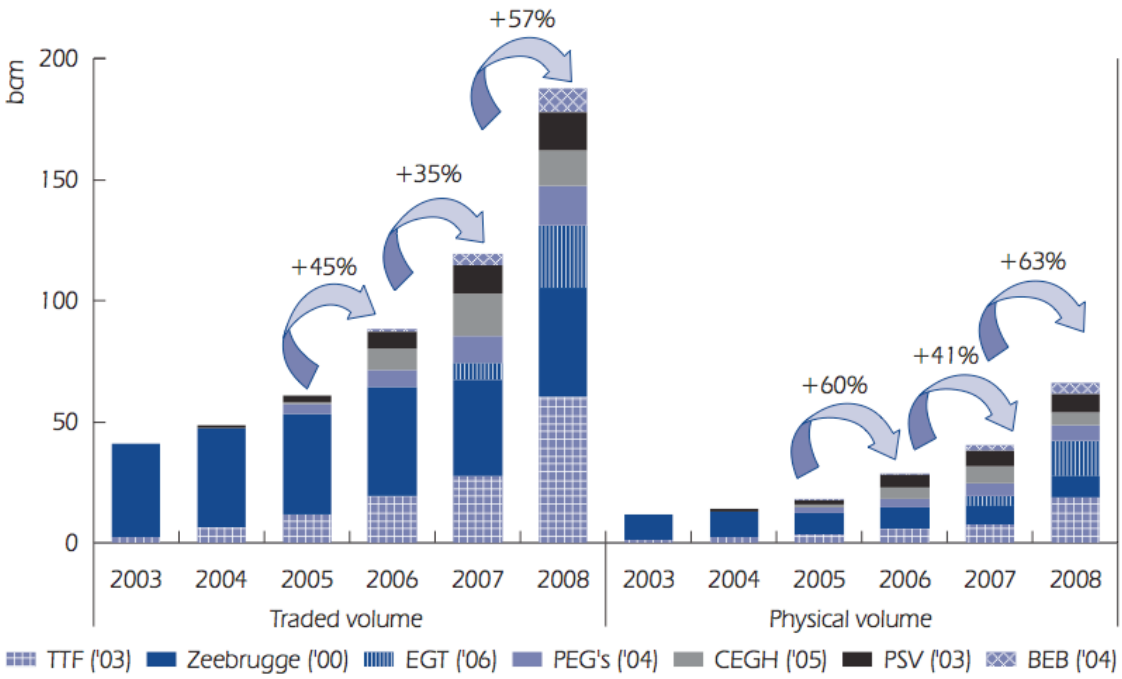
As we can see in graph 5.5 the role of LNG short-term sales is globally growing accounting meanwhile for 11,6 per cent. This fact might imply that there is a constantly growing need for short-term sales and also a certain acceptance of market price mechanisms.

When it comes to Continental Europe most of the LNG imports come via the traditional long-term contracts form Algeria, Nigeria and Trinidad. Prices are generally indexed via oil products but there is an on-going liberalization movement making the LNG prices more competitive. In general it is quite obvious that the European import model is not very reactive on gas-to-gas competition. From a present point of view it is also not likely that to long-term oil-indexed contract regime will quickly change but at least several gas hubs have been developed within the recent years in Western Europe:

- TTF: Title Transfer Facility, Netherlands, virtual
- Zeebrugge: Belgium
- Bunde: Germany
- NBP: National Balancing Point, UK

The hubs reflect a supply-demand situation but due to low liquidity they are threatened by market manipulations and also the prices are more volatile as they display a seasonality trend.[93]

Trading at European hubs is increasing as we can see from graph 5.6. This ensures additional flexibility.



Graph 5.6. Developments on European continental hubs (International Energy Agency (2009), p. 29) Sources used by the IEA (2009): Gas Transport Services, Huberator, GRTgaz, TIGF, CEGH, E.ON Gas Transport, Snam, Gasunie Deutschland

[93] cf. Davoust, Romain (2008), p. 13

bcm per year		NBP ('96)	Zeebrugge ('00)	TTF ('03)	PSV ('03)	PEG's ('04)	BEB ('04)	CEGH ('05)	EGT ('06)
Traded volume	2003	611.0	38.6	2.3	0.1				
	2004	551.9	41.1	6.2	1.1	0.3	0.0		
	2005	500.1	41.7	11.6	2.6	4.0	0.4	0.8	
	2006	615.2	45.1	19.1	7.1	7.0	1.2	8.9	0.2
	2007	902.6	40.2	27.3	11.5	11.1	4.8	17.7	6.6
	2008	960.8	45.4	60.2	15.6	16.5	9.7	14.9	25.3
Physical volume	2003	52.5	10.2	1.3	n/a				
	2004	53.2	10.6	2.3	n/a	n/a	n/a		
	2005	53.7	8.4	3.8	n/a	n/a	n/a	n/a	
	2006	60.6	8.6	5.9	n/a	n/a	n/a	n/a	0.1
	2007	66.8	7.9	7.4	6.8	n/a	n/a	6.9	4.1
	2008	66.6	9.1	18.7	7.7	n/a	n/a	5.2	14.4

Table 5.1. Traded and physical volumes at European hubs (International Energy Agency (2009), p. 30) Sources used by the IEA (2009): Gas Transport Services, Huberator, GRTgaz, TIGF, CEGH, E.ON Gas Transport, Snam, Gasunie Deutschland

Table 5.1 ensures us of two important facts. On the one hand it makes clear that by traded volume there is only one really relevant hub which is the NBP with 960,8 bcm/2008. Also the hubs are not very liquefied with just 66,6 bcm/2008 at NBP accounting for approximately 7 per cent of the traded volumes. This rate is also called the churn rate and serves as a measurement for the liquidity of a gas trading spot.

Yegorov, Wirl (2008) discuss 3 possible future scenarios for Russian strategies:

- Fast development of gas production and pipeline capacity
- Slow expansion of production and yet export growth due to re-export of Central Asian gas
- Fast development gas production and LNG

The last scenario is interesting in terms of overcoming transit games for Russia and more flexibility when it comes to selling the gas. The consumer could be anyone and the question would be if Russia would sell the gas for example at European hubs and spot markets or if it would prefer to sell to others like Japan or the United States.[94]

[94] cf. Yegorov, Wirl (2008), pp. 316-317

5.7. Transition from oil-linked prices to market prices

> „Long-term contract traditional netback market pricing based (largely) on oil products is no longer logical. Oil-products indexation was originally necessitated by an absence of liquid gas markets. Oil was chosen as gas competed directly with various oil products in its main markets. By 2010, the scope of oil products competing directly with gas had narrowed considerably, gas and oil product markets have diverged, fuel oil is no longer used for power generation except in rare cases of peak-load provision and very little switching capacity remains.“[95]

This recent statement by Anouk Honorè (2011b) serves as a prelude for one stream of thinking when it comes to a new approach in European gas pricing. Honorè goes basically along with the ideas of Jonathan Stern that he set in two major publications in 2009 (*Continental European long-term gas contracts: is a transition away from oil product-linked pricing inevitable and imminent?*) and 2011 together with Howard Rogers (*The transition to hub-based gas pricing in continental Europe*). Within this section I will briefly discuss Stern's ideas and afterwards move over to chapter 6 which will put Stern's ideas to further tests based on data sets for EGIX as a market price, the German long-term border price for Russian natural gas imports and oil prices.

Stern (2009c) believes that there are four main reasons for a weakening of the oil link ratio in Continental European gas markets since the 1970s.

- Virtual elimination of oil products from many stationary sectors
- Cost and inconvenience of maintaining oil-burning equipment
- Emergence of modern gas burning equipment
- Tightening environmental standards

In many sectors of Continental Europe it is difficult nowadays to identify fuels, which genuinely compete with gas on a day-to-day basis. This causes problems in the operation of price clauses in the long-term contracts and arbitrage scenarios. Although the oil-link is not the first best solution any more, there is also the fear that a move away from it would strengthen the market power of major players like Gazprom

[95] Honorè, Anouk (2011b), pp. 57-58

too much leading to a kind of gas OPEC. On the other hand the major commercial parties like producers and exporters are also very comfortable with their long-term contracts and there might be fear of lower revenues following a change in the pricing mechanism. The idea supported by Stern is spot gas pricing at market hubs could set long-term contract prices for Europe. A major problem, as we already know, is of course the fact that except for the NBP in the UK there is no major hub yet. A transition to a pricing formula including dominant spot price elements could take around five years and should be generated via an indexation over several European hubs. This would of course have the radical results of an end of existing long-term contracts and a formal end of the relationship between oil and gas prices. Anyway it should be taken under consideration that the correlation between oil and gas is not completely irrelevant anymore. Gas and oil prices may decouple and recouple over time and depending on market conditions but the difference is that the conditions are supply and demand not contracts. If decoupling happens we will most probably see a downward shift in prices for a certain period due to an existing supply surplus. Over time there is of course the threat of a price or volume setting cartel in form of a kind of gas OPEC. Price volatility should be expected to rise as real supply and demand conditions will be reflected. General advantages and disadvantages are uncertain but the concept itself much more correctly mirrors the factual supply-demand situation.[96]

Stern also argues together with Rogers (2011) that is based on wrong assumptions, mainly in the aftermath of the economic recession following 2008, that gas market prices would always be under the level of oil-linked prices. His key propositions are:

- Conditions in the gas market should set gas price levels
- Gas and oil prices will not recouple because their supply and dynamics are different
- There should be a single pricing mechanism[97]

Interesting is that Stern negates his 2009 assumption of temporarily recoupling oil and gas prices in the 2011 paper.

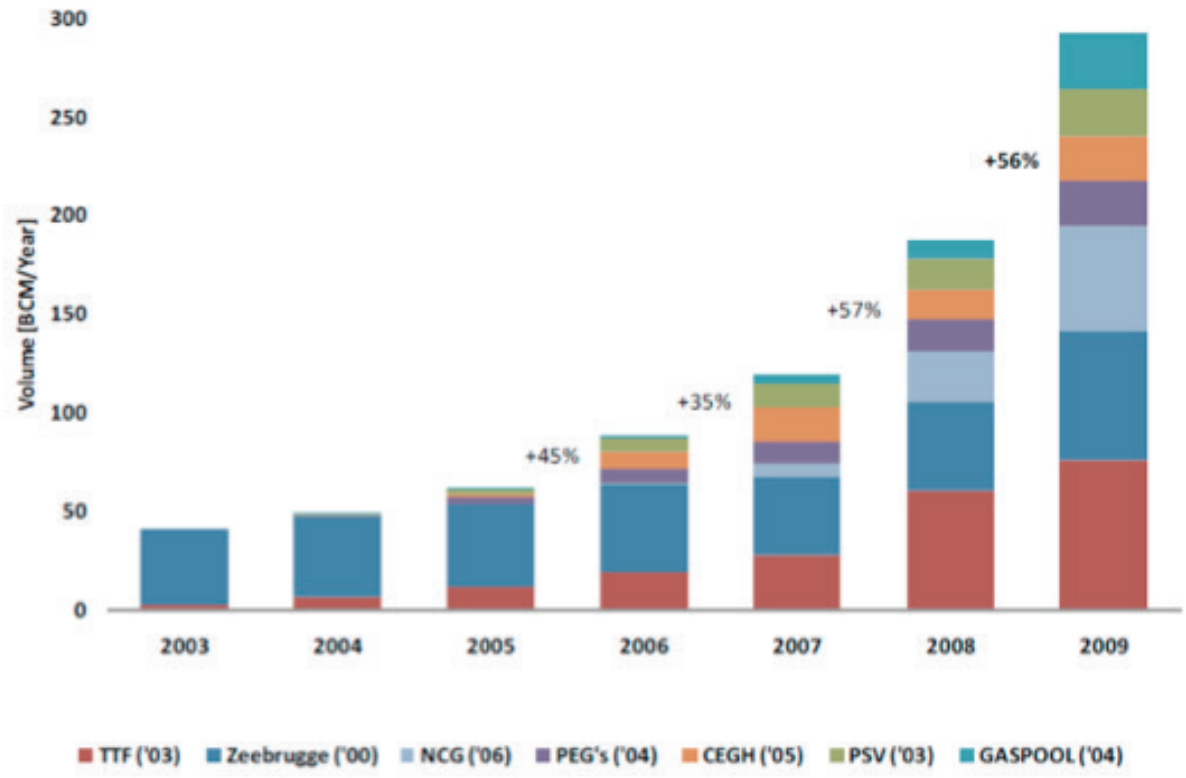
[96] cf. Stern, Jonathan (2009c), pp. 1-16

[97] cf. Stern, Rogers (2011), p. 7

Stern, Rogers (2011) also do not forget to mention the arguments of their opponents.

- Producers with market power favour oil-linked prices
- Decoupling of oil and gas price after 2008 was due to the economic recession
- European gas hubs are insufficiently liquid and prone to manipulation
- Abandoning the oil-link would lead to price manipulation by big players like Gazprom and maybe encourage a *Gas-OPEC*

On the contrary we face a changing commercial environment in the gas markets. LNG supplies starts to connect markets more and more, continents are starting to have an impact on each other and hubs might be the best indicators of real market prices under those conditions.[98]



Graph 5.7. Development of traded volumes at Continental European gas hubs 2003-09 (Stern, Rogers (2011), p. 12)

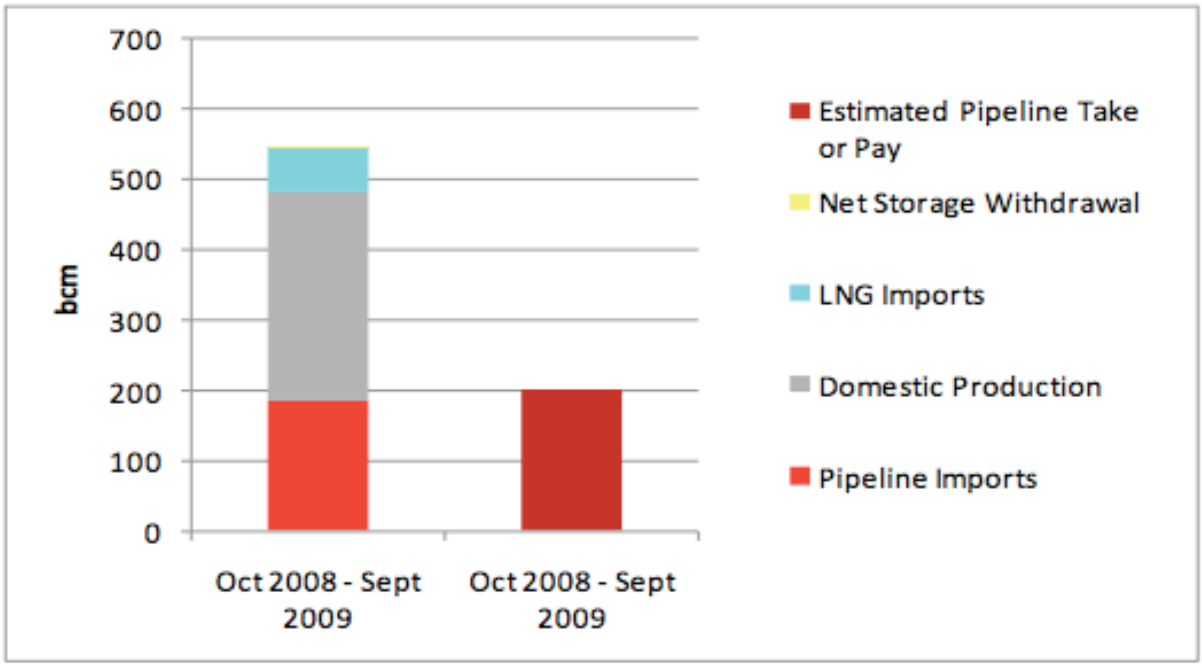
Sources used by Stern, Rogers (2011): IEA, Medium term oil and gas markets 2010, Paris: IEA WEO 2010, p. 207

[98] cf. Stern, Rogers (2011), pp. 2-3

Graph 5.7 illustrates additional to graph 5.5 the further development of the gas volumes traded at European hub showing a massive increase of 56 per cent from 2008 to 2009, indicating a steady rise in the relevance of the hubs.
But there are also some problems:

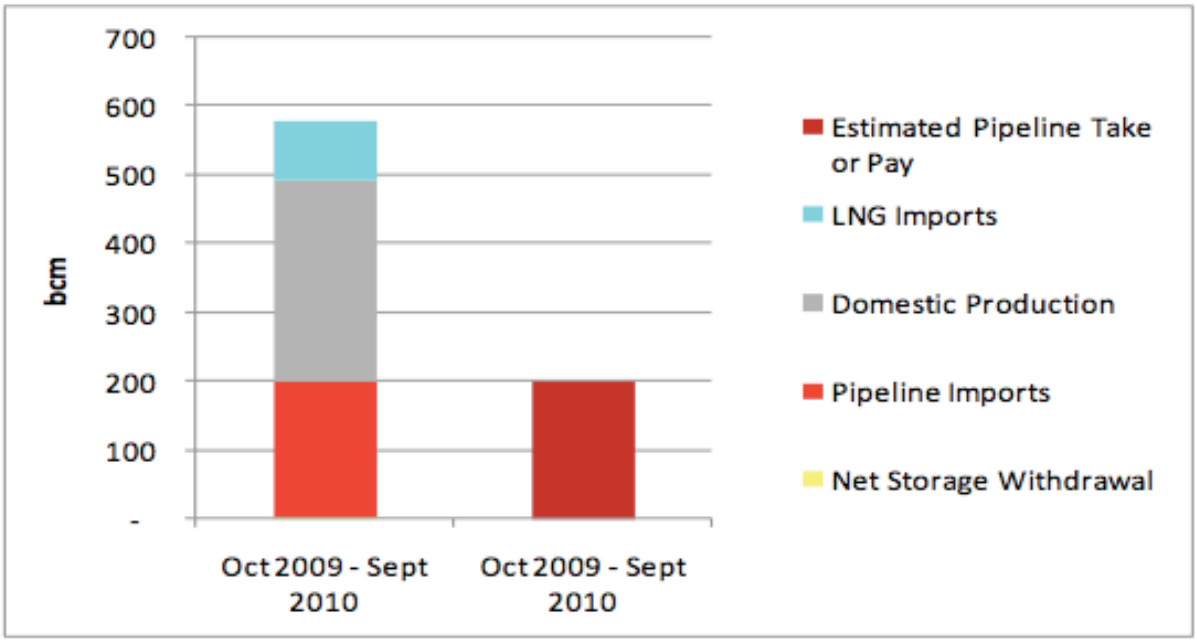
- Lack of sufficient depth and liquidity
- Only the NBP, which is not shown in graph 5.6 is a mature hub with churn ratio of an estimated 15% in 2010
- Only daily trades are possible, futures and future risk hedging are almost not possible
- High price volatility due to possible market manipulation either by sellers or buyers
- Oligopolistic market structure
- Prices become subject of speculators[99]

These fears and possible problems shall be taken under consideration within my further discussion of my data analysis in chapter 6.



Graph 5.8. European gas balance for contract year 2008/09 (Stern, Rogers (2011), p. 23)
Source used by Stern, Rogers (2011): Howard Rogers, OIES

[99] cf. Stern, Rogers (2011), pp. 11-16



Graph 5.9. European gas balance for contract year 200/10 (Stern, Rogers (2011), p. 23)
Source used by Stern, Rogers (2011): Howard Rogers, OIES

From graph 5.8 and graph 5.9 we can take two things under consideration. Once again we see an increase in LNG imports and also a shortage of pipeline imports in comparison with the estimated take or pay levels in 2009 while there seems to be a recovery and almost equality in 2010.

	2007-08	2008-09	2009-10
Germany	39.72	27.02	36.82
Italy	23.57	19.04	12.43
Turkey	24.43	20.75	16.85
France	11.26	9.64	11.16
UK	6.10	7.47	6.68
Total "Western Europe"**	124.08	99.76	101.12
Total "Central Europe"**	44.53	33.4	40.98
TOTAL EUROPE (Gazprom definition)	168.61	133.16	142.10
Total including Baltic Countries***	173.21	136.5	146.28

Table 5.2 Russian gas exports to Europe, contract years 2007-2010 (bcm) (Stern, Rogers (2011), p. 25)
Sources used by Stern, Rogers (2011): Interfax Russia & CIS oil and gas weekly: February 14-20, 2008, p. 20; November 12-18, 2009, p. 27; February 11-17, 2010, p. 31; November 11-17, 2010, p. 30

In this context we should finally also have a look on the Russian side. Table 5.2 first of all gives an impression of the development of Russian gas exports to Europe from 2007 till 2010 showing a drastic decline during the recession period but a friendly increase since 2009 and 2010.

The crisis also showed the drastic outcomes of take or pay levels in combination with the pressure of market priced volumes leading to intensive renegotiation rounds demand by the buyers. This lead to the observation of a certain collective change in the mind-sets of European buyers.

- Traditional utility mind-set: Long-term oil-indexed contracts represent a secure source of supply
- Modern utility mind-set: Long-term oil-indexed contracts represent an unbound future exposure relative to the market price at hubs

Gazprom of course does not favour this change in sentiment and insists on oil-linked pricing. The transition could be carried out via two possible scenarios.

- Arbitration scenario: Industry enters into a substantial scenario of arbitration proceedings carried out by jurisdiction experts with the hope of a landmark arbitral judgement to set the general tone
- Negotiation scenario: Agreement on transitional arrangements which would lead to negotiated settlements or contract terminations in some cases, the agreements would have to be based on the definition of the market price to which contracts will be adjusted, the period of adjustment and the price adjustment during the transition

If a path of transition to market prices will be chosen, one thing is clear: The transition would be highly costly and complex.[100]

An opponent of Sterns ideas is Andrey A. Konoplaynik. He sees generally five options for the future of gas pricing and contractual mechanisms in Europe.

- Option 1: Substitution of gas price indexation by spot quotations
- Option 2: Maintain oil-indexation
- Option 3: Maintain oil-indexation and move to oil parity

[100] cf. Stern, Rogers (2011), pp. 25-32

- Option 4: Adaptation of the mostly oil-linked gas price indexation by pricing formulas that include a broader spectrum of non-oil gas replacement values
- Option 5: Develop completely new concepts[101]

Konoplaynik is in favour for option 4 proposing an adaptation of the existing formula without a radical cut as Stern proposed it.

> „Thus, we have come to the conclusion that that the way proposing to peg the gas prices in EU-oriented LTGECs to gas prices set as a result of gas-to-gas competition at the European spot trading hubs, in particular, at the UK's National Balancing Point, rather than to the basket of gas substitutes based on their replacement value is not a valid one - at least today and in the foreseeable future. This way creates many additional risks for both consumers and, especially, producers outside the EU. The European gas market is not prepared (and should it be?) to switch over to gas-to-gas competition as the key pricing mechanism."[102]

According to Konoplaynik (2010) long-term pricing formulas are supposed to adjust gradually to the new environment of gas pricing. He states that this change will continue through a broader range of gas-to-gas substitutes as a part of the formula and a higher frequency of contract review rounds.[103]

Konoplaynik (2011) also refers to my further subject of analysis, the possibility of the European Gas Index (EGIX) as a gas price indexation tool. He generally agrees that the oil-price indexation can be replaced by a more appropriate instrument and also sees a potential for EGIX to be that tool but he formulates the concern that the belief that at any given point of time, even 10 to 15 years ahead, delivery prices will reflect a justified equilibrium market price is not justified.[104]

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[101] cf. Konoplaynik, Andrey (2011), slide 17

[102] Konoplaynik, Andrey (2010), p. 29

[103] cf. Konoplaynik, Andrey (2010), p. 30

[104] cf. Konoplaynik, Andrey (2011), slide 15

6. Data Analysis (Research question 2 and 3)

So far I have been dealing with research question one, the consolidated overview on Russian gas exports to Europe, especially via transit through the Ukraine and the gas price dynamics of European and Ukraine natural gas imports from Russia and Russia's domestic supply. This was based on findings of acclaimed authors. In the descriptive part of my thesis I will now focus on question two and question three and contribute to the discussion.

2. **What could be outcomes to expect from a shift from oil-linked to market-linked natural gas prices for long-term Russian natural gas supply to Europe? How would the dynamics of European import prices and Ukraine netback prices be influenced?**
3. **What can be advantages and disadvantages of using the European Gas Index (EGIX) to signal European market prices for natural gas in supply contracts for Russian natural gas?**

Within this chapter I will now discuss, following Stern and Konoplaynik, what the outcome of market pricing could be for the European natural gas import price for Russian supply and the outcome for Ukraine as a netback country. Furthermore I will do a general test of the EGIX price series and to find advantages and disadvantages that the use of EGIX as an underlying index for long-term contracts for Russian supply to Europe might have for both point of views. Therefore I will carry out a statistical analysis of a combination of different time series of prices compared with the EGIX price time series.
Before I will come to this core part of my thesis I want to give a brief overview of the present developments European gas market at the direct time of writing this paper.

- 2011 third quarter of EU gas consumption was lower than the same period one year before
- Overall natural gas imports into the EU continued to grow but LNG import fell by 14 per cent
- Overall trend of slight decrease in North Western European hub prices

- Russia's long-term, oil-indexed import prices were amongst the highest gas prices
- Level of hub prices in the UK and in Belgium starts to drive the long-term contract prices
- German border prices start to converge towards German hub prices
- Central and South Eastern gas imports from Russia exceed the average German border prices[105]

This information includes the general trend of long-term oil-indexed prices starting to be under pressure and being influenced by market prices at hubs, especially in countries with strong hubs with a proper churn rate.

6.1. The European Gas Index

> „With the introduction of the EGIX gas price index EEX is establishing a transparent and easily established reference price fort he gas market which can be integrated in the supplier-costumer relationships as a market-based alternative to supply contracts based on natural gas substitutes (e.g. oil or coal).“[106]

With the introduction of the EGIX the European Energy Exchange (EEX) introduced a new promising tool for a European gas industry making efforts changing pricing to a new environment generating maybe a fairer balance of interest between the contract parties. The EGIX is published for a virtual market area of Germany as well as for GASPOOL and NCG market areas after the end of trading on every exchange day at the EEX. The daily values are rounded to two digits. Their practical application in contracts can be within price adjustment clauses. One of the possibilities, which I will also follow within my thesis, is a market priced-based use setting the EGIX equal to the gas price in a contract. In order to simplify my analysis I will follow this way. The EGIX is based on derivatives market transactions, which are concluded in the respectively current front month contracts for the NCG and GASPOOL areas.[107]

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[105] cf. European Commission, 2011, p. 3

[106] EEX, 2011, p. 1

[107] cf. EEX, 2011, pp. 1-2

The concrete algorithm is available, but I will not reproduce it here in my paper.
The EGIX offers the following advantages:

- Efficiency: EGIX represents the current market value of gas at all time, it is free and publicly available
- Transparency: Adjustment, simplification and standardisation of existing gas supply contracts is possible
- Trust: The EGIX is based on concrete exchange transactions concluded on EEX which includes recognised monitoring[108]

For the EEX the EGIX is a very important future tool. Their basic launch arguments were:

- Natural gas is important and deserves its own price
- Referring to other prices as references for the gas price is risky
- EGIX provides a market price and hedges that risk
- EGIX has the potential to replace oil prices in gas supply contracts
- Transparent market gas prices based on an exchange-based index increases confidence of the costumers in pricing by the gas companies[109]

Which advantages and disadvantages EGIX might have in order to be the main index used in Russian long-term supply contracts and how the outcome of EGIX prices in long-term contracts for Russian gas supply would change their dynamics shall be put to evaluation right now.

[108] cf. EEX, 2011, p. 1

[109] cf. Menzel, Hans-Bernd, 2011, slides 7-8

6.2. Data analysis

I am going to deal with the following data, which in each case represents a price series from January 2008 until March 2012. January 2008 is the point in time of the first given EGIX data.

- Russian natural gas: Border price Germany, €/1000 cubic meters: Russian pipeline price
- EGIX market price: NCG and GASPOOL (virtual Germany), €/1000 cubic meters: Market price
- Crude oil (petroleum) price index (2005=100): simple average of three spot prices: Dated Brent, West Texas, Dubai Fateh: Global oil price index
- Crude oil (petroleum), simple average of three spot prices: Dated Brent, West Texas, Dubai Fateh, €/barrel: Global oil price
- Crude oil (petroleum), Dated Brent, light blend 38 API, fob U.K., €/barrel: European oil price
- EGIX market price: NCG and GASPOOL (virtual Germany), €/ MWh: European gas price for a unit of energy
- Crude oil (petroleum), Dated Brent, light blend 38 API, fob U.K., €/MWh: European oil price for a unit of energy

Month	Russian Natural Gas: Border Price Germany, €/1000 cubic meters	EGIX Market Price: NCG, Gaspool, €/1000 cubic meters	Ratio Pipe vs. Market
Jan 2008	251,22	270,255	0,929566521
Feb.08	250,72	246,548	1,016921654
Mar 2008	238,17	260,896	0,912892494
Apr.08	272,01	288,366	0,943280414
May 2008	275,39	296,398	0,929122329
Jun.08	275,47	323,431	0,851711803
Jul.08	327,83	314,12	1,04364574
Aug.08	345,36	286,542	1,205268338
Sep.08	359,85	360,896	0,997101658
Oct 2008	433,47	356,385	1,216296982
Nov.08	453,01	299,457	1,51277145
Dec 2008	429,77	253,206	1,69731365
Jan 2009	435,84	256,915	1,696436565
Feb.09	407,49	195,718	2,082026181
Mar 2009	316,69	140,021	2,261732169
Apr.09	234,75	131,021	1,791697514
May 2009	226,88	126,417	1,794695334
Jun.09	220,9	120,596	1,831735713
Jul.09	173,52	104,271	1,664125212
Aug.09	155,94	101,841	1,531210416
Sep.09	152,81	114,824	1,330819341
Oct 2009	156,73	144,424	1,085207445
Nov.09	155,7	126,343	1,232359529
Dec 2009	158,95	133,409	1,191448853
Jan 2010	191,48	153,192	1,249934722
Feb.10	199,67	147,602	1,352759448
Mar 2010	201,39	131,896	1,526884818
Apr.10	224,25	148,099	1,514189832
May 2010	225,36	186,143	1,21068211
Jun.10	237,7	219,391	1,083453742
Jul.10	239,14	217,67	1,098635549
Aug.10	239,34	206,553	1,158734078
Sep.10	233,87	209,63	1,115632305
Oct 2010	223,85	212,517	1,053327499
Nov.10	228,35	223,45	1,021928843
Dec 2010	237,76	260,375	0,913144503
Jan 2011	247,7	251,397	0,985294176
Feb.11	241,11	243,33	0,990876587

Mar 2011	234,55	271,201	0,864856693
Apr.11	250,07	266,715	0,937592561
May 2011	251,41	258,303	0,973314286
Jun.11	250,23	255,484	0,979435111
Jul.11	282,93	245,634	1,151835658
Aug.11	278,86	249,605	1,117205184
Sep.11	290,91	290,115	1,002740293
Oct 2011	318,06	286,334	1,110800673
Nov.11	318,65	278,536	1,14401729
Dec 2011	330,87	260,666	1,269325497
Jan 2012	343,73	248,094	1,385482922
Feb.12	332,75	267,455	1,244134527
Mar 2012	341,17	274,898	1,241078509

Table 6.1: Price series Russian natural gas, price series EGIX, ratio pipe vs. market, 2008-2012, €/1000 cubic meters

Sources: EEX, Index Mundi, International Monetary Fund

Month	Crude Oil (petroleum), Price index, 2005 = 100, simple average of three spot prices; Dated Brent, West Texas Intermediate, and Dubai Fateh	Crude Oil (petroleum),simple average of three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh, €/barrel, global average price	Crude Oil (petroleum) Dated Brent, light blend 38 API, FOB U.K. €/barrel
Jan 2008	250	61,71	62,46
Feb.08	258	63,58	64,3
Mar 2008	296	65,6	66,53
Apr.08	312	69,24	70,12
May 2008	358	78,92	79,67
Jun.08	384	84,57	85,55
Jul.08	393	84,06	84,91
Aug.08	322	76,54	76,06
Sep.08	268	69,11	68,95
Oct 2008	181	54,64	54,75
Nov.08	128	42,45	41,82
Dec 2008	104	30,95	30,99
Jan 2009	109	33,18	33,9
Feb.09	100	32,67	33,82
Mar 2009	114	36,01	35,92
Apr.09	124	38,12	38,56
May 2009	149	42,58	42,46
Jun.09	181	49,32	48,94
Jul.09	171	45,89	46,09
Aug.09	192	50,21	50,82
Sep.09	187	46,97	46,49
Oct 2009	206	50	49,4
Nov.09	217	52,01	51,66
Dec 2009	205	51,26	51,11
Jan 2010	206	54,04	53,52
Feb.10	192	54,6	54,3
Mar 2010	202	58,45	58,43
Apr.10	211	62,77	63,36
May 2010	178	60,09	60,65
Jun.10	171	61,22	61,31
Jul.10	178	58,37	58,55
Aug.10	183	58,86	59,49
Sep.10	186	58,24	59,52
Oct 2010	213	58,81	59,68

Nov.10	217	61,56	62,39
Dec 2010	223	68,14	69,45
Jan 2011	232	69,37	72,09
Feb.11	251	71,61	76,18
Mar 2011	285	77,62	81,76
Apr.11	316	80,56	85,29
May 2011	291	75,4	79,78
Jun.11	286	73,57	79,07
Jul.11	289	75,7	81,72
Aug.11	271	70,04	76,75
Sep.11	261	73,34	80,65
Oct 2011	258	72,9	79,87
Nov.11	269	77,59	81,37
Dec 2011	258	79,13	81,94
Jan 2012	260	82,77	85,95
Feb.12	280	85,24	90,54
Mar 2012	293	89,23	94,64

Table 6.2: Crude oil (petroleum) price index (2005=100), crude oil (petroleum) simple average of three spot prices series, crude oil (petroleum) Dated Brent price series, 2008-2012, €/barrel
Sources: Index Mundi, International Monetary Fund, World Bank

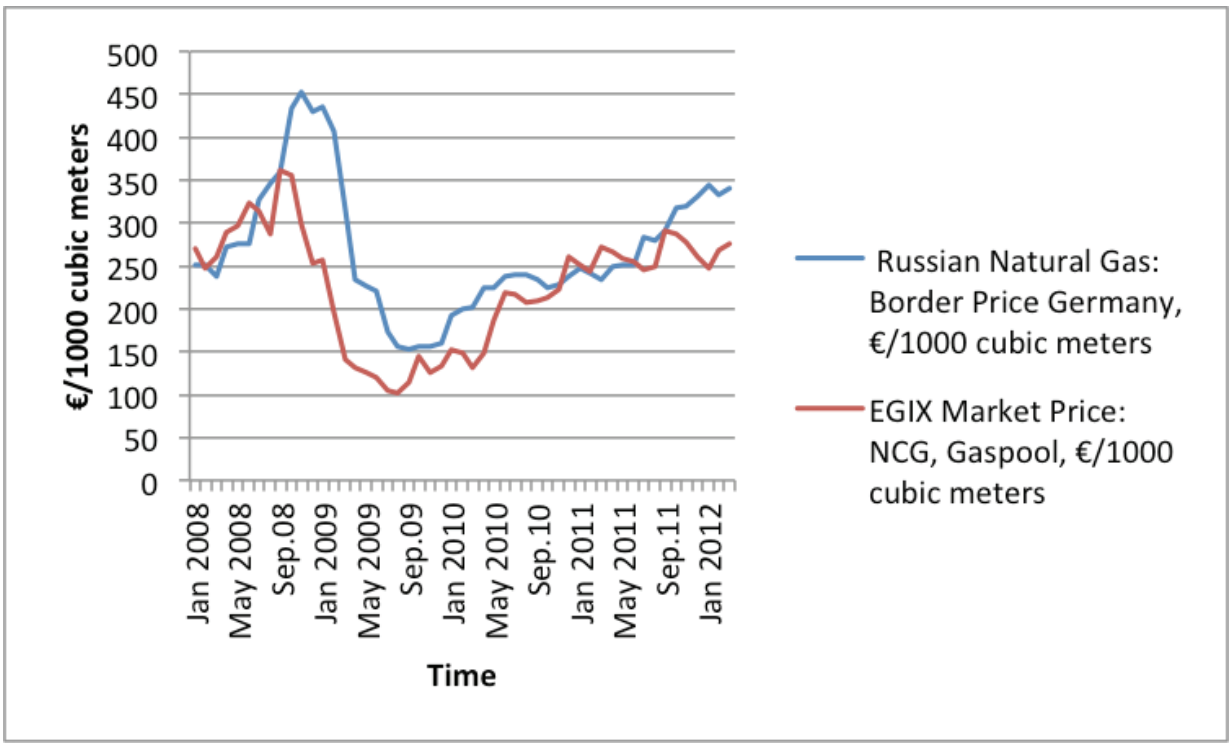
Month	EGIX Market Price: NCG, Gaspool, €/MWh	Crude oil (petroleum) Dated Brent: €/MWH	Ratio EGIX vs. Dated Brent costs of MWh
Jan 2008	24,2	36,75414852	0,658429075
Feb.08	22,08	37,83688361	0,583557574
Mar 2008	23,3	39,14911145	0,595160379
Apr.08	25,83	41,26162175	0,626005448
May 2008	26,54	46,88125221	0,566111159
Jun.08	28,97	50,34129693	0,575471864
Jul.08	28,13	49,96469342	0,56299755
Aug.08	25,66	44,75697305	0,573318485
Sep.08	32,32	40,57314346	0,796586048
Oct 2008	31,92	32,21725315	0,990773479
Nov.08	26,82	24,60868542	1,08985911
Dec 2008	22,68	18,23584795	1,243704163
Jan 2009	23,01	19,94821702	1,153486549
Feb.09	17,53	19,90114158	0,880853992
Mar 2009	12,54	21,13687184	0,593276058
Apr.09	11,73	22,6903613	0,516959595
May 2009	11,32	24,98528893	0,453066604
Jun.09	10,8	28,79839944	0,375020842
Jul.09	9,34	27,12133694	0,344378303
Aug.09	9,12	29,90467224	0,304969067
Sep.09	10,28	27,35671413	0,375776124
Oct 2009	12,93	29,06908321	0,44480247
Nov.09	11,31	30,39896434	0,372052149
Dec 2009	11,95	30,0753207	0,397335746
Jan 2010	13,722	31,49346828	0,435709395
Feb.10	13,22	31,95245381	0,413739742
Mar 2010	11,81	34,38272331	0,343486462
Apr.10	13,26	37,2837472	0,355650947
May 2010	16,67	35,68906673	0,467089827
Jun.10	19,65	36,0774391	0,544661719
Jul.10	19,49	34,45333647	0,565692673
Aug.10	18,5	35,00647287	0,528473693
Sep.10	18,77	35,02412616	0,535916297
Oct 2010	19,04	35,11827704	0,542167828
Nov.10	20,01	36,71295751	0,545039173
Dec 2010	23,32	40,86736495	0,570626465
Jan 2011	22,51	42,42085442	0,530635234
Feb.11	21,79	44,82758621	0,486084615
Mar 2011	24,29	48,11109803	0,504873116

Apr.11	23,89	50,18830175	0,47600734
May 2011	23,13	46,94598093	0,492693933
Jun.11	22,88	46,52818642	0,491744935
Jul.11	22	48,08756032	0,457498776
Aug.11	22,35	45,16299871	0,494874137
Sep.11	25,98	47,45792633	0,547432263
Oct 2011	25,64	46,9989408	0,545544209
Nov.11	24,94	47,88160527	0,520868084
Dec 2011	23,34	48,21701777	0,48406146
Jan 2012	22,22	50,57667412	0,439332961
Feb.12	23,95	53,2776274	0,44953203
Mar 2012	24,62	55,69024362	0,442088208

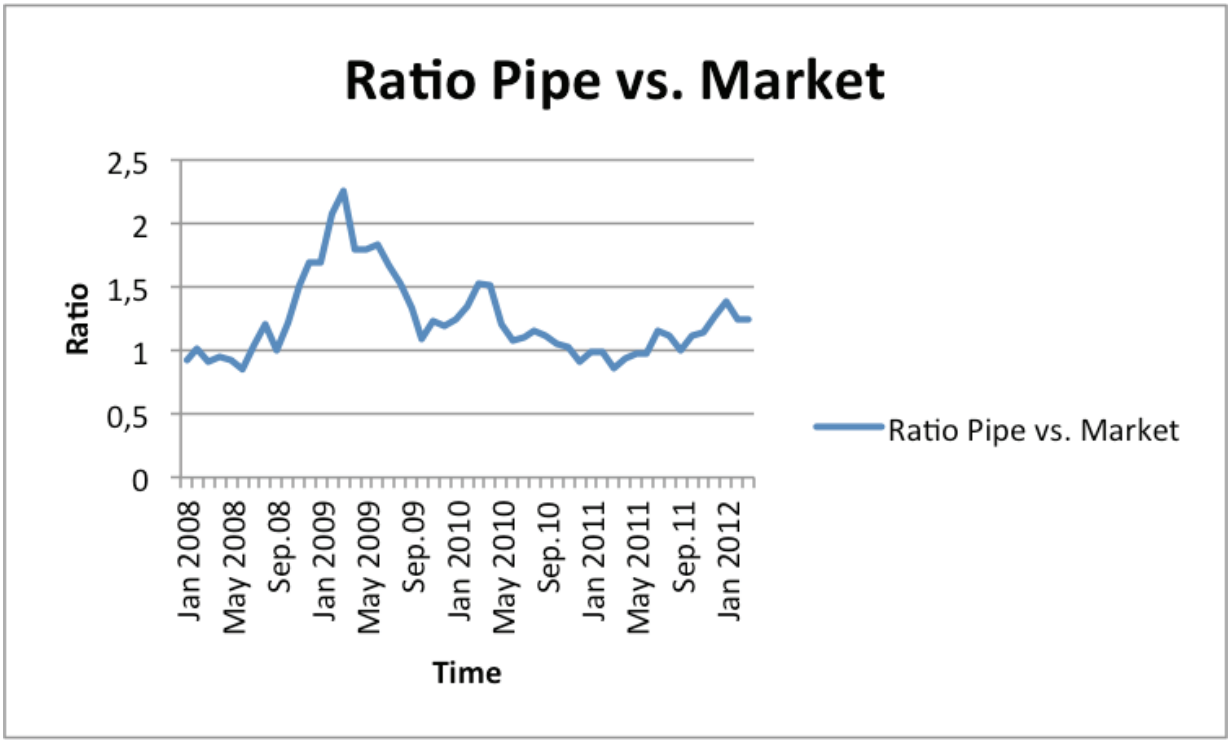
Table 6.3: Price series EGIX in €/MWh, price series Dated Brent in €/MWh, ratio EGIX vs. Dated Brent costs of one MWh, 2008-2012

Source: EEX

6.2.1. Gas prices series



Graph 6.1: Russian natural gas long-term supply price, EGIX, (€/1000 cubic meters) 2008-2012



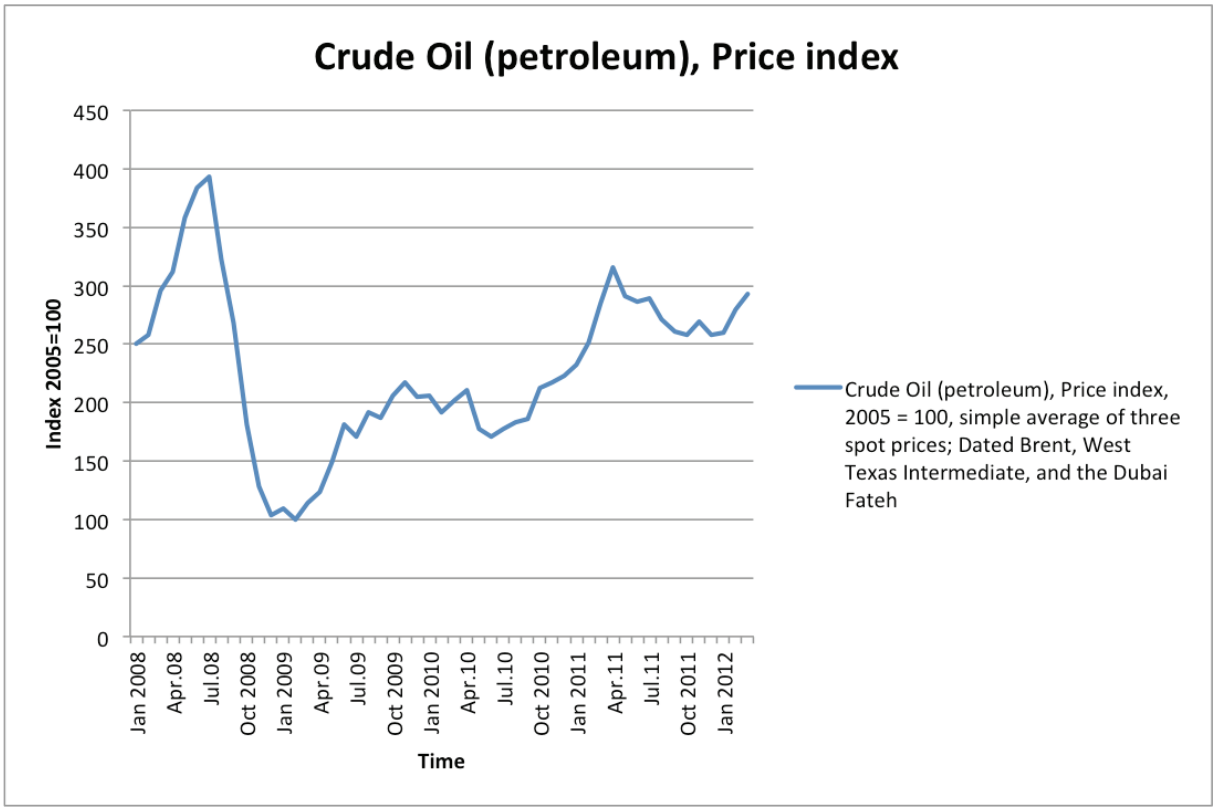
Graph 6.2: Ratio pipeline vs. market prices, 2008-2012

Graph 6.1, graph 6.2 and additionally graph 8.1 and graph 8.2 in the appendix introduce us to a general comparison of Russian long-term oil-indexed gas prices, exemplified by the German border price, compared to a possible market price via the EGIX price series. Obvious is, that the long-term price is at a peak, like it was before the crisis 2008 hit, higher than the market price: Long-term prices peaked at around 450 €/1000 cubic meters around October 2008 while the market price peaked already around July 2008 at around 370 €/1000 cubic meters. This also implies that market prices react faster to given market situations than the oil-indexed prices. This can be explained on the one hand by the renegotiation rounds, which are of course not as fast as a market. In order to be closer to the market situation and to reflect a clearer picture of the market in the pricing schema more frequent renegotiation rounds can be considered.

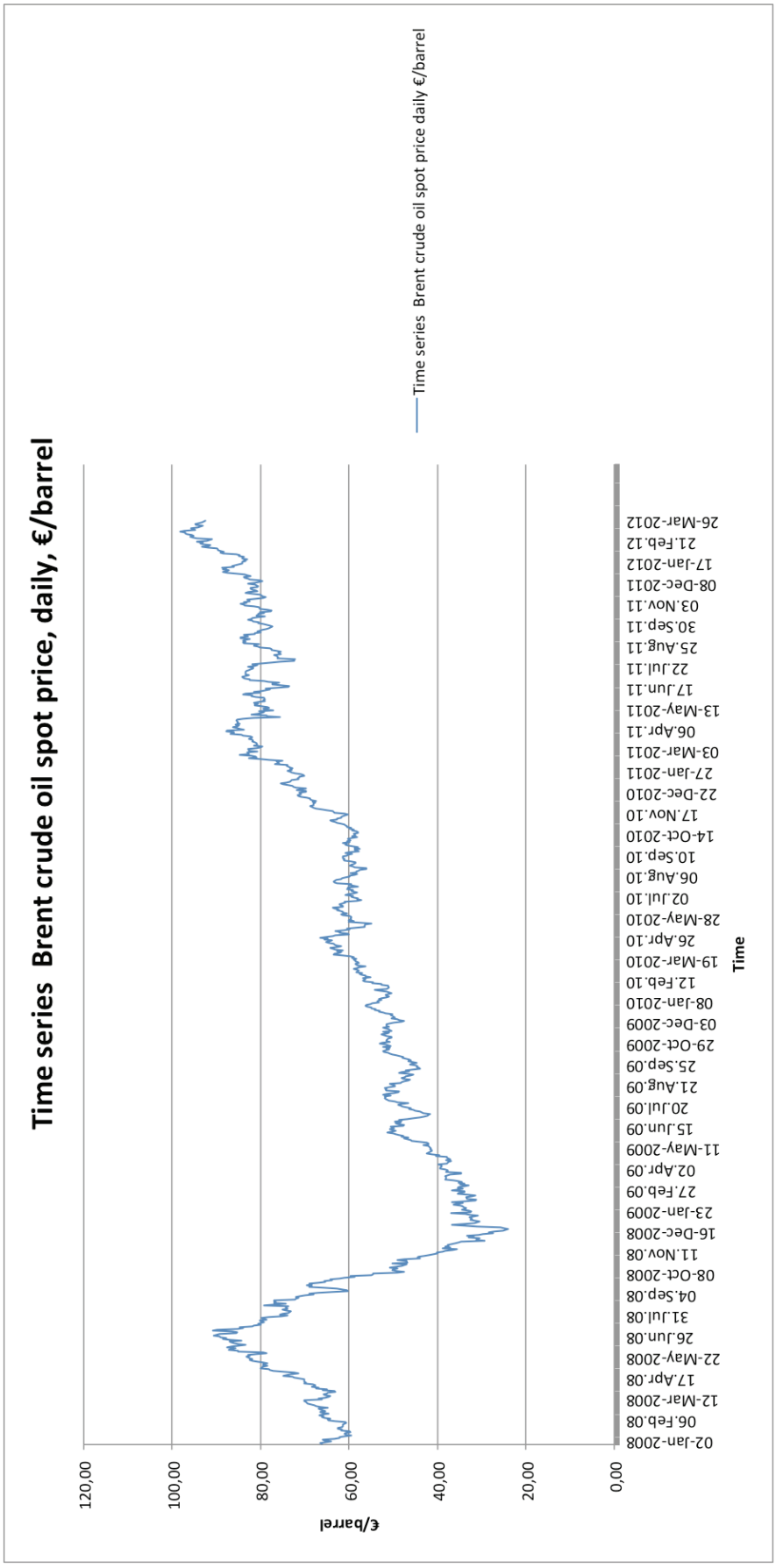
About one year later in August 2009 oil-indexed prices hit their lowest level at 150 €/1000 cubic meters while the market price fell to 100€/1000 cubic meter already in July of the respective year. So market price also seems to imply lower prices than indexed prices, which is interesting in terms of risk hedging. The comparison draws a clear picture of a pricing system, which is more in favour of the supply side. Prices tend to be higher when positive peaks are the case and they stay higher than the market prices in a situation of negative peaks. What we can also examine from the given graphs is a high volatility of market prices and long-term prices in 2011 including a time period of approximately half a year from October 2010 until early summer 2011 were market prices for gas were above the long-term prices. Since autumn 2011 however a strong trend of decoupling between the two price series is observable implying high long-term prices for Russian gas supply to Europe and significantly lower gas market prices. The inception point for this development lies according to the opinion of this author in a decoupling movement of oil and gas market prices which is via a certain time delay of course reflected in the pricing formula for Russian long-term deliveries. The oil-indexed versus market price ratio increased tremendous levels within and in the aftermath of the crisis but stabilized since then, in some time periods of 2011 prices were almost equal and as we already observed market prices were temporarily above oil-indexed long-term prices. At the time of writing the ratio is slightly rising again. This fact illustrates the already observed fact of a decoupling movement between oil and gas market prices and

therefore also a decoupling between gas market prices and gas long-term oil-indexed prices.

6.2.2. Oil price series



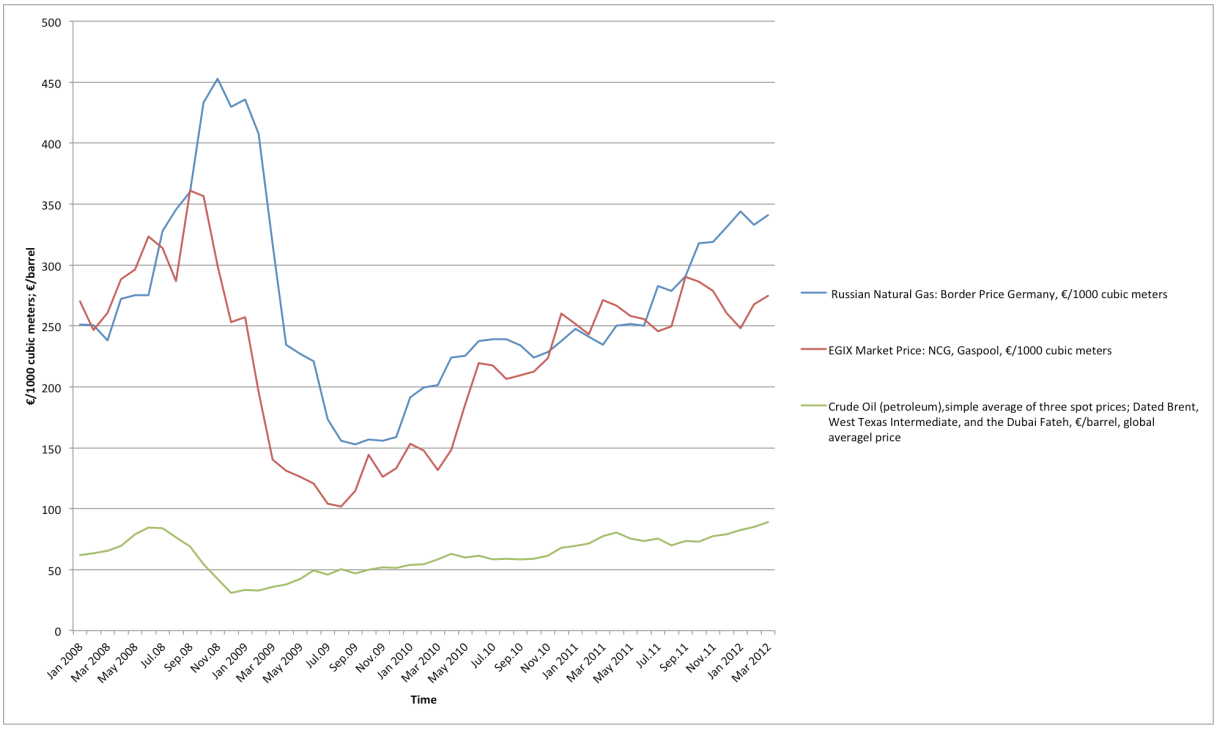
Graph 6.3: Crude oil index, 2008-2012



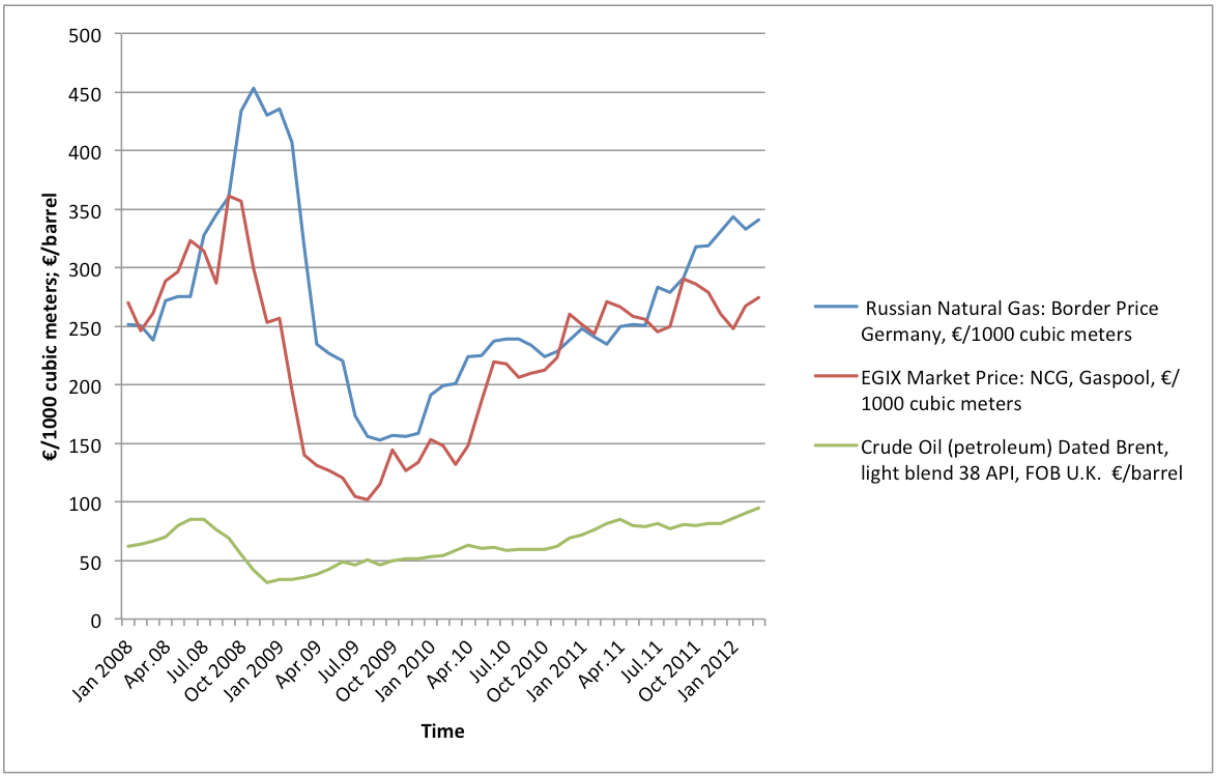
Graph 6.4: Dated Brent (€/barrel), daily 2008-2012

Graph 6.3, graph 6.4 as well as graph 8.3 and 8.4 from the appendix visualize the situation with oil prices for the respective time frame of 2008 until March 2012.
On the one hand I chose to use the index with a level of 100 per cent for the year 2005 in order to get an idea of global oil prices movements within the last several years. This is also interesting as the level of 100 per cent is set several years before the financial and economical crisis of 2008. The index is built up based on a simple average of three major spot prices: West Texas, Dubai Fateh and Dated Brent. The index is given in graph 6.3. It is basically and index of an average global crude oil price. What we can observe here is an extremely heated up situation right before the crisis. Average global crude oil prices reached a level of almost 400 per cent of the 2005 price level in summer 2008. The oil price reacted heavily to a heated up overall economical situation. Within just six months the average global crude oil price was hit back to 2008 levels. Since then it is recovering, pending around 300 per cent of the 2005 level. Additional to the index graph 8.3 gives the real figures for this trend in €/barrel. In total numbers the global average world price fell down to almost 30 €/barrel in the autumn of 2008. In March 2012 it rose steadily up to around 90 €/barrel. The trend is upward moving at the time of writing.
Graph 8.4 shows the respective curve for the European oil brand Brent. The curve corresponds very close with the global average curve reaching also a low peak in the autumn of 2008 at around 30 €/barrel and showing an upward moving trend of already prices above 90 €/barrel at the time of writing. As oil prices are generally more volatile than gas prices, which are mostly, fixed via long-term delivery contracts, I also included a curve for the Brent crude oil prices based not on monthly averages but on daily prices. This curve is given in graph 6.4. The respective detailed data is in the appendix in table 8.3. This graph shows that the exact negative peak of Brand spot prices was in December 2008 with prices way below 30 €/barrel. Since then we can examine the upward moving trend, which is accompanied by very high volatility on a day-to-day basis. The latest relevant implication is that at the beginning of 2012 Brent peaked at almost 100 €/barrel and shows a slight downward drift at the moment. The general trend however is upward moving.

6.2.3. Gas and oil price series in comparison



Graph 6.5: Russian natural gas long-term supply price (€/1000 cubic meters), EGIX (€/1000 cubic meters), crude oil world price average (€/barrel), 2008-2012

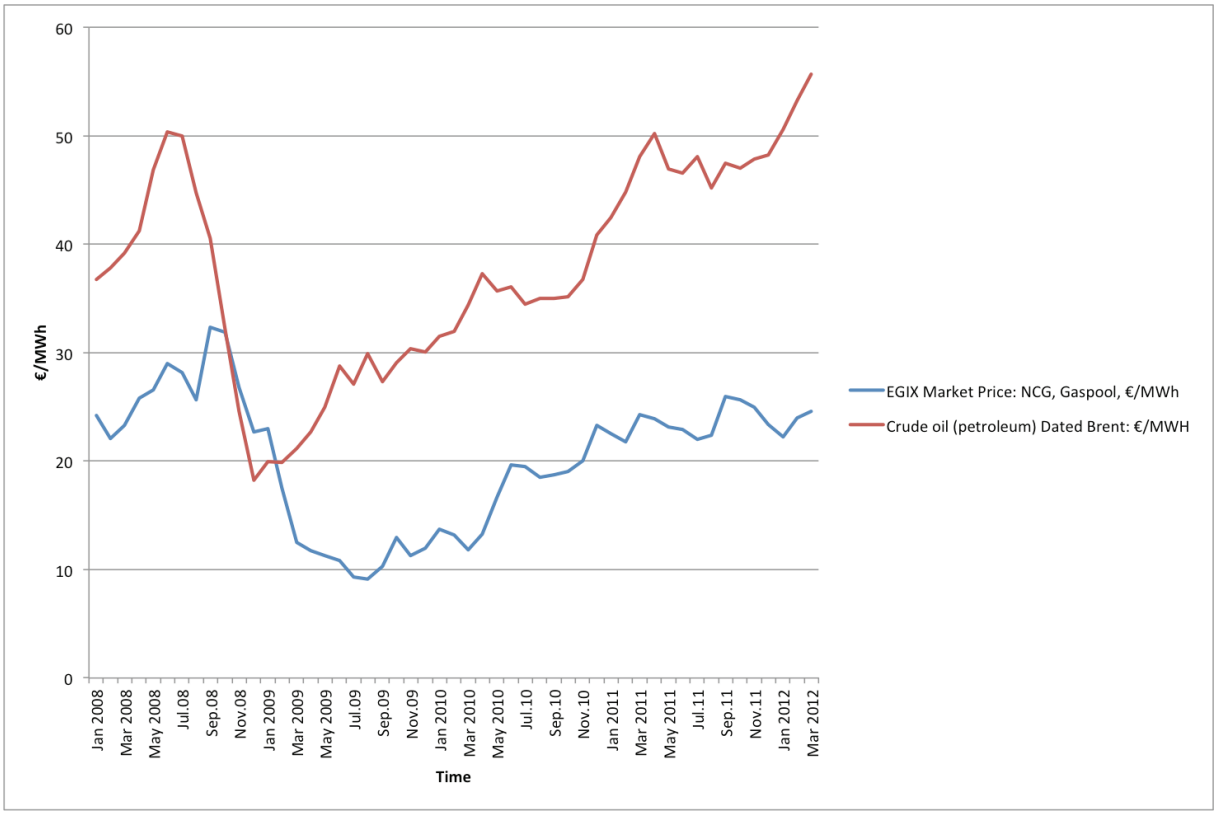


Graph 6.6: Russian natural gas long-term supply price (€/1000 cubic meters), EGIX (€/cubic meters), crude oil Dated Brent (€/barrel), 2008-2012

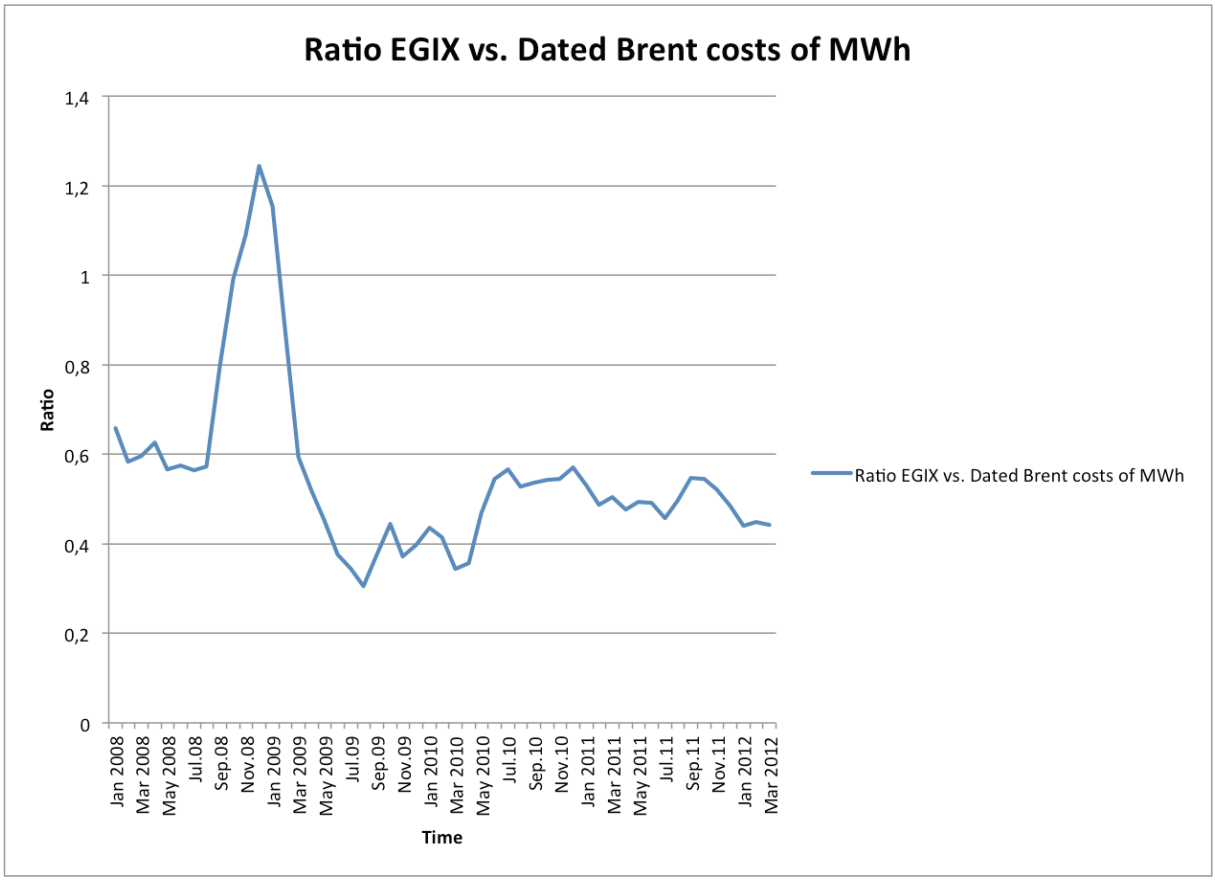
Graph 6.5 and graph 6.6 show the comparison of what we saw in graph 6.1, which was the price curves of EGIX, and Russian gas border price in Germany put together, in comparison with the oil-index based on the average global price from graph 6.3 and the Dated Brent reference price series for Europe from graph 6.4 and 8.4. Technically it is important to take under consideration that the vertical axis is defined as €/1000 cubic meters for the oil prices and €/barrel for the oil prices. Oil is not generally cheaper for the energy unit than gas. The graphs are supposed to show trends.

Here we can again examine that the first significant price moves seem to come from oil directly followed by the gas market price around one month later. The oil-indexed prices respond very slowly to the market, usually almost one quarter later. This implies that with an EGIX price formula indexed gas prices in long-term contracts would be closer to real market situations given additionally more frequent renegotiation rounds. Later on when it comes to the statistical analysis of this paper I will on the one hand test for general relations between those curves via correlations and also the interdependences of these curves via regressions.

6.2.4. Energy unit price series gas and oil



Graph 6.7: EGIX, Dated Brent, (€/MWh), 2008-2012



Graph 6.8: Ratio EGIX vs. Dated Brent, (€/MWh), 2008-2012

Graph 6.7, graph 6.8 and graph 8.5 and graph 8.6 from the appendix give us additional information on the de facto energy production prices of gas compared to oil showing the price of a produced MWh in Euro. The price of a unit of energy so to say also gives some hint on the interrelations between gas and oil. Here we can see that oil prices respond much faster to market situations than gas prices. The Dated Brent reached its lowest point already in November 2008 while the EGIX negatively peaked just in summer 2009. Graph 6.7 also implies that the gas MWh is generally cheaper than the oil MWh, just at the end of 2008 and the beginning of 2009 the oil MWh was a little cheaper than the gas MWh. At the time of writing this paper the two prices diverge showing a much more expensive oil MWh than gas MWh. This is an interesting fact. Just back at the end of 2008 until the beginning of 2009 gas prices and oil prices recoupled introducing even a slight period where the gas MWh was more expensive than the oil MWh. This might be due to the Ukraine transit crisis of January 2009 when spot gas was a relatively more scarce good than maybe oil. Since then the price for the oil MWh is steadily rising while the gas MWh is flattening

within the last year, pending around 25 €/MWh. This might be a systemic change. Oil becomes a generally more scarce good while gas is an available good, which is introduced to the European economies more and more. Additionally it also has to be stated that the ratio between the oil MWh and the gas MWh is smoothing out on a high oil MWh, implying the gas MWh is pending between 40 per cent and 60 per cent of the price of the oil MWh (graph 6.8).

6.2.5. Econometrical analysis of oil and gas time series

To analyse the data I used simple descriptive analysis of the price series, correlations and regressions.
The descriptive analysis has the general idea of the development of the respective time series.
Correlations I used in order to find out if there are any significant relationships between the different prices series. For example it is interesting if oil global market prices and oil European market prices are correlated with the market gas prices series represented by the EGIX. Correlations offer a simple tool in order to find indicators for relationships between data sets.
Additionally I used regressions in order to interpret the interdependence between oil market prices and EGIX gas market prices as well as gas prices for Russian long-term contracts and EGIX market prices on an additional level. Linear regression is here my tool of choice in order to try to find out more about the interrelations between Russian long-term prices and gas market prices represented by the EGIX price series and also between EGIX market prices and oil market prices. It is important to mention that the regression analysis is not yet enough to determine the causality between two time series. It is still working on a correlation basis, not yet definitely saying, if one time series influences the other directly. The next step for future research, which is not featured in this paper, would be to run a Granger causality test in order to test causality between time series.

6.2.6. Descriptive analysis

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Russia_pipe	51	100,0%	0	0,0%	51	100,0%
EGIX_market	51	100,0%	0	0,0%	51	100,0%
Oil_world	51	100,0%	0	0,0%	51	100,0%
Oil_brent	51	100,0%	0	0,0%	51	100,0%
EGIX_MWh	51	100,0%	0	0,0%	51	100,0%
Brent_MWh	51	100,0%	0	0,0%	51	100,0%

Report

	Russia_pipe	EGIX_market	Oil_world	Oil_brent	EGIX_MWh	Brent_MWh
Mean	268,6986	225,8154	62,3296	63,9908	20,2216	37,6549
N	51	51	51	51	51	51
Std. Deviation	76,05329	68,65355	15,15508	16,66988	6,14812	9,80927

Table 6.4: Russian natural gas long-term supply price (€/1000 cubic meters), EGIX (€/1000 cubic meters), Average oil world price (€/barrel), Dated Brent (€/barrel), EGIX (€/MWh), Dated Brent (€/MWh), descriptive analysis

Table 6.4 gives the general arithmetic means and standard deviations for the Russian long-term border price to Germany, the EGIX, the oil-world average, the oil Dated Brent, the EGIX gas MWh and the Brent oil. The most important thing is to look at gas market, gas pipe and oil Europe. It is important to mention that standard deviations and in that matter volatility is always relative. To get comparable figures for volatility I divided the standard deviations by the respective means, so we have a volatility of 0,2828 for the pipe gas, 0,3040 for EGIX gas and 0,26 for oil Europe. As a matter of fact that implies that EGIX gas is slightly more volatile than pipe gas under Russian long-term contracts. This implies that the gas market is more volatile than oil-indexed long-term delivery prices. Compared to the Brent oil we can see a lower volatility for oil prices. Here it is important to mention that this is true for the €/barrel unit. If we would examine a unit like ton of oil the volatility would be higher. When we compare the €/MWh price for oil and gas we have, using the same method, a higher volatility for the gas energy unit than for the oil energy unit.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Russia_pipe	51	152,81	453,01	268,6986	76,05329
EGIX_market	51	101,84	360,90	225,8154	68,65355
Oil_world	51	30,95	89,23	62,3296	15,15508
Oil_brent	51	30,99	94,64	63,9908	16,66988
EGIX_MWh	51	9,12	32,32	20,2216	6,14812
Brent_MWh	51	18,24	55,69	37,6549	9,80927
Valid N (listwise)	51				

Table 6.5: Russian natural gas long-term supply price (€/1000 cubic meters), EGIX (€/1000 cubic meters), Average oil world price (€/barrel), Dated Brent (€/barrel), EGIX (€/MWh), dated Brent (€/MWh), descriptive analysis part 2

From the descriptive analysis of table 6.5 it is clear that the spread between minimum and maximum prices of the 2008 until 2012 time series is much higher for the pipe prices than it is for the EGIX market prices. Also the maximum price of 360 €/1000 cubic meters is much lower on the market than the maximum of 453 €/1000 cubic meter while the minimum is lower on the market with 225 €/1000 cubic meters compared to the Russian pipe price of 268 €/1000 cubic meters. The average pipe delivery price for Russian long-term contracts is with 268 €/1000 cubic meters much higher than the average market price which lies around 225 €/1000 cubic meters for the respective time period. In relative figures this implies a 19 per cent ad on for Russian oil-indexed prices on the actual market price. This trend implies that the Russian contracts for long-term supply are in favour for the supply side rather than the buyer side. The average gas MWH hour was around 20 €/MWh while the oil MWh cost on average 37 €. This implies again the situation of much higher energy unit prices for oil than for gas. Table 8.1 in the appendix shows additionally the descriptive analysis for the daily Brent price series. Means and standard deviations are just slightly different and do not add any additional interesting insights.

6.2.7. Correlations

Correlations

		Russia_pipe	EGIX_market
Russia_pipe	Pearson Correlation	1	,674**
	Sig. (2-tailed)		,000
	N	51	51
EGIX_market	Pearson Correlation	,674**	1
	Sig. (2-tailed)	,000	
	N	51	51

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6.6: Russian natural gas long-term supply price (€/1000 cubic meters), EGIX (€/1000 cubic meters), correlation

Correlations

		Russia_pipe	Oil_world
Russia_pipe	Pearson Correlation	1	,029
	Sig. (2-tailed)		,839
	N	51	51
Oil_world	Pearson Correlation	,029	1
	Sig. (2-tailed)	,839	
	N	51	51

Table 6.7: Russian natural gas long-term supply price (€/1000 cubic meters), Average oil world price (€/barrel), correlation

Correlations

		Russia_pipe	Oil_brent
Russia_pipe	Pearson Correlation	1	,050
	Sig. (2-tailed)		,729
	N	51	51
Oil_brent	Pearson Correlation	,050	1
	Sig. (2-tailed)	,729	
	N	51	51

Table 6.8: Russian natural gas long-term supply price (€/1000 cubic meters), Dated Brent (€/barrel), correlation

Correlations

		EGIX_market	Oil_world
EGIX_market	Pearson Correlation	1	,594**
	Sig. (2-tailed)		,000
	N	51	51
Oil_world	Pearson Correlation	,594**	1
	Sig. (2-tailed)	,000	
	N	51	51

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6.9: EGIX (€/1000 cubic meters), Average oil world price (€/barrel), correlation

Correlations

		EGIX_market	Oil_brent
EGIX_market	Pearson Correlation	1	,596**
	Sig. (2-tailed)		,000
	N	51	51
Oil_brent	Pearson Correlation	,596**	1
	Sig. (2-tailed)	,000	
	N	51	51

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6.10: EGIX (€/1000 cubic meters), Dated Brent (€/barrel), correlation

Correlations

		EGIX_MWh	Brent_MWh
EGIX_MWh	Pearson Correlation	1	,595**
	Sig. (2-tailed)		,000
	N	51	51
Brent_MWh	Pearson Correlation	,595**	1
	Sig. (2-tailed)	,000	
	N	51	51

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6.11: EGIX (€/MWh) Dated Brent (€/MWh), correlation

After the basic descriptive analysis of the time series my next step is to search for correlations between the time series in order to find significant relations between them.
Table 6.6 until table 6.11 show the significance of the correlations between the different price series. Exactly we are dealing with a Pearson product-moment correlation coefficient. Correlation can reach outcomes of -1 till +1. -1 would be a total negative correlation, whereas +1 would be a total positive correlation.
The following existing correlations we can examine:

- Russian pipeline gas and the EGIX market price are significant on the 0,01 level, 2-tailed and show a Pearson correlation of 0,674 (table 6.6)
- EGIX market price and the average oil world price are significant on the 0,01 level, 2-tailed and show a Pearson correlation of 0,594 (table 6.9)
- EGIX market price and Dated Brent Europe gas reference price are significant on the 0,01 level, 2-tailed and show a Pearson correlation of 0,595 (table 6.10)
- EGIX MWh and Dated Brent MWh price are significant on the 0,01 level, 2-tailed and show a Pearson correlation of 0,596 (table 6.11)

Not significant are:

- Russian pipeline gas and the oil world market reference price, Pearson correlation 0,029 (table 6.7)
- Russian pipeline gas and the Dated Brent Europe oil reference price, Pearson correlation 0,05 (table 6.8)

These are very interesting findings. On the one hand we see that market prices for oil and gas are significantly correlated at least moving along similar curves. The EGIX price series is positively correlated with the average crude oil world price and also the Brent price series. This does not mean that the directly influence each other but the possibility of such an influence is given. If there is any deeper relationship will be tested within the following regression analysis. Also we see that the Russian pipeline gas is at least developing correlated to the EGIX market price but there is no significant correlation to the world market reference price of crude oil and the European reference price of crude oil. This might be reasoned by the fact that the Russian long-term pricing formula is based on light fuel oil and heavy fuel oil rather

than on crude oil. So the correlation would be more dependent on the dynamics of the fuel oil price series in this case.

6.2.8. Regressions

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	EGIX_market[b]	.	Enter

a. Dependent Variable: Russia_pipe

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,674[a]	,454	,443	56,76674

a. Predictors: (Constant), EGIX_market

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	131304,438	1	131304,438	40,747	,000[b]
	Residual	157900,697	49	3222,463		
	Total	289205,134	50			

a. Dependent Variable: Russia_pipe

b. Predictors: (Constant), EGIX_market

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	100,142	27,576		3,631	,001
	EGIX_market	,746	,117	,674	6,383	,000

a. Dependent Variable: Russia_pipe

Table 6.12: EGIX (€/1000 cubic meters) independent, Russian natural gas long-term supply price (€/1000 cubic meters) dependent, regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Brent_daily[b]	.	Enter

a. Dependent Variable: EGIX_market

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,430[a]	,185	,168	62,60893

a. Predictors: (Constant), Brent_daily

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	43591,477	1	43591,477	11,121	,002[b]
	Residual	192074,007	49	3919,878		
	Total	235665,483	50			

a. Dependent Variable: EGIX_market

b. Predictors: (Constant), Brent_daily

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-424,295	195,147		-2,174	,035
	Brent_daily	10,101	3,029	,430	3,335	,002

a. Dependent Variable: EGIX_market

Table 6.13: Dated Brent daily (€/barrel) independent, EGIX (€/1000 cubic meters) dependent, regression

The final statistical analysis that I carried out was a simple linear regression analysis in order to test two hypotheses concerning the dependence of the most important price series more in detail.
Hypothesis 1 tests if Russian long-term prices are dependent on the gas market represented by EGIX. Here I expected a negative outcome as the prices are derived via the oil-indexation.
Hypothesis 2 tests if EGIX gas prices are actually dependent on the oil price. Here I also expected a negative outcome as we already before saw a decoupling movement of oil and gas prices at the time writing.

- Hypothesis 1: Russian long-term gas price is dependent on EGIX gas market prices.
- Hypothesis 2: EGIX gas market price is dependent on the European market price for oil represented by the Brent series

In order to examine hypothesis 1 one I did a regression analysis with the EGIX price series being the independent variable and the Russian long-term delivery prices at the German border as the dependent variable. The linear regression equation for this relationship looks like this:

Russia_pipe = 100,142 + 0,746 * EGIX_market **(equ.5)**

100,142 is where the regression line hits Y-axis at zero and 0,746 is the ascending slope. So that means if the EGIX market price changes by one point, the Russian pipe gas prices would change by 0,746. To measure the quality of the model and to get the significance of the regression equation we need to have a look at column R square in the model summary of table 6.12. 45,4 per cent of the variance of Russian delivery prices can be explained via the market price. This is less than half of the cases. The analysis of variance (ANOVA) field implies redundant information. So what we face is Russian delivery contracts that move along market prices but the actual natural gas market does not significantly influence them. The prices in the Russian contracts can hardly be determined through the given situation in the natural gas market. Hypothesis 1 is not supported.

An additional finding for hypothesis 2 we see in table 6.13. Here the oil market price for Europe represented through the daily Brent curve is the independent variable while the EGIX series is dependent. First the regression equation:

EGIX_market = -424,295 + 10,101 * BRENT_daily (equ.6)

-424,295 is where the regression line hits Y-axis at zero and 10,101 is the ascending slope. So that means if the BRENT price changes by one point, the EGIX prices would change by 10,101. To measure the quality of the model and to get the significance of the regression equation we need to have a look at column R square in the model summary of table 6.13. 18,5 per cent of the variance of Russian delivery prices can be explained via the market price. This is very minor. The analysis of variance (ANOVA) field implies redundant information.
The market price for natural gas can be explained through the market price for crude oil just in 18,5 per cent of all cases. This we can see in the R square column. The prices in EGIX market prices can not be determined through the given situation in the crude oil market. Hypothesis 2 is not supported.

So we can keep in mind: Gas market prices do not significantly mirror oil prices and the Russian long-term contracts do hardly mirror actual market situations.

At this stage it is important to mention again that regression analysis is close to correlations. To get exact more significant causality measures a next step for further research has to be a test for Granger causality between the respective price series.

6.3. Interpretation

The goal of my data analysis was to generate fresh findings and new input when it comes to the discussion of linking long-term natural gas delivery contracts between Russia and Europe to a different derivative than oil, which is closer to the real market situation and gives a more realistic market indexation than oil. I would like the highlight that I am indifferent when it comes to support either the side of supporters of the oil-linked pricing or the side of market prices supporters like Jonathan Stern. I am trying to add new input to the discussion and give possible advantages and disadvantages of EGIX as much as I will try to highlight possible outcomes for the Ukraine as a netback priced transit country. I also believe that a market price generally appeals to me as a fair price to both sides, the demand and the supply sides. Anyway the idea of fairness might not be a relevant parameter in the discussion.

As a prelude to the interpretation of my findings I would like to recall the main topics of this thesis: In chapter two we learned that Russia and Gazprom are financially very dependent on the supply of natural gas to Europe as they use gas as a political subsidy to the domestic industry and the people of Russia and produce a negative revenue in the home market. Additionally there is a thrive towards raising CIS delivery prices to European netback in order to make higher revenues in those countries as well. A major question mark is Gazprom's gas exploration programme, which is yet unclear. The exploration strategy can serve as a tool in order to make natural gas scarcer and raise margins. On the other hand such a strategy is a threat to supply security and to Russia's image as a gas supplier. The Ukraine on the other hand is dealing with heavily rising gas delivery prices, a very inefficient energy use and uses transit as geopolitical tool in order to pressure Russia. Europe finally is widely dependent on Russian supply. In chapter 5 we learned about the rising influence of LNG and gas hubs leading to the possibility of setting a market price for gas, which is exemplified by, the EGIX issued by the EEX. This opens the possibility of using a natural gas market price as a derivative in the Russian pricing formula for supply to Europe. This possibility is addressed in research question two.

In research question three I followed the idea of a rather new index, the EGIX to deliver that job. One of the main objectives of the EGIX is, according to the EEX, establishing it as and index that mirrors natural gas market prices in order to be a tool that is being used in long-term contracts.

In order to contrast my findings especially with the propositions of Jonathan Stern I would like to recall also his major points:

- The oil-link is not logical as it does not reflect real market situations: Oil products are virtually eliminated form stationary sectors, oil-burning equipment is highly costly, new modern gas burning equipment is coming up, environmental standards are tightening
- Correlation between oil and gas prices does not exist, they do not temporarily recouple and decouple
- Higher volatility as real market situations are being reflected
- Possibility of a price and/or volume setting gas OPEC
- European gas hubs are insufficiently liquid and prone to manipulation
- But LNG supplies and the liquidity of hubs are increasing
- Mind-sets: Long-term oil-indexed contracts represent on the one hand secure supply and on the other hand exposure relative to the market price[110]

Konoplaynik is one of the commentators who already discussed the EGIX as a possibility of a gas price indexation tool also in long-term contracts. But he believes, that the EGIX will not represent a justified market price equilibrium 10 to 15 years ahead.[111]

The major points of my analysis were as follows:

- Market prices have lower peaks than oil-indexed prices
- Market prices peak around 3 months earlier than the oil-indexed prices
- Market prices fall lower than oil-indexed prices when it comes to negative peaks
- Russian long-term contracts favour the supply side
- Oil prices respond fastest to market situations, closely followed by gas market prices, the oil-indexed gas price takes the longest to react
- The gas MWh is generally cheaper than the oil MWh, prices are decoupling, ratio stabilizes

[110] cf. Stern (2009) and Stern, Rogers (2011)

[111] cf. Konoplaynik, Andrey (2011), slide 15

- Oil and gas prices are at the moment decoupling
- Gas prices are highly volatile, the market price is more volatile than the long-term oil-indexed price
- Russian oil-indexed gas prices are not correlated to crude oil prices
- EGIX has a positive correlation with the crude oil market price and with Russian oil-indexed gas prices
- EGIX is not widely influenced by the Brent oil price series
- Russian long-term delivery prices are hardly influenced by gas market prices

If I now contrast my findings with Jonathan Stern I can state the following:

The oil-indexation in Russian long-term contracts with Europe does by far not fully reflect true market situations. The market is around three months ahead of the oil-indexed prices, which I believe has its roots in the regular renegotiation rounds. Additionally the existing contracts favour the supply side in a way that the price peaks upwards stronger than the market and downward prices stay higher than market prices. So generally Stern is on the right track when he says that the current pricing formula for long-term gas contracts does not reflect market situations. When it comes to the correlation between oil and gas prices in general, my data cannot fully prove Stern's assumptions. In his latest paper he believes that a correlation does not exist at all. It is true that at the time writing there is a decoupling process going on, but my findings also showed positive correlations of gas market prices with crude oil market prices. So on the basis of my data a strict decoupling cannot be proved. When it comes to volatility Stern is right. Gas prices are generally highly volatile and market prices have an even higher volatility than long-term prices. That oil-indexed gas prices of Russian long-term contracts are not correlated to the crude oil prices might have its roots in the fact that the pricing formula mainly includes fuel oils.
Gas market prices are not significantly influenced by oil market prices and gas market prices are hardly mirrored in Russian long-term delivery prices. These are actually my most important findings. I observed a decoupling of oil and gas prices in the recent years and I showed that gas prices are not dependent on oil prices as much as Russia's pricing formula does not reflect given gas market situations. All of those findings are of course just true for the time period of 2008 until March 2012 and lack an additional Granger causality test. Now, when Stern says that the oil-link for

gas prices is not logical anymore he seems to be right. In order to increase the reflection of true market situations long-term contracts should include a certain index that reflects market situations in the gas market in the pricing formula. If this index should be EGIX or not is a different question. A turn to market implications will lead to advantages for the demand side compared to the current situation. Prices fall lower and also peak lower in the market so the supply side would be worse off and most probably start to influence the markets via strategically volume setting. This might imply a dangerous situation for supply security.

If now think this analysis one step further assuming that the Ukraine would face a European netback price for gas supply we would see relatively volatile pricing dynamics which implies a certain form of instability and might lead to new geopolitical games. So a netback of European long-term prices indexed via market prices to Ukraine might bear a higher risk of transit games. On the other hand markets seem to be more buyer friendly than the existing long-term contract so with lower import costs Ukraine might also be able to purchase a certain degree of political freedom, as it does not have to repay debts barter style. This is especially interesting taking into consideration that Russia's ultimate barter with the Ukraine might be taking passion of the transit network.

The EGIX itself is a very young tool in order to mirror given market situations but as my analysis showed it has the potential to do so. The main question that will remain is the low churn rate that it is based on. Yes, EGIX showed in this analysis that the dynamics at spot markets for natural gas are indeed different than in the oil market but how realistically does it reflect the true market situations as it is based on just a rather small percentage of the whole market. And how much is it in danger to be influenced by price and volume setting activities from the supply side? Those questions can just be addressed after a certain period of development for the EGIX. In a few years it might be possible to examine the true relevance of the EGIX based on the market share of the EEX spot market.

Table 6.14 sums up my findings and picture them contrasted with official EGIX statements issued by the EEX and Jonathan Stern's main points.

EEX[112]	Stern[113]	Hochreiner
EGIX is free and publicly available	Oil-linked pricing is not logical	Russian oil-indexed prices are generally higher than EGIX prices, EGIX would be more demand friendly
Transparent, recognised monitoring	No correlation between oil- and gas prices	Oil and gas prices are decoupling
Gives market prices	Market volatility is too high for oil-indexed prices	Oil/gas price ratio is stabilizing
Potential to replace oil-link in long-term contracts	Possibility of a volume setting gas OPEC	Generally upward moving oil prices
Strengthens consumer confidence in gas prices	Insufficient churn rates at European hubs	Oil-indexed prices respond three months later than EGIX to market situations
		Gas energy unit is cheaper than oil energy unit
		EGIX has a higher volatility than oil-indexed prices
		The spread between min. and max. prices for the given price series is bigger for oil-indexed prices
		Russian oil-indexed gas and EGIX are correlated
		Russian long-term prices are hardly influenced by EGIX market prices
		EGIX market price does not mirror oil market prices

[112] cf. Stern (2009) and Stern, Rogers (2011)

[113] cf. EEX, 2011, p.1 and Menzel, Hans-Bernd, 2011, slides 7-8

		Churn rates at European hubs are still rather small and give just a small market share which can not represent the whole market
		European hubs do not have safety measures to prevent manipulation by an oligopolistic supply side

Table 6.14: EEX and Jonathan Stern contrasted with the findings of this paper

7. Conclusion

Within this thesis I followed three main objectives:

- Up-to-date overview on the Russian-European gas import-export relationship including the Ukraine as a transit country and gas price dynamics
- Statistical examination of the implications that a shift from oil-indexed to market-indexed pricing formulas in Russian long-term contracts with Europe could have based on specific data sets of price dynamics
- Possible Advantages and disadvantages of EGIX as a suggested indexation tool for Russian long-term gas supply to Europe

The first part of the thesis was a descriptive part based on acclaimed authors and commentators in order too answer research question number one. Based on the most relevant literature available I tried to draw a consolidated picture on the gas supply relations between Russia and Europe including the externality of the most important transit country Ukraine. This part culminated in the description of gas pricing and its mechanisms. The overview started out with a description of the use of barter agreements in the post-Soviet times as a payment method. Barter payments were step by step abandoned and replaced by monetary payment methods. Russia turned out to have basically three major markets: the domestic market, the CIS market and the European market. As Gazprom is a state-owned entity with massive market power natural gas is used in the home market as a political subsidy for the domestic industry and domestic people. No surprise that Gazprom does not make revenues in its home market. In that sense the European market and the deliveries to Europe are from great relevance as prices are much higher on the exports than on domestic supply and therefore generate the needed revenues and profits for Gazprom. Step by step net backed European prices are also to be introduced for deliveries to CIS countries like Ukraine and Belorussia in order to generate additional profits. So in this way Gazprom and gas deliveries are used as a political and a strategical tool by Russia. One of the big challenges for Gazprom however is to find the right exploration path for new natural gas resources in order to meet the Russian natural gas balance.
On the European side it can be stated that demand for gas is steadily increasing and that Europe shows a dependence on Russian gas supply, which differs country wise.

The Ukraine has a very difficult post-Soviet gas relationship with Russia. Starting out with barter agreements in order to clear gas debts Russia meanwhile follows a strong agenda of raising prices to European netback. Russia's real goal however seems to be again political. Russia wants to obtain the transit network of the Ukraine and therefore sets heavy pressure on the country. Ukraine on the other side is also willing to use the transit network as a geopolitical tool. This lead to the gas wars of 2006 and 2009. The relationship between Russia and the Ukraine is also very dependent on the political climate in the Ukraine. At the time of writing we face a very pro Russian atmosphere leading to discounts in gas pricing for the Ukraine. Ukraine's major problems are the gas dependence on Russia and the inefficient use of gas. So in order to stabilize the situation Ukraine would have to technically increase the efficiency of its gas use and to find new resources to deplete. As the gas reserves on Ukraine soil are very modest coal might be a potential substitute. Anyway, this is a question of long run and free to further investigation.

The link between the theoretical part of my thesis and the practical analysis is gas pricing. As the theoretical part gave an overview on political and geopolitical implications of gas prices as a next step I introduced the theoretical background of gas pricing. I started out by a brief introduction to the replacement value and followed the way via theoretical links of gas pricing to concepts like *Ricardian Rent, Hotelling Theorem and Principal-Agent Theory* to the contracting practice in Russian long-term supply contracts to Europe including an exemplified pricing formula. Additionally I featured I possible netback pricing formula for Ukraine prices.

In order to link the theoretical background with the idea of market pricing the development of European gas hubs and the relevance of LNG was introduced. The technical necessities of LNG production are met more and more and therefore also the churn rates of European natural gas hubs, which are mostly served via LNG, are increasing. Anyway the churn rates are still very small in order to serve as a real significant gas market.

The empirical part of the thesis added new input to Jonathan Stern's ideas of linking long-term gas prices to a certain market index. For the purpose of testing Stern's propositions the I used the price series relatively new EGIX as vehicle to statistically test some of Stern's assumption and show possible advantages and disadvantages that the use of EGIX is the derivative for long/term contracts with Russia could have. The outcome is many-folded:

- Russian oil-indexed prices are generally higher than EGIX prices, EGIX would be more demand friendly
- Oil and gas prices are decoupling at the moment of writing this paper
- Oil/gas price ratio is stabilizing
- Generally upward moving oil prices
- Oil-indexed prices respond three months later than EGIX to market situations
- Gas energy unit is cheaper than oil energy unit
- EGIX has a higher volatility than oil-indexed prices
- The spread between min. and max. prices for the given price series is bigger for oil-indexed prices
- Russian oil-indexed gas and EGIX are correlated
- Russian long-term prices are hardly influenced by EGIX market prices
- EGIX market price does not mirror oil market prices
- Churn rates at European hubs are still rather small and give just a small market share, which can not represent the whole market
- European hubs do not have safety measures to prevent manipulation by an oligopolistic supply side

So on the basis of my data, I can agree to the fact that the oil-indexation does nut fully reflect market prices of natural gas. Furthermore the oil-indexation favours the supply side. On the other hand a decoupling of oil and gas prices seems to take place at the time of writing but it cannot be fully proved on basis of correlations.
To sum up I can state that Stern can be generally supported on basis of the EGIX data when it comes to suggesting that oil-indexation is not market-based pricing. The link between oil and gas prices seems to be in a trend of decoupling. The EGIX might have the potential to become a significant factor in gas-pricing formulas. It seems to reflect the current market, but of course just based on a very minor market share. So the question that has to be asked is if the churn rate of the EEX is significant enough in order to publish an index, which is supposed to serve as a derivative for the whole market. Additionally instruments in order to prevent EGIX market manipulations are vacant at the time writing. It is of course to young in order to function as a significant instrument and also it reflects just a little market share at the time of writing, but it should be under further investigation.

When it comes to risks of hub-based pricing it should be taken under consideration that the gas supply side is more or less an oligopoly consisting of few major players, which might have an incentive to manipulate the market to their favour, so for further investigation the author suggests the following question:

- *The churn rate of European gas hubs is generally low. How would a change to market-indexed pricing based on hubs with low liquidity be a victim to the formation of a kind of gas OPEC, which would be able to manipulate the market via volumes or price setting?*

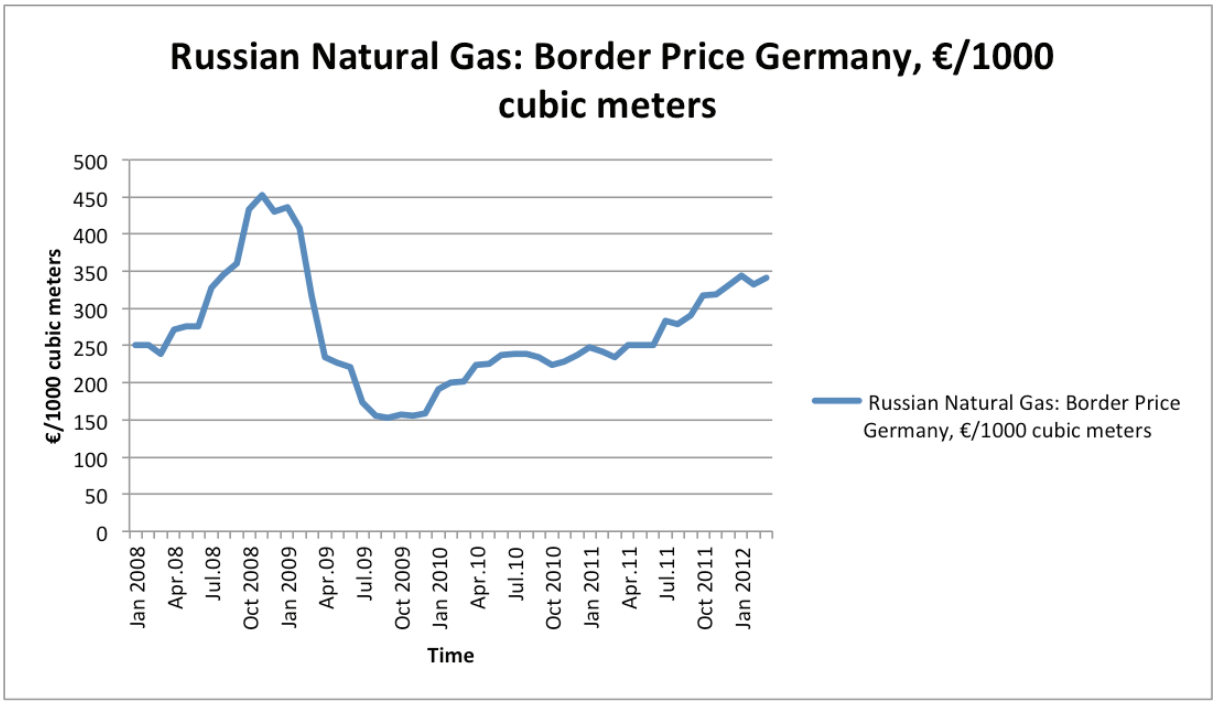
8. Appendix

8.1. List of conversions for chapter 6.2

1 barrel of oil equivalent = 1,6995 MWh[114]

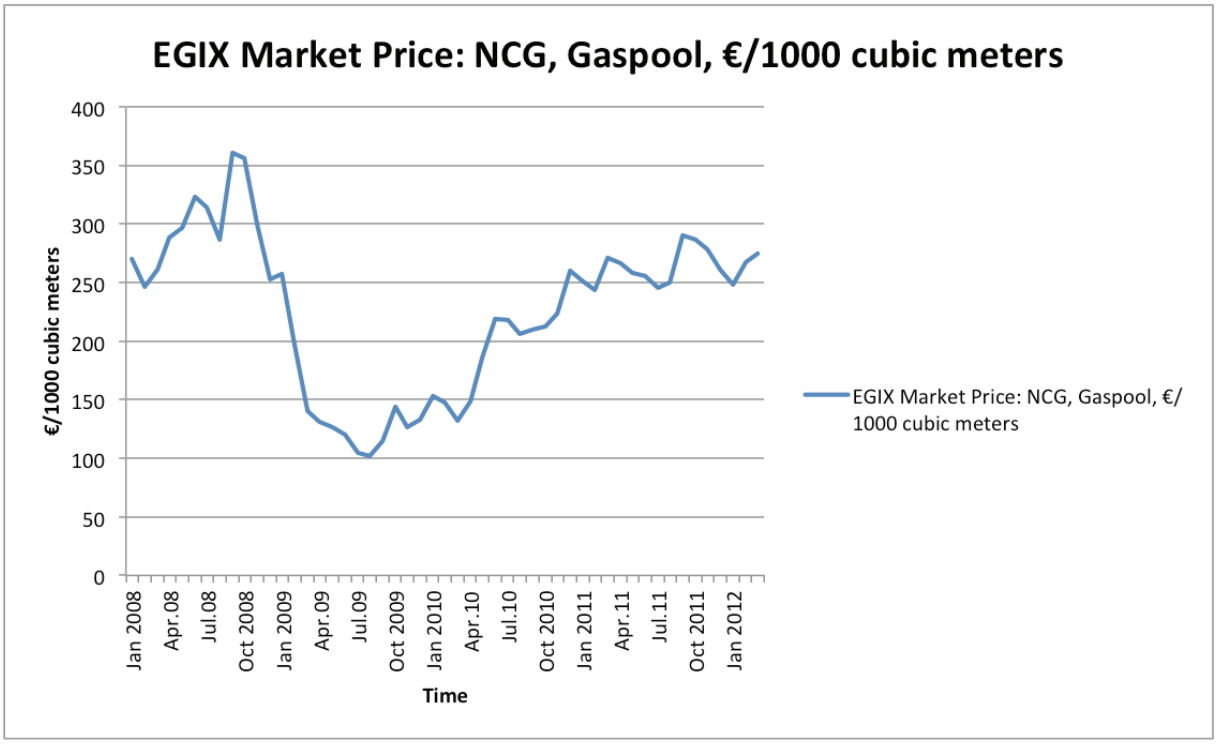
€/MWh = 11,164 €/1000 cubic meter (based on: 1bcm=11.164.000 MWh)

8.2. Additional graphs and tables for chapter 6.2

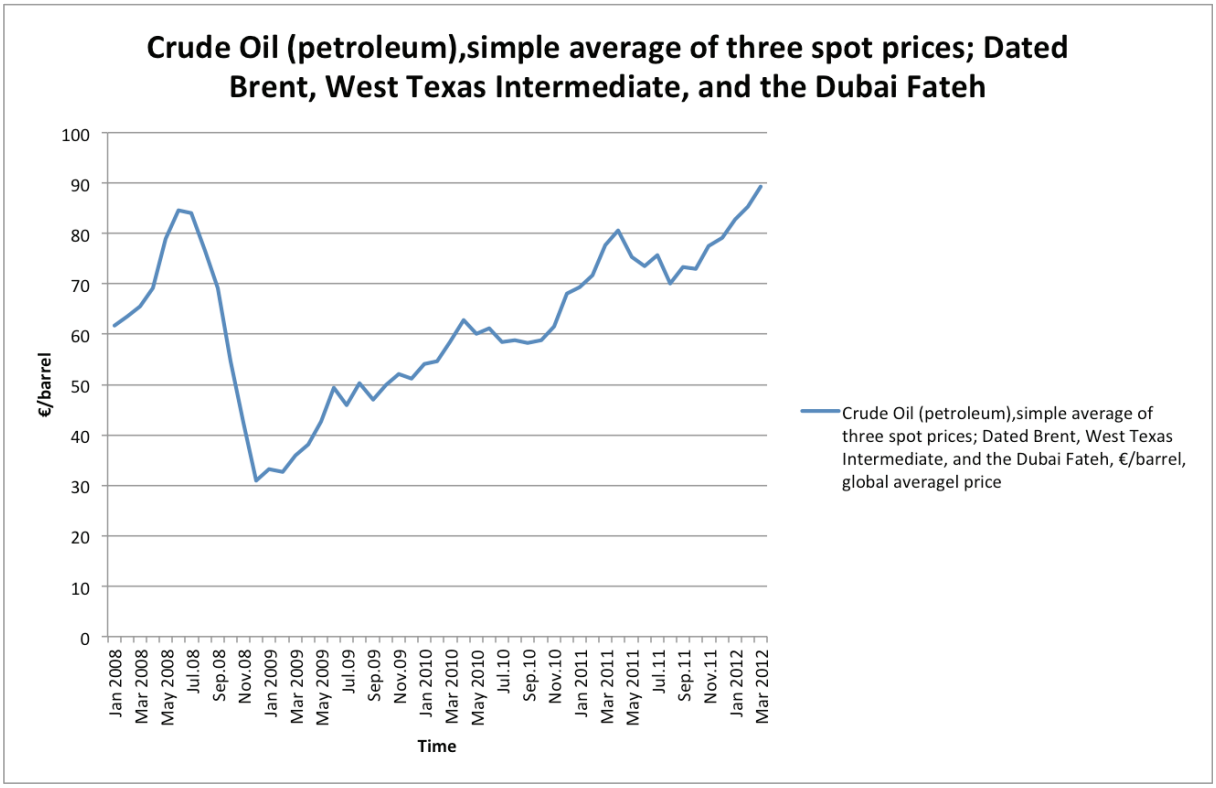


Graph 8.1: Russian natural gas long-term supply price, border price Germany (€/1000 cubic meters), 2008-2012

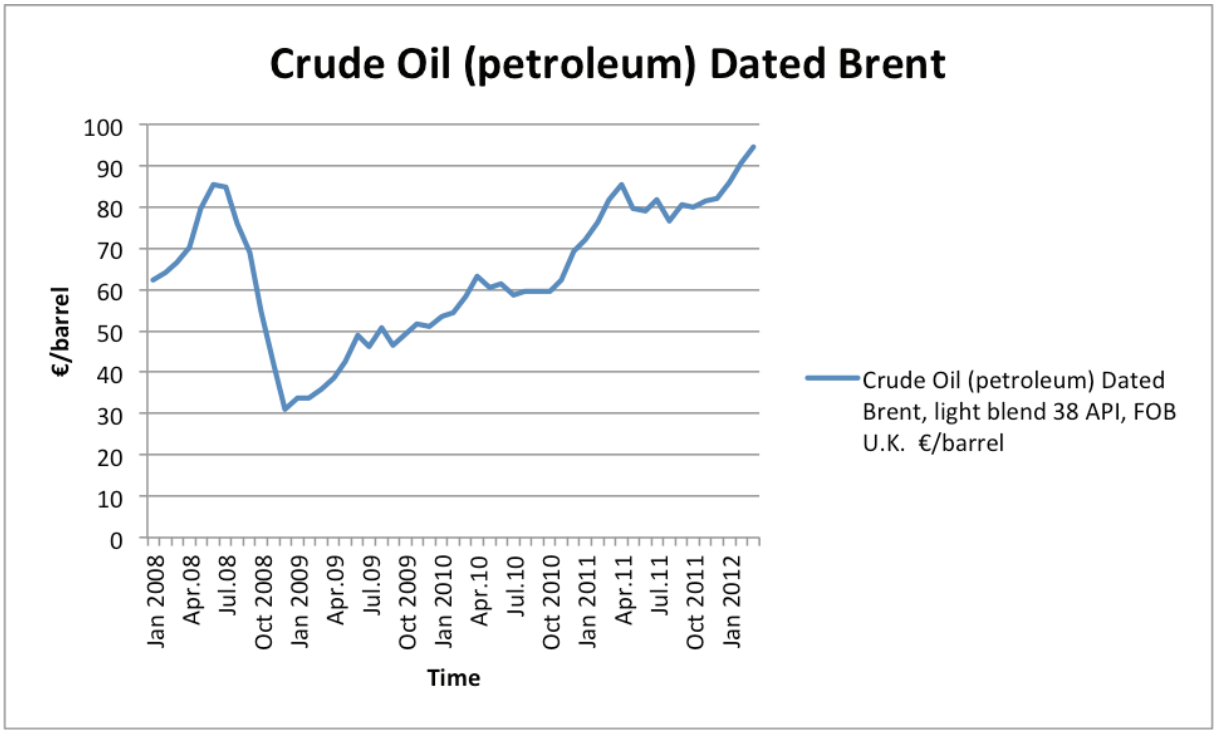
[114] http://www.conversion-website.com/energy/barrel_of_oil_equivalent_to_megawatt_hour.html, 17.6.2012



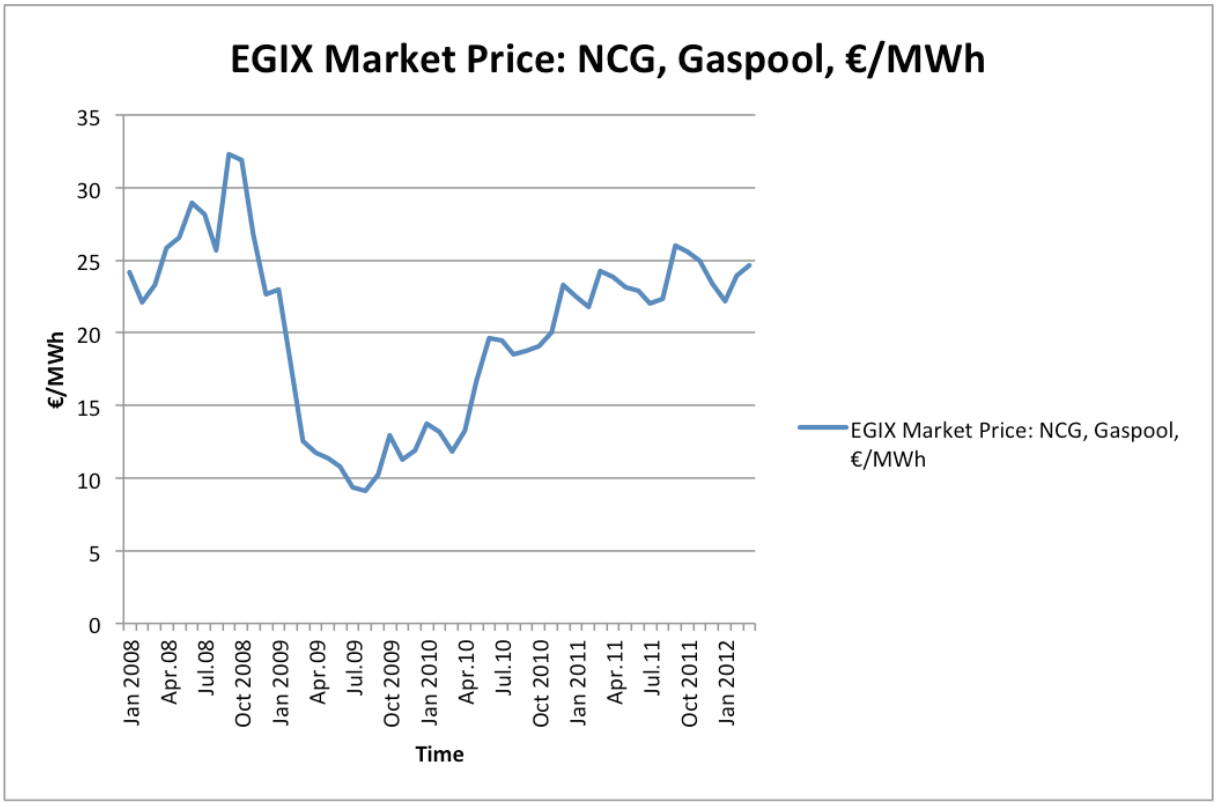
Graph 8.2: EGIX (€/1000 cubic meters), 2008-2012



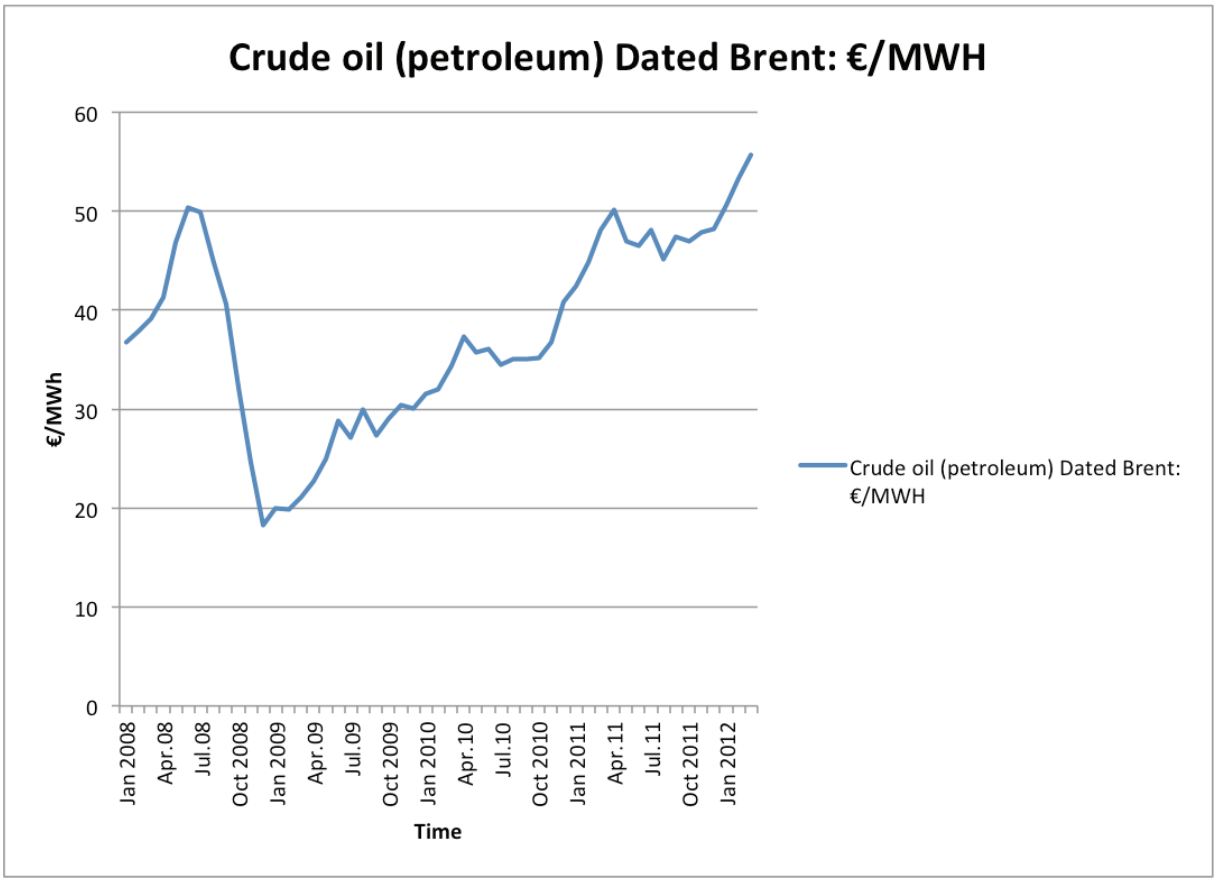
Graph 8.3: Crude oil world average price (€/barrel), 2008-2012



Graph 8.4: Dated Brent (€/barrel), monthly 2008-2012



Graph 8.5: EGIX (€/MWh), 2008-2012



Graph 8.6: Dated Brent, (€/MWh), 2008-2012

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Brent_daily	1061	63,8889	16,76204	,51460

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Brent_daily	124,153	1060	,000	63,88891	62,8792	64,8987

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Brent_daily	1061	23,94	98,14	63,8889	16,76204
Valid N (listwise)	1061				

Table 8.1: Dated Brent, daily (€/MWh), descriptive statistics and t-test

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Russia_pipe	51	268,6986	76,05329	10,64959
EGIX_market	51	225,8154	68,65355	9,61342
Oil_world	51	62,3296	15,15508	2,12214
Oil_brent	51	63,9908	16,66988	2,33425
EGIX_MWh	51	20,2216	6,14812	,86091
Brent_MWh	51	37,6549	9,80927	1,37357

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Russia_pipe	25,231	50	,000	268,69863	247,3083	290,0890
EGIX_market	23,490	50	,000	225,81539	206,5063	245,1245
Oil_world	29,371	50	,000	62,32961	58,0672	66,5920
Oil_brent	27,414	50	,000	63,99078	59,3023	68,6793
EGIX_MWh	23,489	50	,000	20,22161	18,4924	21,9508
Brent_MWh	27,414	50	,000	37,65493	34,8960	40,4138

Table 8.2: Russian natural gas long-term supply price (€/1000 cubic meters), EGIX (€/1000 cubic meters), Average oil world price (€/barrel), Dated Brent (€/barrel), EGIX (€/MWh), dated Brent (€/MWh), T-test

8.3. $/€ conversion for the Dated Brent daily, graph 6.4

Conversion series taken from:
http://www.finanz-links.de/waehrung/historische-devisenkurse.htm

8.4. Data set Brent daily, graph 6.4

Date	€/$ Exchange rate	Time series Brent crude oil spot price daily $/barrel	Time series Brent crude oil spot price daily €/barrel
02-Jan-2008	1,47	97	66,04
03-Jan-2008	1,48	98	66,43
04-Jan-2008	1,47	96	65,19
07-Jan-2008	1,47	94,19	63,97
08-Jan-2008	1,47	96,37	65,54
09-Jan-2008	1,47	96,76	65,91
10-Jan-2008	1,47	92,8	63,29
11-Jan-2008	1,48	91,86	62,10
14-Jan-2008	1,49	92,58	62,16
15-Jan-2008	1,49	90,87	61,04
16-Jan-2008	1,48	88,1	59,56
17-Jan-2008	1,47	88,96	60,55
18-Jan-2008	1,47	89,66	61,10
22-Jan-2008	1,45	88,11	60,79
23-Jan-2008	1,46	87,06	59,74
24-Jan-2008	1,47	87,69	59,80
25-Jan-2008	1,47	90,96	61,86
28-Jan-2008	1,48	90,91	61,61
29-Jan-2008	1,48	92,49	62,61
30-Jan-2008	1,48	92,46	62,43
31-Jan-2008	1,49	91,58	61,59
01.Feb.08	1,49	91,41	61,39
04.Feb.08	1,48	91,09	61,43
05.Feb.08	1,47	89,6	61,00
06.Feb.08	1,46	88,73	60,69
07.Feb.08	1,46	88,55	60,78
08.Feb.08	1,45	91,45	63,01
11.Feb.08	1,45	93,93	64,59
12.Feb.08	1,45	94,28	64,85
13.Feb.08	1,46	93,82	64,32
14.Feb.08	1,46	95,92	65,58
15.Feb.08	1,47	96,96	66,08
19.Feb.08	1,47	97,03	65,82
20.Feb.08	1,47	97,88	66,78
21.Feb.08	1,47	97,52	66,18
22.Feb.08	1,48	96,07	64,70
25.Feb.08	1,48	97,43	65,76
26.Feb.08	1,49	99,05	66,59
27.Feb.08	1,50	98,28	65,33
28.Feb.08	1,51	99,83	66,02

29.Feb.08	1,52	100,9	66,53
03-Mar-2008	1,52	101,83	66,98
04-Mar-2008	1,52	98,6	64,84
05-Mar-2008	1,52	100,95	66,43
06-Mar-2008	1,53	103,47	67,54
07-Mar-2008	1,54	104,66	67,89
10-Mar-2008	1,53	105,33	68,66
11-Mar-2008	1,54	106,78	69,43
12-Mar-2008	1,55	107,99	69,77
13-Mar-2008	1,56	109,18	70,09
14-Mar-2008	1,56	109,16	70,15
17-Mar-2008	1,58	104,41	66,21
18-Mar-2008	1,58	105,35	66,80
19-Mar-2008	1,57	102,65	65,42
20-Mar-2008	1,54	99,78	64,70
25-Mar-2008	1,56	99,91	64,17
26-Mar-2008	1,57	102,83	65,46
27-Mar-2008	1,58	103,89	65,81
28-Mar-2008	1,58	102,68	65,00
31-Mar-2008	1,58	102,33	64,72
01.Apr.08	1,57	98,69	63,02
02.Apr.08	1,56	98,85	63,24
03.Apr.08	1,55	102,31	65,90
04.Apr.08	1,57	102,21	65,01
07.Apr.08	1,57	105,98	67,53
08.Apr.08	1,57	105,05	66,94
09.Apr.08	1,57	107,46	68,33
10.Apr.08	1,59	107,37	67,63
11.Apr.08	1,58	107,15	67,68
14.Apr.08	1,59	108,32	68,26
15.Apr.08	1,58	110,84	70,03
16.Apr.08	1,59	110,95	69,66
17.Apr.08	1,59	111,34	70,15
18.Apr.08	1,58	110,67	70,13
21.Apr.08	1,59	111,35	70,04
22.Apr.08	1,59	113,54	71,27
23.Apr.08	1,59	115,34	72,36
24.Apr.08	1,58	114,85	72,83
25.Apr.08	1,56	116,62	74,78
28.Apr.08	1,56	115,7	74,03
29.Apr.08	1,56	113,86	73,12
30.Apr.08	1,55	111,12	71,51
02-May-2008	1,55	111,92	72,40
05-May-2008	1,55	115,68	74,83
06-May-2008	1,55	119,88	77,20
07-May-2008	1,54	120,27	77,95

08-May-2008	1,53	119,85	78,09
09-May-2008	1,55	123,54	79,92
12-May-2008	1,54	122,89	79,64
13-May-2008	1,55	123,11	79,56
14-May-2008	1,54	121,18	78,49
15-May-2008	1,55	122,76	79,33
16-May-2008	1,55	122,98	79,35
19-May-2008	1,56	122,19	78,44
20-May-2008	1,56	124,12	79,37
21-May-2008	1,58	127,28	80,80
22-May-2008	1,58	129,04	81,90
23-May-2008	1,57	129,72	82,40
27-May-2008	1,58	128,92	81,80
28-May-2008	1,57	128,93	82,35
29-May-2008	1,56	129,33	83,17
30-May-2008	1,55	127,85	82,44
02.Jun.08	1,55	128,5	82,79
03.Jun.08	1,56	126,28	80,99
04.Jun.08	1,55	121,72	78,70
05.Jun.08	1,54	122,36	79,44
06.Jun.08	1,56	132,81	85,15
09.Jun.08	1,58	134,43	85,17
10.Jun.08	1,55	135,24	87,11
11.Jun.08	1,55	134,52	86,70
12.Jun.08	1,54	132,11	85,69
13.Jun.08	1,53	134,29	87,57
16.Jun.08	1,55	133,9	86,62
17.Jun.08	1,55	131,27	84,82
18.Jun.08	1,55	129,12	83,34
19.Jun.08	1,55	131,84	85,16
20.Jun.08	1,56	134,28	86,02
23.Jun.08	1,55	134,54	86,68
24.Jun.08	1,56	135,37	86,95
25.Jun.08	1,56	131,59	84,36
26.Jun.08	1,57	136,82	86,97
27.Jun.08	1,57	139,38	88,51
30.Jun.08	1,58	138,4	87,79
01.Jul.08	1,58	140,67	89,17
02.Jul.08	1,58	141,24	89,36
03.Jul.08	1,59	143,95	90,62
07.Jul.08	1,57	139,62	89,21
08.Jul.08	1,57	134,15	85,52
09.Jul.08	1,57	133,91	85,21
10.Jul.08	1,57	135,81	86,46
11.Jul.08	1,58	143,68	90,74
14.Jul.08	1,58	142,43	89,88

15.Jul.08	1,60	136,02	85,07
16.Jul.08	1,59	133,31	83,91
17.Jul.08	1,58	134,16	84,65
18.Jul.08	1,58	129,34	81,78
21.Jul.08	1,59	129,34	81,56
22.Jul.08	1,59	127,18	79,89
23.Jul.08	1,57	126,86	80,59
24.Jul.08	1,57	125,43	80,01
25.Jul.08	1,57	124,7	79,26
28.Jul.08	1,57	125,67	79,81
29.Jul.08	1,57	125,77	80,08
30.Jul.08	1,56	122,46	78,56
31.Jul.08	1,56	124,1	79,50
01.Aug.08	1,56	124,16	79,72
04.Aug.08	1,56	121,87	78,29
05.Aug.08	1,55	116,5	75,22
06.Aug.08	1,55	114,47	73,96
07.Aug.08	1,55	116,94	75,59
08.Aug.08	1,51	113,03	74,98
11.Aug.08	1,50	110,54	73,63
12.Aug.08	1,49	108,98	73,11
13.Aug.08	1,49	110,68	74,27
14.Aug.08	1,49	111,82	75,01
15.Aug.08	1,47	108,8	73,87
18.Aug.08	1,47	109,33	74,35
19.Aug.08	1,47	109,02	74,28
20.Aug.08	1,47	108,72	73,79
21.Aug.08	1,48	117,24	79,14
22.Aug.08	1,48	113,99	76,98
25.Aug.08	1,48	109,74	74,31
26.Aug.08	1,46	112,2	76,86
27.Aug.08	1,48	113,05	76,56
28.Aug.08	1,48	113,54	76,87
29.Aug.08	1,47	113,49	77,02
02.Sep.08	1,45	104,94	72,29
03.Sep.08	1,44	103,88	71,93
04.Sep.08	1,45	103,41	71,38
05.Sep.08	1,42	102,51	71,95
08.Sep.08	1,42	101,08	71,11
09.Sep.08	1,41	98,94	69,95
10.Sep.08	1,41	96	68,11
11.Sep.08	1,39	96,01	68,90
12.Sep.08	1,41	94,37	67,09
15.Sep.08	1,42	90,45	63,92
16.Sep.08	1,43	85,85	60,17
17.Sep.08	1,42	86,09	60,52

18.Sep.08	1,45	90,89	62,67
19.Sep.08	1,42	93,46	65,65
22.Sep.08	1,46	100,43	68,92
23.Sep.08	1,47	100,72	68,37
24.Sep.08	1,47	102,09	69,50
25.Sep.08	1,47	100,45	68,33
26.Sep.08	1,46	100,88	68,91
29.Sep.08	1,43	95,96	66,88
30.Sep.08	1,43	93,52	65,38
01-Oct-2008	1,41	92,19	65,47
02-Oct-2008	1,39	88,88	63,93
03-Oct-2008	1,38	88,95	64,30
06-Oct-2008	1,36	84,71	62,13
07-Oct-2008	1,36	83,17	61,01
08-Oct-2008	1,37	80,77	58,82
09-Oct-2008	1,37	81,65	59,68
10-Oct-2008	1,36	74,58	54,92
13-Oct-2008	1,36	74,37	54,53
14-Oct-2008	1,38	74,98	54,52
15-Oct-2008	1,36	66,86	49,07
16-Oct-2008	1,35	64,14	47,49
17-Oct-2008	1,34	66,05	49,28
20-Oct-2008	1,34	67,45	50,25
21-Oct-2008	1,32	65,99	50,05
22-Oct-2008	1,28	62,95	49,02
23-Oct-2008	1,28	65,06	50,79
24-Oct-2008	1,26	60,57	48,09
27-Oct-2008	1,25	59,34	47,62
28-Oct-2008	1,25	58,87	47,00
29-Oct-2008	1,28	64	50,12
30-Oct-2008	1,30	60,86	46,69
31-Oct-2008	1,28	60	47,03
03.Nov.08	1,28	60,32	47,04
04.Nov.08	1,28	62,78	48,97
05.Nov.08	1,29	61,09	47,47
06.Nov.08	1,28	56,14	43,96
07.Nov.08	1,28	56,84	44,56
10.Nov.08	1,29	57,08	44,28
11.Nov.08	1,27	54,76	42,96
12.Nov.08	1,25	52,47	41,88
13.Nov.08	1,25	51,32	40,97
14.Nov.08	1,27	50,7	40,00
17.Nov.08	1,27	50,82	40,14
18.Nov.08	1,27	49,1	38,81
19.Nov.08	1,26	48,35	38,27
20.Nov.08	1,25	45,79	36,51

21.Nov.08	1,26	44,91	35,64
24.Nov.08	1,28	49,51	38,76
25.Nov.08	1,28	47,51	37,09
26.Nov.08	1,29	49,39	38,18
28.Nov.08	1,27	47,72	37,50
01-Dec-2008	1,26	47,58	37,74
02-Dec-2008	1,27	45,64	35,95
03-Dec-2008	1,26	44,39	35,17
04-Dec-2008	1,26	43,83	34,73
05-Dec-2008	1,27	37,04	29,25
08-Dec-2008	1,29	40,02	31,13
09-Dec-2008	1,28	39,77	30,98
10-Dec-2008	1,29	39,34	30,44
11-Dec-2008	1,32	43,54	32,95
12-Dec-2008	1,33	42,38	31,77
15-Dec-2008	1,35	45,02	33,32
16-Dec-2008	1,37	42	30,68
17-Dec-2008	1,41	41,84	29,76
18-Dec-2008	1,46	40,19	27,50
19-Dec-2008	1,39	39,52	28,35
22-Dec-2008	1,40	38,08	27,26
23-Dec-2008	1,40	35,27	25,23
24-Dec-2008	1,40	34,45	24,60
29-Dec-2008	1,43	34,16	23,94
30-Dec-2008	1,41	35,22	24,98
31-Dec-2008	1,39	35,82	25,74
02-Jan-2009	1,39	42,94	30,97
05-Jan-2009	1,36	45,84	33,75
06-Jan-2009	1,33	48,89	36,67
07-Jan-2009	1,36	46,23	34,01
08-Jan-2009	1,36	42,94	31,53
09-Jan-2009	1,37	42,34	30,94
12-Jan-2009	1,34	40,86	30,51
13-Jan-2009	1,33	43,05	32,46
14-Jan-2009	1,32	42,27	32,09
15-Jan-2009	1,31	42,32	32,34
16-Jan-2009	1,33	43,42	32,72
20-Jan-2009	1,29	41,22	31,88
21-Jan-2009	1,29	39,9	30,91
22-Jan-2009	1,30	42,42	32,67
23-Jan-2009	1,28	43,13	33,71
26-Jan-2009	1,30	48	36,95
27-Jan-2009	1,32	42,86	32,53
28-Jan-2009	1,33	42,86	32,32
29-Jan-2009	1,31	43,13	32,90
30-Jan-2009	1,28	44,17	34,46

02.Feb.09	1,28	42,96	33,67
03.Feb.09	1,28	43,15	33,58
04.Feb.09	1,28	43,68	34,08
05.Feb.09	1,28	43,92	34,23
06.Feb.09	1,28	44,49	34,77
09.Feb.09	1,30	47,23	36,31
10.Feb.09	1,30	45,88	35,38
11.Feb.09	1,29	44,24	34,19
12.Feb.09	1,28	47,23	36,80
13.Feb.09	1,28	43,36	33,81
17.Feb.09	1,26	39,69	31,42
18.Feb.09	1,26	39,41	31,29
19.Feb.09	1,27	42,36	33,34
20.Feb.09	1,26	42,19	33,51
23.Feb.09	1,28	41,27	32,25
24.Feb.09	1,28	40,18	31,48
25.Feb.09	1,28	42,37	33,11
26.Feb.09	1,28	45,15	35,32
27.Feb.09	1,26	44,41	35,12
02-Mar-2009	1,26	42,6	33,82
03-Mar-2009	1,26	42,72	33,86
04-Mar-2009	1,26	46,07	36,69
05-Mar-2009	1,26	44,45	35,40
06-Mar-2009	1,27	43,48	34,35
09-Mar-2009	1,26	44,55	35,46
10-Mar-2009	1,28	44,99	35,20
11-Mar-2009	1,28	43,2	33,79
12-Mar-2009	1,28	42,19	33,01
13-Mar-2009	1,29	44,97	34,85
16-Mar-2009	1,30	44,12	33,83
17-Mar-2009	1,29	45,53	35,18
18-Mar-2009	1,31	45,22	34,44
19-Mar-2009	1,37	48,03	35,13
20-Mar-2009	1,35	49,27	36,36
23-Mar-2009	1,36	51,84	38,24
24-Mar-2009	1,35	51,32	38,00
25-Mar-2009	1,35	51,46	38,14
26-Mar-2009	1,36	51,89	38,13
27-Mar-2009	1,33	50,81	38,22
30-Mar-2009	1,32	49,05	37,18
31-Mar-2009	1,33	46,13	34,66
01.Apr.09	1,32	45,92	34,67
02.Apr.09	1,34	50,89	38,00
03.Apr.09	1,34	50,48	37,60
06.Apr.09	1,35	50,91	37,72
07.Apr.09	1,33	50,62	38,19

08.Apr.09	1,32	52,06	39,35
09.Apr.09	1,33	52,33	39,43
14.Apr.09	1,33	52,06	39,21
15.Apr.09	1,32	51,31	38,95
16.Apr.09	1,32	51,83	39,28
17.Apr.09	1,31	52,02	39,84
20.Apr.09	1,30	49,06	37,84
21.Apr.09	1,29	48,69	37,65
22.Apr.09	1,29	48,5	37,46
23.Apr.09	1,31	48,29	37,00
24.Apr.09	1,32	50,29	38,01
27.Apr.09	1,31	48,67	37,08
28.Apr.09	1,30	48,64	37,44
29.Apr.09	1,33	50,22	37,86
30.Apr.09	1,33	50,3	37,89
04-May-2009	1,32	53,26	40,28
05-May-2009	1,34	53,16	39,66
06-May-2009	1,33	55,07	41,34
07-May-2009	1,34	56,63	42,38
08-May-2009	1,34	56,02	41,73
11-May-2009	1,36	55,99	41,25
12-May-2009	1,37	56,52	41,31
13-May-2009	1,36	56,84	41,72
14-May-2009	1,36	56,25	41,47
15-May-2009	1,35	56,33	41,67
18-May-2009	1,35	56,51	41,88
19-May-2009	1,36	57,12	41,96
20-May-2009	1,37	59,1	43,17
21-May-2009	1,38	58,02	42,13
22-May-2009	1,40	58,7	42,01
26-May-2009	1,39	59,05	42,46
27-May-2009	1,39	61,28	44,08
28-May-2009	1,39	63,47	45,81
29-May-2009	1,41	64,98	46,09
01.Jun.09	1,42	66,6	46,84
02.Jun.09	1,42	67,67	47,53
03.Jun.09	1,42	66,15	46,56
04.Jun.09	1,41	67,68	48,02
05.Jun.09	1,42	67,77	47,80
08.Jun.09	1,39	67,61	48,76
09.Jun.09	1,40	68,94	49,39
10.Jun.09	1,41	70,52	50,01
11.Jun.09	1,40	71,71	51,34
12.Jun.09	1,40	70,62	50,43
15.Jun.09	1,39	68,49	49,45
16.Jun.09	1,39	70,52	50,77

17.Jun.09	1,38	68,95	49,82
18.Jun.09	1,39	69,96	50,26
19.Jun.09	1,39	70,48	50,59
22.Jun.09	1,39	66,13	47,72
23.Jun.09	1,40	66,36	47,47
24.Jun.09	1,40	68,47	48,81
25.Jun.09	1,39	68,82	49,37
26.Jun.09	1,41	68,1	48,31
29.Jun.09	1,41	69,75	49,62
30.Jun.09	1,41	68,11	48,19
01.Jul.09	1,41	68,52	48,61
02.Jul.09	1,40	65,74	46,79
06.Jul.09	1,39	63,12	45,42
07.Jul.09	1,40	61,54	43,90
08.Jul.09	1,39	59,71	42,95
09.Jul.09	1,40	59,17	42,29
10.Jul.09	1,39	58,43	42,03
13.Jul.09	1,40	58,25	41,68
14.Jul.09	1,40	60,48	43,23
15.Jul.09	1,41	61,25	43,47
16.Jul.09	1,41	62,02	43,89
17.Jul.09	1,41	63,54	45,10
20.Jul.09	1,42	64,64	45,47
21.Jul.09	1,42	65,93	46,35
22.Jul.09	1,42	65,36	46,06
23.Jul.09	1,42	68,06	47,83
24.Jul.09	1,42	68,82	48,37
27.Jul.09	1,43	69,78	48,90
28.Jul.09	1,42	68,53	48,16
29.Jul.09	1,41	65,79	46,65
30.Jul.09	1,41	68,82	48,97
31.Jul.09	1,41	70,08	49,57
03.Aug.09	1,43	72,9	50,97
04.Aug.09	1,44	73,82	51,32
05.Aug.09	1,44	74,39	51,62
06.Aug.09	1,44	74,61	51,92
07.Aug.09	1,44	74,21	51,69
10.Aug.09	1,42	73,79	51,96
11.Aug.09	1,42	71,58	50,53
12.Aug.09	1,42	74,03	52,24
13.Aug.09	1,43	73,76	51,61
14.Aug.09	1,43	71,33	49,90
17.Aug.09	1,41	68,65	48,78
18.Aug.09	1,41	68,66	48,69
19.Aug.09	1,41	72,81	51,59
20.Aug.09	1,42	73,75	51,78

21.Aug.09	1,43	73,71	51,44
24.Aug.09	1,43	74,34	51,90
25.Aug.09	1,43	73,1	51,03
26.Aug.09	1,43	70,74	49,57
27.Aug.09	1,43	70,68	49,54
28.Aug.09	1,44	72,8	50,68
31.Aug.09	1,43	69,02	48,36
01.Sep.09	1,43	68,78	48,05
02.Sep.09	1,42	67,6	47,54
03.Sep.09	1,43	66,78	46,59
04.Sep.09	1,43	65,84	46,16
08.Sep.09	1,45	69,2	47,81
09.Sep.09	1,45	69,76	48,04
10.Sep.09	1,45	68,96	47,41
11.Sep.09	1,46	68,76	47,12
14.Sep.09	1,46	66,91	45,95
15.Sep.09	1,46	66,53	45,53
16.Sep.09	1,47	68,51	46,70
17.Sep.09	1,47	71,56	48,64
18.Sep.09	1,47	70,72	48,09
21.Sep.09	1,47	68,11	46,47
22.Sep.09	1,48	69,65	47,12
23.Sep.09	1,48	67,43	45,61
24.Sep.09	1,48	64,99	44,01
25.Sep.09	1,47	64,6	44,04
28.Sep.09	1,47	65,43	44,66
29.Sep.09	1,45	64,63	44,42
30.Sep.09	1,46	65,82	44,95
01-Oct-2009	1,45	67,12	46,17
02-Oct-2009	1,45	66,5	45,75
05-Oct-2009	1,46	65,26	44,65
06-Oct-2009	1,47	68,51	46,54
07-Oct-2009	1,47	67,65	46,04
08-Oct-2009	1,48	68,47	46,38
09-Oct-2009	1,48	69,45	47,08
12-Oct-2009	1,48	70,75	47,92
13-Oct-2009	1,49	70,81	47,64
14-Oct-2009	1,49	72,16	48,49
15-Oct-2009	1,49	73,14	49,21
16-Oct-2009	1,49	74,58	50,16
19-Oct-2009	1,49	75,86	50,85
20-Oct-2009	1,50	76,51	51,11
21-Oct-2009	1,49	77,74	52,10
22-Oct-2009	1,50	78,36	52,24
23-Oct-2009	1,50	77,72	51,74
26-Oct-2009	1,50	76,45	50,90

27-Oct-2009	1,49	76,69	51,56
28-Oct-2009	1,48	75,11	50,80
29-Oct-2009	1,48	77,18	52,19
30-Oct-2009	1,48	74,91	50,61
02.Nov.09	1,48	75,56	51,15
03.Nov.09	1,47	75,68	51,63
04.Nov.09	1,48	78,21	52,98
05.Nov.09	1,49	78,02	52,48
06.Nov.09	1,49	75,51	50,81
09.Nov.09	1,50	77,18	51,51
10.Nov.09	1,50	77,07	51,50
11.Nov.09	1,50	76,99	51,20
12.Nov.09	1,49	75,18	50,38
13.Nov.09	1,49	74,81	50,32
16.Nov.09	1,50	77,14	51,55
17.Nov.09	1,49	77,36	52,01
18.Nov.09	1,50	78,64	52,58
19.Nov.09	1,49	76,45	51,44
20.Nov.09	1,48	75,61	51,04
23.Nov.09	1,50	78,14	52,20
24.Nov.09	1,50	75,35	50,34
25.Nov.09	1,51	76,57	50,77
27.Nov.09	1,49	76	50,95
30.Nov.09	1,50	77,77	51,77
01-Dec-2009	1,51	78,68	52,20
02-Dec-2009	1,51	76,96	51,00
03-Dec-2009	1,51	77,76	51,43
04-Dec-2009	1,51	77,74	51,59
07-Dec-2009	1,48	76,18	51,52
08-Dec-2009	1,48	74,93	50,72
09-Dec-2009	1,48	73,63	49,86
10-Dec-2009	1,47	70,91	48,14
11-Dec-2009	1,48	70,07	47,48
14-Dec-2009	1,46	71,19	48,60
15-Dec-2009	1,45	71,33	49,05
16-Dec-2009	1,46	73,34	50,37
17-Dec-2009	1,43	71,28	49,70
18-Dec-2009	1,43	71,87	50,13
21-Dec-2009	1,44	72,74	50,63
22-Dec-2009	1,43	71,64	50,17
23-Dec-2009	1,43	73,87	51,74
24-Dec-2009	1,44	75,15	52,19
28-Dec-2009	1,44	76,59	53,17
29-Dec-2009	1,44	76,65	53,11
30-Dec-2009	1,43	77,62	54,14
31-Dec-2009	1,44	77,91	54,08

04-Jan-2010	1,44	79,05	54,94
05-Jan-2010	1,44	79,27	54,89
06-Jan-2010	1,44	80,14	55,85
07-Jan-2010	1,43	80,57	56,33
08-Jan-2010	1,43	80,06	56,09
11-Jan-2010	1,45	80,14	55,16
12-Jan-2010	1,45	79,38	54,82
13-Jan-2010	1,46	77,57	53,27
14-Jan-2010	1,45	77,61	53,58
15-Jan-2010	1,44	76,85	53,46
19-Jan-2010	1,43	75,18	52,65
20-Jan-2010	1,41	75,09	53,13
21-Jan-2010	1,41	74,13	52,71
22-Jan-2010	1,41	72,73	51,45
25-Jan-2010	1,42	72,18	51,01
26-Jan-2010	1,41	72,63	51,57
27-Jan-2010	1,41	72,75	51,70
28-Jan-2010	1,40	70,65	50,47
29-Jan-2010	1,40	71,2	50,98
01.Feb.10	1,39	71,58	51,45
02.Feb.10	1,39	73,94	53,05
03.Feb.10	1,40	75,77	54,18
04.Feb.10	1,38	71,3	51,49
05.Feb.10	1,37	70,11	51,21
08.Feb.10	1,37	69,62	50,91
09.Feb.10	1,38	70,4	51,16
10.Feb.10	1,37	70,4	51,24
11.Feb.10	1,37	72,35	52,74
12.Feb.10	1,36	71,49	52,67
16.Feb.10	1,36	74,82	54,82
17.Feb.10	1,37	74,89	54,56
18.Feb.10	1,36	76,61	56,47
19.Feb.10	1,35	76,88	56,87
22.Feb.10	1,36	76,95	56,47
23.Feb.10	1,36	76,44	56,30
24.Feb.10	1,35	77	56,84
25.Feb.10	1,35	74,38	55,14
26.Feb.10	1,36	76,36	56,27
01-Mar-2010	1,35	76,07	56,24
02-Mar-2010	1,35	77,5	57,20
03-Mar-2010	1,36	78,66	57,66
04-Mar-2010	1,37	77,88	56,98
05-Mar-2010	1,36	79,2	58,31
08-Mar-2010	1,37	78,94	57,78
09-Mar-2010	1,36	78,77	58,10
10-Mar-2010	1,36	80,29	58,99

11-Mar-2010	1,37	79,44	58,17
12-Mar-2010	1,38	79,38	57,67
15-Mar-2010	1,37	77,08	56,24
16-Mar-2010	1,37	79,45	57,90
17-Mar-2010	1,38	80,28	58,36
18-Mar-2010	1,37	80,09	58,63
19-Mar-2010	1,35	78,37	57,85
22-Mar-2010	1,35	78,09	57,97
23-Mar-2010	1,35	79,17	58,56
24-Mar-2010	1,33	78,03	58,50
25-Mar-2010	1,34	78,64	58,88
26-Mar-2010	1,34	77,98	58,40
29-Mar-2010	1,35	79,89	59,31
30-Mar-2010	1,35	79,46	58,94
31-Mar-2010	1,35	80,37	59,63
01.Apr.10	1,35	82,63	61,35
06.Apr.10	1,34	85,05	63,49
07.Apr.10	1,33	84,49	63,34
08.Apr.10	1,33	82,63	62,15
09.Apr.10	1,34	82,77	61,84
12.Apr.10	1,36	85,21	62,72
13.Apr.10	1,36	83,44	61,43
14.Apr.10	1,36	85,81	63,03
15.Apr.10	1,35	86,9	64,16
16.Apr.10	1,35	84,81	62,66
19.Apr.10	1,34	83,09	61,86
20.Apr.10	1,35	84,73	62,83
21.Apr.10	1,34	84,55	63,22
22.Apr.10	1,33	84,58	63,41
23.Apr.10	1,33	86,09	64,68
26.Apr.10	1,33	86,72	65,10
27.Apr.10	1,33	85,59	64,40
28.Apr.10	1,32	84,59	63,87
29.Apr.10	1,33	86,82	65,49
30.Apr.10	1,33	86,19	64,73
03-May-2010	1,32	88,09	66,54
04-May-2010	1,31	85,39	65,24
05-May-2010	1,29	82,31	63,69
06-May-2010	1,27	80,21	63,02
07-May-2010	1,27	76,48	60,00
10-May-2010	1,30	78,08	60,21
11-May-2010	1,27	79	62,21
12-May-2010	1,27	78,7	62,04
13-May-2010	1,26	79,41	63,09
14-May-2010	1,25	76,43	61,18
17-May-2010	1,23	73,87	59,82

18-May-2010	1,24	75,12	60,44
19-May-2010	1,23	71,86	58,57
20-May-2010	1,23	69,56	56,40
21-May-2010	1,25	70,45	56,37
24-May-2010	1,24	69,62	56,33
25-May-2010	1,22	67,18	54,96
26-May-2010	1,23	70,59	57,35
27-May-2010	1,23	73,56	60,02
28-May-2010	1,24	73	58,95
01.Jun.10	1,22	73,08	60,12
02.Jun.10	1,22	72,78	59,57
03.Jun.10	1,23	73,12	59,60
04.Jun.10	1,21	71,84	59,57
07.Jun.10	1,20	71,09	59,44
08.Jun.10	1,19	71,43	59,81
09.Jun.10	1,20	73,68	61,35
10.Jun.10	1,20	74,33	61,71
11.Jun.10	1,21	73,28	60,43
14.Jun.10	1,22	75,11	61,32
15.Jun.10	1,23	75,29	61,42
16.Jun.10	1,23	76,12	62,00
17.Jun.10	1,24	77,52	62,70
18.Jun.10	1,24	77,05	62,28
21.Jun.10	1,24	78,53	63,38
22.Jun.10	1,23	78,08	63,70
23.Jun.10	1,23	75,22	61,30
24.Jun.10	1,23	75,17	61,30
25.Jun.10	1,23	76,21	61,99
28.Jun.10	1,23	76,66	62,13
29.Jun.10	1,22	74,21	60,84
30.Jun.10	1,23	74,94	61,07
01.Jul.10	1,23	71,73	58,18
02.Jul.10	1,25	71,75	57,18
06.Jul.10	1,26	73,08	58,10
07.Jul.10	1,26	72,97	58,06
08.Jul.10	1,27	74,56	58,89
09.Jul.10	1,26	75,2	59,51
12.Jul.10	1,26	74,35	59,14
13.Jul.10	1,26	76,45	60,82
14.Jul.10	1,27	76,63	60,32
15.Jul.10	1,28	75,52	58,87
16.Jul.10	1,30	75,55	58,12
19.Jul.10	1,30	76,29	58,88
20.Jul.10	1,28	76,31	59,41
21.Jul.10	1,28	75,75	59,10
22.Jul.10	1,29	77,59	60,38

23.Jul.10	1,29	77,27	59,91
26.Jul.10	1,29	77,9	60,24
27.Jul.10	1,30	75,52	57,95
28.Jul.10	1,30	76,66	59,01
29.Jul.10	1,31	78,6	60,14
30.Jul.10	1,30	77,5	59,49
02.Aug.10	1,31	81,93	62,67
03.Aug.10	1,32	83,6	63,23
04.Aug.10	1,32	83,76	63,43
05.Aug.10	1,32	82,9	62,88
06.Aug.10	1,32	81,28	61,69
09.Aug.10	1,33	81,54	61,53
10.Aug.10	1,31	79,89	60,83
11.Aug.10	1,30	77,83	59,80
12.Aug.10	1,28	76,63	59,91
13.Aug.10	1,28	75,14	58,71
16.Aug.10	1,28	74,56	58,16
17.Aug.10	1,29	76,74	59,67
18.Aug.10	1,29	75,1	58,31
19.Aug.10	1,28	74,84	58,30
20.Aug.10	1,27	73,48	57,81
23.Aug.10	1,27	73,08	57,53
24.Aug.10	1,26	70,61	55,99
25.Aug.10	1,26	70,74	56,08
26.Aug.10	1,27	74,5	58,69
27.Aug.10	1,27	75,16	59,12
30.Aug.10	1,27	76,05	59,88
31.Aug.10	1,27	75,51	59,55
01.Sep.10	1,28	75,53	59,01
02.Sep.10	1,28	74,93	58,46
03.Sep.10	1,28	75,03	58,46
07.Sep.10	1,27	75,78	59,46
08.Sep.10	1,27	77,48	61,02
09.Sep.10	1,27	77,87	61,24
10.Sep.10	1,27	77,54	60,94
13.Sep.10	1,28	78,52	61,34
14.Sep.10	1,29	78,89	61,39
15.Sep.10	1,30	78,46	60,40
16.Sep.10	1,31	78,89	60,32
17.Sep.10	1,31	77,43	59,29
20.Sep.10	1,31	79,42	60,75
21.Sep.10	1,31	78,76	60,03
22.Sep.10	1,34	77,29	57,83
23.Sep.10	1,33	77,69	58,31
24.Sep.10	1,34	78,73	58,70
27.Sep.10	1,35	77,71	57,66

28.Sep.10	1,35	79,14	58,80
29.Sep.10	1,36	78,79	57,89
30.Sep.10	1,36	80,77	59,18
01-Oct-2010	1,37	82,69	60,24
04-Oct-2010	1,37	83,42	60,87
05-Oct-2010	1,38	83,35	60,49
06-Oct-2010	1,39	85,01	61,35
07-Oct-2010	1,40	83,67	59,89
08-Oct-2010	1,39	83,88	60,46
11-Oct-2010	1,39	83,08	59,62
12-Oct-2010	1,38	82,99	59,99
13-Oct-2010	1,40	84,01	60,19
14-Oct-2010	1,41	83,55	59,25
15-Oct-2010	1,41	81,94	58,16
18-Oct-2010	1,39	82,3	59,23
19-Oct-2010	1,39	81,12	58,53
20-Oct-2010	1,39	81,68	58,93
21-Oct-2010	1,40	81,28	57,99
22-Oct-2010	1,39	80,75	57,95
25-Oct-2010	1,40	81,91	58,38
26-Oct-2010	1,39	82,62	59,39
27-Oct-2010	1,38	81,27	58,88
28-Oct-2010	1,39	82,97	59,88
29-Oct-2010	1,39	82,47	59,52
01.Nov.10	1,39	84,06	60,36
02.Nov.10	1,40	84,71	60,43
03.Nov.10	1,40	85,33	60,89
04.Nov.10	1,42	86,83	60,96
05.Nov.10	1,41	87,05	61,81
08.Nov.10	1,39	87,15	62,62
09.Nov.10	1,39	87,93	63,05
10.Nov.10	1,38	87,92	63,85
11.Nov.10	1,37	88,08	64,29
12.Nov.10	1,37	86,07	62,77
15.Nov.10	1,36	85,49	62,74
16.Nov.10	1,36	83,98	61,70
17.Nov.10	1,35	83,36	61,84
18.Nov.10	1,36	83,7	61,33
19.Nov.10	1,37	83,17	60,82
22.Nov.10	1,36	82,34	60,34
23.Nov.10	1,35	82,37	61,03
24.Nov.10	1,33	84,53	63,37
26.Nov.10	1,33	84,78	63,64
29.Nov.10	1,32	85,9	64,95
30.Nov.10	1,30	86,02	66,18
01-Dec-2010	1,31	88,56	67,53

02-Dec-2010	1,32	89,37	67,94
03-Dec-2010	1,32	90,65	68,44
06-Dec-2010	1,33	91,25	68,71
07-Dec-2010	1,34	90,78	67,93
08-Dec-2010	1,32	89,74	67,98
09-Dec-2010	1,32	89,93	68,06
10-Dec-2010	1,32	89,54	67,61
13-Dec-2010	1,33	90,4	68,14
14-Dec-2010	1,34	90,63	67,46
15-Dec-2010	1,34	91,33	68,36
16-Dec-2010	1,32	91,09	68,81
17-Dec-2010	1,33	91,11	68,71
20-Dec-2010	1,31	91,31	69,45
21-Dec-2010	1,32	93,11	70,78
22-Dec-2010	1,31	93,55	71,35
23-Dec-2010	1,31	93,63	71,67
27-Dec-2010	1,31	93,08	70,86
28-Dec-2010	1,32	93,52	70,88
29-Dec-2010	1,31	93,52	71,19
30-Dec-2010	1,33	92,5	69,65
31-Dec-2010	1,34	93,23	69,77
03-Jan-2011	1,33	95,82	71,79
04-Jan-2011	1,34	93,52	69,68
05-Jan-2011	1,32	95,07	71,95
06-Jan-2011	1,31	94,95	72,53
07-Jan-2011	1,30	94,25	72,72
10-Jan-2011	1,29	95,05	73,67
11-Jan-2011	1,29	96,8	74,76
12-Jan-2011	1,30	97,86	75,43
13-Jan-2011	1,32	97,86	74,14
14-Jan-2011	1,33	97,86	73,31
18-Jan-2011	1,34	97,83	73,17
19-Jan-2011	1,35	98,42	72,87
20-Jan-2011	1,35	96,27	71,46
21-Jan-2011	1,35	96,84	71,62
24-Jan-2011	1,36	96,76	71,30
25-Jan-2011	1,36	96,76	71,17
26-Jan-2011	1,37	96,04	70,20
27-Jan-2011	1,37	96,48	70,34
28-Jan-2011	1,37	97,06	70,80
31-Jan-2011	1,37	98,97	72,28
01.Feb.11	1,38	100,4	72,99
02.Feb.11	1,38	101,3	73,39
03.Feb.11	1,37	101,69	73,98
04.Feb.11	1,36	99,43	72,94
07.Feb.11	1,36	99,44	73,37

08.Feb.11	1,36	99,25	72,79
09.Feb.11	1,36	100,16	73,39
10.Feb.11	1,36	100,74	74,05
11.Feb.11	1,35	99,93	73,89
14.Feb.11	1,34	103,12	76,73
15.Feb.11	1,35	102,48	75,85
16.Feb.11	1,35	102,78	76,08
17.Feb.11	1,36	103,45	76,29
18.Feb.11	1,36	102,2	75,00
22.Feb.11	1,37	106,82	78,16
23.Feb.11	1,37	109,77	79,94
24.Feb.11	1,38	113,91	82,71
25.Feb.11	1,38	111,47	81,00
28.Feb.11	1,38	112,27	81,16
01-Mar-2011	1,38	113,34	81,98
02-Mar-2011	1,38	116,89	84,65
03-Mar-2011	1,39	114,42	82,61
04-Mar-2011	1,40	115,71	82,90
07-Mar-2011	1,40	116,58	83,11
08-Mar-2011	1,39	112,32	80,82
09-Mar-2011	1,39	115,19	82,70
10-Mar-2011	1,38	114,07	82,56
11-Mar-2011	1,38	114,07	82,82
14-Mar-2011	1,39	112,95	80,98
15-Mar-2011	1,39	111,11	80,03
16-Mar-2011	1,40	110,96	79,54
17-Mar-2011	1,40	114,18	81,53
18-Mar-2011	1,41	114,13	80,77
21-Mar-2011	1,42	114,92	80,96
22-Mar-2011	1,42	115,63	81,37
23-Mar-2011	1,41	115,65	81,81
24-Mar-2011	1,41	115,41	81,69
25-Mar-2011	1,41	115,45	81,79
28-Mar-2011	1,40	115,95	82,63
29-Mar-2011	1,41	115,58	82,17
30-Mar-2011	1,41	115,35	81,87
31-Mar-2011	1,42	116,94	82,31
01.Apr.11	1,41	118,63	83,89
04.Apr.11	1,42	120,07	84,32
05.Apr.11	1,42	122,87	86,74
06.Apr.11	1,43	123,01	86,02
07.Apr.11	1,43	122,9	86,05
08.Apr.11	1,44	126,3	87,70
11.Apr.11	1,44	126,46	87,61
12.Apr.11	1,45	121,33	83,85
13.Apr.11	1,45	122,7	84,66

14.Apr.11	1,44	122,74	85,23
15.Apr.11	1,45	124,63	86,25
18.Apr.11	1,43	121,69	85,25
19.Apr.11	1,43	121,35	84,85
20.Apr.11	1,45	124,26	85,61
21.Apr.11	1,46	123,64	84,78
26.Apr.11	1,46	124,55	85,21
27.Apr.11	1,47	124,94	85,18
28.Apr.11	1,48	126,59	85,57
02-May-2011	1,48	126,64	85,35
03-May-2011	1,48	124,01	83,90
04-May-2011	1,49	121,55	81,68
05-May-2011	1,48	111,93	75,56
06-May-2011	1,45	113,69	78,40
09-May-2011	1,44	113,21	78,63
10-May-2011	1,44	117,82	82,06
11-May-2011	1,44	115,66	80,56
12-May-2011	1,42	112,87	79,75
13-May-2011	1,43	113,08	79,19
16-May-2011	1,41	113,72	80,41
17-May-2011	1,42	109,39	77,19
18-May-2011	1,42	112,54	79,10
19-May-2011	1,43	113,2	79,36
20-May-2011	1,42	111,25	78,14
23-May-2011	1,40	110,13	78,55
24-May-2011	1,41	112,52	79,86
25-May-2011	1,41	114,47	81,36
26-May-2011	1,42	115,06	81,21
27-May-2011	1,43	114,85	80,51
31-May-2011	1,44	117,18	81,46
01.Jun.11	1,44	116,15	80,61
02.Jun.11	1,45	114,3	79,05
03.Jun.11	1,45	115,09	79,44
06.Jun.11	1,46	115,4	79,06
07.Jun.11	1,47	116,14	79,27
08.Jun.11	1,46	118,43	81,07
09.Jun.11	1,46	119,95	82,08
10.Jun.11	1,45	118,71	81,95
13.Jun.11	1,44	120,49	83,94
14.Jun.11	1,44	120,35	83,30
15.Jun.11	1,43	114,67	80,23
16.Jun.11	1,41	114,69	81,41
17.Jun.11	1,43	113,74	79,71
20.Jun.11	1,42	112,21	78,83
21.Jun.11	1,44	112,02	77,94
22.Jun.11	1,44	113,59	78,90

23.Jun.11	1,42	108,27	76,18
24.Jun.11	1,42	104,79	73,69
27.Jun.11	1,42	104,57	73,61
28.Jun.11	1,43	107,57	75,43
29.Jun.11	1,44	111,49	77,29
30.Jun.11	1,45	111,71	77,29
01.Jul.11	1,45	109,82	75,80
05.Jul.11	1,45	113,21	78,29
06.Jul.11	1,43	113,55	79,31
07.Jul.11	1,42	117,4	82,40
08.Jul.11	1,42	117,4	82,43
11.Jul.11	1,41	117,35	83,49
12.Jul.11	1,40	117,36	83,98
13.Jul.11	1,41	118,46	84,18
14.Jul.11	1,42	117,38	82,65
15.Jul.11	1,41	118,06	83,46
18.Jul.11	1,40	117,05	83,34
19.Jul.11	1,42	118,18	83,46
20.Jul.11	1,42	118,52	83,42
21.Jul.11	1,42	118,25	83,15
22.Jul.11	1,44	118,99	82,68
25.Jul.11	1,44	118,27	82,25
26.Jul.11	1,45	118,14	81,64
27.Jul.11	1,44	117,99	81,68
28.Jul.11	1,43	118,16	82,86
29.Jul.11	1,43	115,93	81,30
01.Aug.11	1,44	116,37	80,73
02.Aug.11	1,42	116,02	81,88
03.Aug.11	1,43	113,74	79,54
04.Aug.11	1,42	110,22	77,46
05.Aug.11	1,42	106,92	75,54
08.Aug.11	1,42	103,06	72,45
09.Aug.11	1,43	103,63	72,64
10.Aug.11	1,44	103,84	72,28
11.Aug.11	1,41	107,82	76,24
12.Aug.11	1,43	108,17	75,91
15.Aug.11	1,43	108,89	76,10
16.Aug.11	1,44	109,69	76,39
17.Aug.11	1,45	111,37	76,93
18.Aug.11	1,44	108,36	75,41
19.Aug.11	1,44	109,37	76,03
22.Aug.11	1,44	108,83	75,51
23.Aug.11	1,45	110,35	76,30
24.Aug.11	1,44	111,91	77,54
25.Aug.11	1,44	111,91	77,59
26.Aug.11	1,44	112,29	77,97

30.Aug.11	1,44	115,59	80,26
31.Aug.11	1,45	116,48	80,61
01.Sep.11	1,43	116,43	81,51
02.Sep.11	1,43	115,92	81,32
06.Sep.11	1,41	113,29	80,35
07.Sep.11	1,40	117,5	83,71
08.Sep.11	1,40	117,99	84,01
09.Sep.11	1,38	115,1	83,30
12.Sep.11	1,37	114,75	84,03
13.Sep.11	1,36	114,08	83,61
14.Sep.11	1,37	113,1	82,38
15.Sep.11	1,38	116,71	84,60
16.Sep.11	1,38	116,26	84,49
19.Sep.11	1,36	112,89	82,76
20.Sep.11	1,37	114,39	83,44
21.Sep.11	1,36	114,26	83,79
22.Sep.11	1,34	109,21	81,21
23.Sep.11	1,34	109,17	81,29
26.Sep.11	1,35	107,9	79,93
27.Sep.11	1,36	109,54	80,67
28.Sep.11	1,36	108,52	79,61
29.Sep.11	1,36	107,08	78,65
30.Sep.11	1,35	105,42	78,07
03-Oct-2011	1,33	103,61	77,74
04-Oct-2011	1,32	101,84	77,26
05-Oct-2011	1,33	103,77	77,81
06-Oct-2011	1,33	104,38	78,66
07-Oct-2011	1,34	106,56	79,32
10-Oct-2011	1,36	109,49	80,55
11-Oct-2011	1,36	109,22	80,27
12-Oct-2011	1,38	112,44	81,68
13-Oct-2011	1,37	112,45	81,92
14-Oct-2011	1,38	114,33	82,81
17-Oct-2011	1,38	112,92	81,97
18-Oct-2011	1,37	112,08	81,95
19-Oct-2011	1,38	111,76	80,82
20-Oct-2011	1,38	109	78,95
21-Oct-2011	1,38	111,6	80,88
24-Oct-2011	1,39	111,67	80,59
25-Oct-2011	1,39	112,11	80,55
26-Oct-2011	1,39	110,43	79,29
27-Oct-2011	1,40	112,45	80,10
28-Oct-2011	1,42	110,01	77,69
31-Oct-2011	1,40	108,43	77,44
01.Nov.11	1,36	106,97	78,50
02.Nov.11	1,38	110,82	80,25

03.Nov.11	1,38	110,76	80,42
04.Nov.11	1,38	112,22	81,48
07.Nov.11	1,37	114,75	83,50
08.Nov.11	1,38	115,61	83,85
09.Nov.11	1,36	115,29	84,57
10.Nov.11	1,36	113,32	83,23
11.Nov.11	1,37	114,43	83,83
14.Nov.11	1,37	112,57	82,41
15.Nov.11	1,35	111,9	82,69
16.Nov.11	1,35	111,91	82,99
17.Nov.11	1,35	109,25	81,05
18.Nov.11	1,36	107,82	79,42
21.Nov.11	1,35	105,98	78,75
22.Nov.11	1,35	107,77	79,62
23.Nov.11	1,34	106,83	79,80
25.Nov.11	1,32	106,08	80,19
28.Nov.11	1,33	109,38	81,94
29.Nov.11	1,33	111,25	83,42
30.Nov.11	1,34	111,22	82,89
01-Dec-2011	1,35	108,83	80,66
02-Dec-2011	1,35	109,59	81,11
05-Dec-2011	1,34	110,18	81,97
06-Dec-2011	1,34	110,16	82,25
07-Dec-2011	1,34	110,07	82,28
08-Dec-2011	1,34	108,23	80,71
09-Dec-2011	1,34	107,91	80,63
12-Dec-2011	1,33	107,82	81,37
13-Dec-2011	1,32	109,25	82,88
14-Dec-2011	1,30	105,72	81,37
15-Dec-2011	1,30	104,52	80,28
16-Dec-2011	1,31	104	79,61
19-Dec-2011	1,30	104,55	80,18
20-Dec-2011	1,31	107,8	82,45
21-Dec-2011	1,31	108	82,73
22-Dec-2011	1,30	108,98	83,53
23-Dec-2011	1,31	109,28	83,69
28-Dec-2011	1,31	107,54	82,25
29-Dec-2011	1,29	106,89	82,93
30-Dec-2011	1,29	108,09	83,54
03-Jan-2012	1,30	111,12	85,38
04-Jan-2012	1,29	113,37	87,56
05-Jan-2012	1,28	113,59	88,52
06-Jan-2012	1,28	111,96	87,63
09-Jan-2012	1,27	111,07	87,26
10-Jan-2012	1,28	113,3	88,46
11-Jan-2012	1,27	111,66	87,80

12-Jan-2012	1,27	112,97	88,70
13-Jan-2012	1,28	109,88	86,04
17-Jan-2012	1,28	110,55	86,43
18-Jan-2012	1,28	109,81	85,58
19-Jan-2012	1,29	109,54	84,84
20-Jan-2012	1,29	108,5	84,10
23-Jan-2012	1,30	109,46	84,09
24-Jan-2012	1,30	108,38	83,35
25-Jan-2012	1,29	108,48	83,82
26-Jan-2012	1,31	109,08	82,98
27-Jan-2012	1,31	110,5	84,06
30-Jan-2012	1,31	110,24	84,09
31-Jan-2012	1,32	110,26	83,68
01.Feb.12	1,32	111,96	84,98
02.Feb.12	1,31	110,96	84,74
03.Feb.12	1,32	112,56	85,53
06.Feb.12	1,30	115,47	88,54
07.Feb.12	1,31	116,86	89,12
08.Feb.12	1,33	117,18	88,28
09.Feb.12	1,33	118,4	89,10
10.Feb.12	1,32	118,13	89,57
13.Feb.12	1,33	118,73	89,58
14.Feb.12	1,32	118,3	89,83
15.Feb.12	1,31	120,25	91,85
16.Feb.12	1,30	121	93,21
17.Feb.12	1,32	120,69	91,72
21.Feb.12	1,32	120,85	91,40
22.Feb.12	1,32	123,07	93,02
23.Feb.12	1,33	124,53	93,63
24.Feb.12	1,34	124,89	93,12
27.Feb.12	1,34	126,46	94,46
28.Feb.12	1,35	124,02	92,18
29.Feb.12	1,34	122,23	90,92
01-Mar-2012	1,33	125,76	94,47
02-Mar-2012	1,32	125,93	95,28
05-Mar-2012	1,32	126,68	95,82
06-Mar-2012	1,32	125,03	95,06
07-Mar-2012	1,31	125,37	95,56
08-Mar-2012	1,32	127,96	96,63
09-Mar-2012	1,32	128,08	97,10
12-Mar-2012	1,31	127,27	97,01
13-Mar-2012	1,31	128,14	98,14
14-Mar-2012	1,31	126,98	97,21
15-Mar-2012	1,31	123,63	94,68
16-Mar-2012	1,31	125,09	95,37
19-Mar-2012	1,32	125,76	95,63

20-Mar-2012	1,32	124,38	94,24
21-Mar-2012	1,32	123,89	93,68
22-Mar-2012	1,32	122,49	93,03
23-Mar-2012	1,32	125,21	94,56
26-Mar-2012	1,33	125,85	94,80
27-Mar-2012	1,33	125,25	93,94
28-Mar-2012	1,33	124,41	93,28
29-Mar-2012	1,33	123,23	92,85
30-Mar-2012	1,34	123,41	92,40

Table 8.3: Europe Brent spot price FOB

Sources: Wikiposit.org, US Department of Energy

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- **EGIX, daily**
  http://www.eex.com/de/Marktdaten/Handelsdaten/Erdgas

- **Crude oil price index, monthly**
  http://www.indexmundi.com/commodities/?commodity=petroleum-price-index

- **Crude oil average global price (Dated Brent, West Texas, Dubai Fateh), monthly**
  http://www.indexmundi.com/commodities/?commodity=crude-oil

- **Crude oil: Dated Brent, monthly**
  http://www.indexmundi.com/commodities/?commodity=crude-oil-brent

- **Crude oil: Dated Brent, daily**
  http://wikiposit.org/a?uid=DOE.RBRTE

VIII) Curriculum Vitae

Personal Data

Name: Bernhard Hochreiner

Birthdate: 07.12.1983

Birthplace: Grieskirchen

Citizenship: Austria

Family Status: Married

Education

2004-2012: University of Vienna: International Business Administration and Theatre-Film and Media Studies

Aug. 2007-June 2008: BI International School of Management, Oslo, Norway (Erasmus Exchange)

2003-2004: Civil Service

1998-2003: HTL Vöcklabruck

1994-1998: Secondary School Realgymnasium Lambach

1990-1994: Elementary School Schwanenstadt