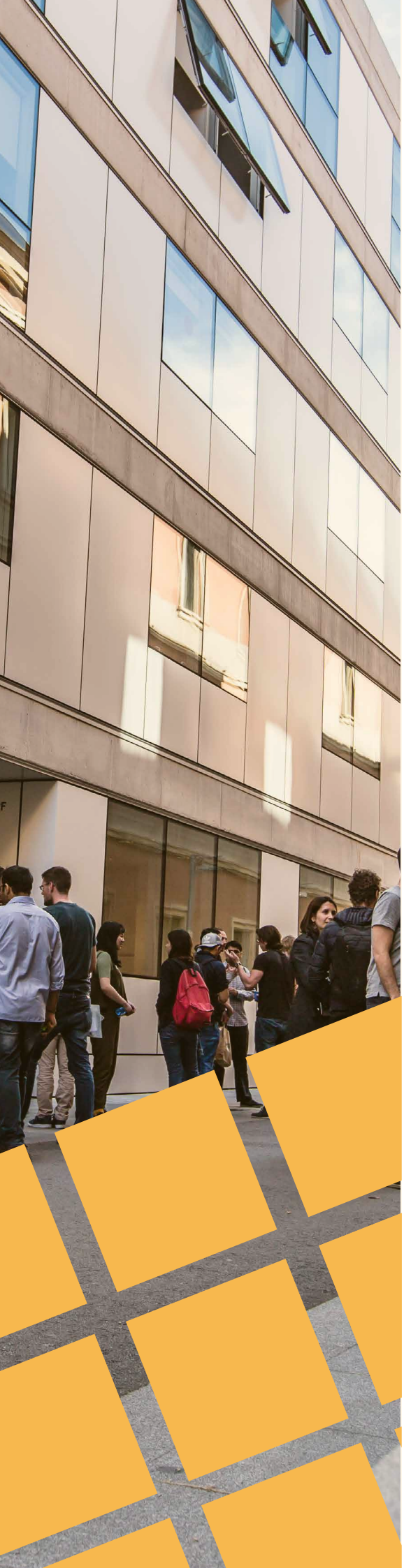

STUDENT PAPER SERIES 09

A Game-Theoretic Approach to Cooperation in the European Gas Market. Why a Gas Exporters' Cartel Has Not Yet Materialized

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Master's in International Relations

Academic year 2011-2012

INSTITUT BARCELONA ESTUDIS INTERNACIONALS

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Word count: 9,581

Abstract

The paper analyzes the strategic payoffs of three key players to cooperate in the European gas market: Russia, Algeria, and Qatar. A game-theoretic model is developed that evaluates each player's interest in terms of gas policies. It is shown that because interests are diverging, both in economic and geopolitical terms, each will seek a different preferred form of cooperation. A cartel does not materialize. To arrive at the individual payoff matrices the Analytical Hierarchy Process (AHP) is utilized considering two dimensions: first, the effectiveness of a player's gas policies with respect to current changes in the international gas market and, second, the value of these gas policies in four different types of cooperative settings. The findings suggest that the rise of liquefied natural gas (LNG) and the increase in spot-market pricing most substantially affect the European gas market. In this context, Russia needs to enhance its LNG capacity and expertise and thus would gain most from technology transfers. Algeria would gain most from quota restrictions given its tendency to favor high prices over market share. Qatar with the highest LNG capacity among all players is concerned about keeping these capacities utilized and would gain most from calibrating investment plans among potential partners. Overall, there is no common ground for outright quota restrictions to manipulate prices, which has positive implications for European energy security.

1. Introduction

The idea of a gas exporter's alliance is not new and has been discussed by various commentators and analysts with both skepticism and apprehension (e.g. Bahgat 2008; Gabriel *et al.* 2012;Hallouche 2006; Wagbara 2007). In Europe, concerns are particularly stronggiven the high dependence on Russian and other foreign gas. Indeed, models assessing the impact of a possible gas carteldemonstrate that it could raise prices for European importers by 15 to 20 percent(Egging*et al.* 2008, p. 20). But a cartelization among gas exporters thus far has not materialized.This paper assesses why this has not happened and thereby focuses on diverging interests between key players in a European context: Russia, Algeria, and Qatar.

The Gas Exporting Countries Forum (GECF) is so far the closest realization of what is frequently referred to as a "Gas-OPEC". Founded in 2001, the GECF brings together the world's fifteen largest gas producing countries and accounts for roughly 73 percent of global gas reserves and 41 percent of production (Chernavsky and Eismont 2009, p. 129).But the GECF, up until now, is far from being an effective organization. Rather, it is characterized by weak institutional and organizational structures,convenes only irregularly, has no consistent attendance or agenda, and apart from information exchange among members has not produced any tangible outcome.

However, the concept of a "Gas-OPEC"gained new attention with Russia's increasingly active involvement in the GECFsince 2006. Russia is the largest gas reserves holder and one of its biggest producers. As such, it provides a critical mass for any concerted effort on the gas market to be effective. In 2007, President Putin stated publiclythat the idea of a gas-producing cartel was an "interesting"one and worth thinking about (*The Economist* 2007).In addition, bilateral coordination between Russia and Algeria appear to be rising. Russia is also seeking participation of Qatar, a relatively new player on the European gas market, for developing its gas resources. For example, in April 2010, the energy ministers of Russia and Qatar agreedon joining efforts to developRussia's Western Siberian gas fields (*RIA Novosti* 2010).

In 2011, Russia, Algeria, and Qatar accounted for roughly 51percent of all traded gas in Europe (own calculations based on BP 2012, pp. 27-28). Thus, agreementsbetween these three key players have the potential to influence the European gas market at the expense of consuming countries. However, while it may be theoretically true that Russia, Algeria, and Qatar could collude to raise gas prices for the European countries, it is not clear whether it would be in their short- to medium-term interests, both respective and mutual, to do so.

This paper investigates this question by identifying the strategic gas policies of Russia, Algeria, and Qatar and relates them to each other in a quantitative game-theoretic framework.The analysis will be placed in the context of changing international gas markets. It will be shown that because the effectiveness of individual gas policies under changing conditions are diverging, each player would gain most from a different form of cooperative arrangement. The potential for a real gas-cartel on the European market, meaning direct influence on prices through quota restrictions, are rather slim and cannot be confirmed by this study.

The paper is organized as follows. The next sectionprovides some background information on natural resource cartels and compares the potential of a gas-cartel with the better-known OPEC-cartel in the petroleum industry. Section three lays down the research design for the game-theoretic analysis and the determination of numerical payoff-matrices. Section four describes the current changes in the global international gas market and evaluates their importance to the European market. Section five identifies the three most important gas policies of Russia, Algeria, and Qatar considering both economical and geopolitical components. Their intrinsic values are evaluated with respect to the market changes of the previous section. Section six determines the suitability of eachplayer's gas policy against four potential types of cooperation. This will ultimately lead to a synthesis in terms of individual payoff-matrices for each player. These payoff-matrices will be evaluated and compared in section seven. The paper finishes with a conclusion.

2. Background

Natural resource cartels are characterized by an organized group of producers with the intention to obtain higher prices by restricting production or dividing the market(Alhajji and Huettner 2000, p. 1152). One may think immediately of OPEC as the paradigm to a classical resource cartel. The gas market, however, hasseveral features that constrainthekind of market power which OPEC possesses in the petroleum industry.

First, there is no unified transparent international price for gas, thusproviding a potential cartel no clear target around which it can coordinate its actions. Gas prices are traditionally determined by long-term contracts that are linked to the price of oil. Although this linkage between gas and oil prices is gradually declining to the favor of spot markets, the continuing limitations on a global formation of the gas price make market manipulation difficult (Orttung and Overland, p. 59).

Second, not only for the traditional pipeline-traded gas, but also for LNG trades, suppliers prefer to work on the basis of long-term contracts because of the large up-front costs necessary forgas liquefying infrastructure. While LNG spot sales are growing quickly, long-term contracts still regulated roughly 80 percent of sales in 2010 (IGU 2010, p. 12). While the role of such contracts is constantly shrinking, gas markets are not expected to be as liquid as oil markets for the near time being.

Third, as opposed to oil markets, which can be considered global, the gas market lacks global fungibility and is fragmented into regional blocs (Wood 2007, p. 7). The emergence of substantial new LNG production capacity makes it theoretically possible to link different regional markets. Nevertheless, the persisting segmentation still has an important impact on the overall developments in the gas market (Orttung and Overland, p. 59).

Despite these impediments for cartelization, a gas cartel could be imagined to play a role that OPEC by definition does not perform in the global oil market: namely, determining the exact destinations and routes of gas supplies from producer to consumer countries, practically allocating certain markets to certain suppliers on a

long-term basis, thereby influencing the price. Given the fragmented nature of gas markets, cooperation among exporterson a regional level appears particularly favorable.

In order for such a cartel-type structure to be effective there should be a relatively small number of producers as to facilitate decision-making and collective action. SinceRussia, Algeria, and Qatar have ajoint market share of roughly 51percent in the European market this prerequisite is given (own calculations based on BP 2012, pp. 27-28). Russia would be the main factor in any cartelizing initiative by virtue of its superior export potential, entrenched dominance in some European countries, field technology, and control of key transit routes (Socor 2008, p. 113).

A key to an effective cartel, particularly under the conditions as described above, is collective decision-making which impliesthe alignment of interests. These interests, of course, have an economic domain of which raising overall economic benefits from gas exports appears as most obvious. Russia and Algeria, in particular, can be classified as "rentier states" meaning that they are highly dependent on gas revenues. In the case of Russiathis is mainly to secure macroeconomic stability (Götz 2007, p. 137),whereasAlgeria requires gas rents to maintaininner-political stability (Werenfels 2007, p. 91).

But apart from that, interests among Russia, Algeria, and Qatar in supplying the European market may not be matching. In fact, they may be conflicting as they are, after all, competitors for market share and profit. They may moreoverhave diverging geopolitical interests and use their gas policies as a foreign-policy vehicle to pursue them.

This is the backdrop on which the analysis of this paper will be conceptualized. The study examines the individual interests of Russia, Algeria, and Qatar as potential partners in a European suppliers' cartel. It hypothesizes that the interests of Russia, Algeria and Qatar are diverging. Specifically, they do not align with respect to the current changes in the gas market, on the one hand, and with respect to conceivableforms of cooperation, on the other.

The next section frames the research design, on which all further analysis will be based.

3. Research design

The overarching theoretical framework in which the analysis of this paper is embedded rests on rationalist IR theory. Essentially, rationalist approaches of IR assume a gain-seeking behavior on the part of the actors to explain the formation of international cooperation. Neoliberal institutionalisttheory, more specifically,suggestsa maximization of*absolute* gains implying that actors base their individual utility from cooperation independently from the gains of others (e.g. Keohane 1985). Accordingly, actors will cooperate if the individual benefits from cooperation outweigh the costs, regardless of the benefits to others.This is in sharp contrast to neorealist thinking, which assumes a positionalist behavior between actors as to be largely responsible for cooperation to take place or not (e.g. Grieco *et al.* 1993).

The assumption of rational gain-seeking behavior is frequently applied to game-theoretic models (e.g.refer to Gilligan and Johns 2012 for an up-to-date overview). In such models, cooperative behavior is determined by the payoff structure of each actor's interests given a constellation of possible alternatives.The strategic nature of forming cooperative relationships in the natural gas market makes a game-theoretic approachan appropriate analytic tool for analysis and will be applied here.

The game-theoretic analysis in this study will be framed under neoliberal institutionalist assumptions. The postulation is that Russia possesses far more political weight in the international system and more economic weight in the international gas market than either Algeria or Qatar. As such, the consideration of relative gains is arguably of less importance and calculations in cost-benefit terms are assumed to take place in a non-zero sum game.

The general parameters included for the game-theoretic analysis as applied here are the strategic setting (the antecedent condition), the individual interests of players (the

independent variable) and possible forms of cooperation (the dependent variable). The strategic setting is defined as the structural condition of the international gas market and their effect on the European market in particular. The independent variable consists of the respective interestsof Russia, Algeria and Qatar. "Interests" in the context here are defined in terms of "gas policy" and will be used interchangeably for that purpose. It is furthermore a central assumption that the gas policies of each player comprise both economical and geopolitical components, which are inherently interdependent (Fang 2012, p. 28).The utilityin terms of payoffs then determines whether cooperation actually materializes or not. More specifically, only if players seek similar cooperative agreements to enhance their individual gains will cooperation actually emerge. However, it is the central hypothesis of this study that players seek different forms of cooperation to enhance their individual gains. Therefore, a cartel in the natural gas market has thus far not materialized.

A common problem for the practical application of game-theory is the measurement of intangible factors, as in the case here evaluating a country's gas policies (Saaty 2008a, p. 10). This study resorts to the Analytical Hierarchy Process (AHP)to determine the payoff matrices for each player. The use of the AHP for the application of game theory was first promoted by Thomas Saaty (1979) and has the major benefit in that it allows operationalizing qualitative judgments into quantitative measurements (for greater detail on the AHP method please refer to the appendix). In the context here this is done by pairwise comparisons of gas policies with respect to two dimensions: first, the current changes in the international gas market and, second,regarding potential cooperative agreements. The respective results are synthesized to determine the payoff-matrices for each player, where the value of a player's gas policy is weighted against a certain cooperative constellation. The judgments for the pairwise comparisons are surmised from recent primary and secondary literature, statements fromindustry officials, and expert assessments. It is the view of the author that the use of quantitative analysis adds value to the current literature on the topic by providing additional substance to previous argumentative analysis.

The procedure to arrive at the payoff matrices for Russia, Algeria, and Qatar is presented below. The further sections of this paper essentially follow along these steps.

1. Construct a hierarchy of market changeswith respect to their importance in affecting the European gas market
2. Identify the relative suitability of each player's gaspolicies with respect to these market changes
3. Identify the relative suitability of each player's gaspolicies with respect to potential forms of cooperation
4. Synthesize the results of the first three steps to derive the payoff matrix for each player
5. Compare the individual payoff matrices between players

To set the scene, the following section describes the current changes that are taking place in the international gas market and evaluates their effect on the European gas market in particular.

4. What are the changes in the international gas market?

The reputed industry consultancy Wood Mackenzie assessed in a 2007 report that a potential gas-cartel's near term, potential sphere of influence would be limited by the existing terms and conditions of long-term, predominantly oil-indexed, gas contracts which, as mentioned, are a traditional feature of the global gas market (Wood Mackenzie 2007). But since 2007, the international gas markets are going through rapid changes. The descriptions of the next three sectionsarelargely builton Orttung and Overland (2011, pp. 55-63) who next to providing the most recent assessment of Russian cartelization initiatives also offer a comprehensive account on the most important changes in the gas market. Specifically, they detect four main developments: the emergence of shale gas, the rise ofliquefied natural gas (LNG) production, the growing importance of spot market pricing, and a relocation of

demand. Each of these factors will be briefly discussed in turn and eventually evaluated regarding their effect on the European market.

4.1 The shale gas revolution

Russia expected to become an indispensable supplier not only to Europe but also to the United States. Instead, the recent shale gas revolution in the United States has radically increased U.S. production from hitherto-untapped resources and thereby significantly reduced US demand for imported gas(Orttung and Overland 2011, p. 55). In fact, in 2009 the United States overtook Russia to become the world's largest producer of gas.

As a logical result, there is less demand for Russian but also other foreign gas. However, while advocates of the shale gas revolution think that supplies of this unconventional form of gas will have a long-term impact on global gas supplies, Russian officialsdismiss such expectations.Noteworthy, Gazprom Chairman CEO Alexey Miller argues that shale gas is expensive and complicated to produce (Miller 2010). Moreover, he assessesthat shale gaswill only have local consequences in that it balances regional markets and compensates for diminishing supplies of conventional gas in these markets.On the European market, however,it will substitute for Russia's extensive supplies of conventional pipeline-gas.

4.2 The rise in LNG production

According to Orttung and Overland (2011, p. 55) a second important change in international gas markets is the rise of LNG, which poses an alternative to the traditional pipeline-traded gas. Because they typically force producers and consumers to agree on long-term contracts to ensure their profitability, pipelines do not stimulate markets. Moreover, pipelines give rise to the highly debated supplier dependency, which in the case of European-Russian relationship is particularly strong.

LNG, on the other hand, opens up opportunities to transform the bilateral linkagesinherent to pipelines into more dynamic markets. The main consequence of

increased LNG supplies for Russia is that Europe now can buy gas from a broad range of non-Russian suppliers including, for example, Qatar. Noteworthy, Qatar's sharein EU-27 imports grew from 0 percent in 2001 to 11 percent in 2011, while Russia's market share dropped from 48 percent to 33 percent (Eurostat 2012).

4.3 The increase in spot market pricing

Russia maintains that the traditional system of linking the gas price to the price of oil provides the fairest way to determine the price of gasfor both producers and customers alike (Miller 2010). Butspot markets are making available ever larger gas supplies at a price determined by supply and demand. The connection between gas and oil prices may become even more difficult to sustain as more LNG capacity comes available and the traditional, regionally defined pipeline markets are becoming more integrated into global ones (Orttung and Overland 2011, p. 55).

The growing importance of spot markets in the context of rising supply of LNG is likely to exert continuing downward pressure on prices, much to the concern of major LNG producers like Qatar and Algeria.But Russia, too, feels the increasing pressurefrom spot market prices.For the sake of securing market share, it ever more often has to accommodateEuropean customers'request to shift away from purely oil-indexedpricing (Flauger 2012).

4.4 The relocation of demand

A final change in the gas market concerns future markets. Russia has traditionally sold its gas on the European market. While most observers expect European demand to increase over time, the main expansion will be in Asia, particularly China and India (Orttung and Overland 2011, p.56). But Russian efforts to increase sales in Asia proved difficult in the past mainly due to price disagreements with China. On the other hand, Russia is also expecting greater domestic demand. In fact Gazprom's Miller anticipates that the domestic market will be as profitable for Gazprom as the European market by 2014 (Miller 2010).

To sum up, the conditions on the international gas markets are changing and may force gas exporters to reassess their strategies. If theirgas policies appear ineffective in coping with future market conditions, they may either reconfigure them or engage in cooperative agreements, that is, ifthey increase absolute gains. It is against this background that Russia, Algeria, and Qatar may examine their options to collude in the European gas market.

A first step in the game-theoretic analysis of this study is to evaluate the relative importance ofthese changing market conditions. The weight of each factorregarding its effect on the European market is given below. For calculation details please refer to the appendix.

Table-1: Which global market change does most significantly affect the European gas market?

Market changes	*Weight*
(M_1)Shale gas revolution	0.082
(M_2)Rise in LNG production	0.626
(M_3)Increase in spot market pricing	0.236
(M_4)Relocation of demand	0.056

Source: own calculations, for details please refer to the appendix

According to the values above, the rise in LNG production provides the most important change to the European gas market structure. Spot market pricing follows second and can be interpreted as a function of excess LNG supply. These two conditions arguably provide incentives for gas exporters to work together. That is, like OPEC in the oil industry, gas producers would need a functioning global spot markets to exert price influence as it provides the target around which to coordinate collective action. The shale gas revolution is assumed to have an effect mainly on the North American gas market with spillover effects on Europe through increased LNG available. The relocation of demand ranks last, because it is assumed that the

European market will most likely remain an important and lucrative gas market for all three exporters well into the near future.

The next section examines the gas policies of Russia, Algeria and Qatar. As the second step to the game-theoretic analysis, the aimis toevaluate which of a country's current gas policy is best suited to cope with the above mentioned market changes. It will moreover be a first hint at how far interests between players are diverging.

5. What are the interests of Russia, Algeria and Qatar?

As the discussion below will show, although Russia, Algeria and Qatar may all have the reasonable economic interests to raise gas prices, their individual interests in supplying the European gas market are somewhat competing. After all, a gas-cartel has not materialized and, as this paper hypothesizes, this is to a significant extent caused by conflicting interests. As will be made evident, this can be traced to both economical and geopoliticalcomponents.In particular, it will be evaluated in how far the current gaspoliciesare effective given the current market changes as outlined in the section above. For the sake of clarity three strategies will be evaluated for each player.

5.1 Russia's interests

Russia has benefitted greatly from the former status quo in international gas markets. It currently ranks as the predominant gas supplier to Europe and so far profited from gas prices tied to the oil price and stressed the importance of pipeline infrastructureswith long-term contracts (Orttung and Overland 2011, p. 59).

Russia's key goal is to prevent the further erosion of its share of sales on the EU market, where it accounts for roughly 33 percent of all imported gas (Eurostat 2012). Currently, Russia sends the majority of its exports to Europe through pipelines and is keen on expanding its pipeline infrastructure. Russia recently opened Nord Stream, a new pipeline connecting Russia with Germany and is planning South Stream,another

pipeline connecting Russia to Europe. At the same time, it is only slowly expanding its LNG production capacity.

Europe has been rapidly increasing its LNGimport capacities opposing Russia's preference for pipeline gas. As a result, during the recession year 2009, Russia lost market share at the same time as Qatar doubled its sales to the EU (Orttung and Overland 2011, p. 60).

On another aspect, Russia's dominant position in the European gas market sparks controversy claiming that Russia might use it as leverage to level EU influences in its European neighborhood (Darbouche 2007, p. 3). Proponents of this view often refer to President Putin's PhD thesis which arguesfor Russia's gas (and oil) potential as the principal means to reassert its international and regional dominance.

Russia's three most apparentgas policies are given below. In addition,the intrinsic value of each policy is weighted with respect to the current changes in the international gas market of section two. For the calculation details,again, please refer to the appendix.

Table-2: Which of Russia's gaspoliciesis most effective given the changes in the international gas market?

Russia's gas policies	*Weight*
(R_1)Expanding pipeline infrastructure	0.316
(R_2)Maintaining long-term contracts with oil-indexed gas prices	0.319
(R_3)Using gas as a vehicle to reassert regional and global status	0.365

Source: own calculations, for details please refer to the appendix

The above evaluations indicate that all three of Russia's gas policies possess roughly equal weight. This does not mean that all of these policies are equally well suited to the changing market conditions. Quite the opposite, none is particularly appropriate implying increasing pressure on Russia to reconfigure its strategy or seek cooperation with other gas producers to enhance its fit for the gas market of the future. The reason that (R_3) has a slightly higher value than the other two suggests that Russia's current position on the European market is so dominantthat even under changing circumstances its influence will still be highly relevant both economically and politically.

5.2 Algeria's interests

Algeria is the oldest and most experienced LNG exporter in the world and is theonly country to date that enjoys a diversified LNG and pipeline export capacity extensive (Hallouche 2011, p. 28). Algeria has long been pushing to get the best return for its resources, but its interests do not always coincide with that of other exporters.

Algeria competes directly with Russia for sales to the European market. Orttung and Overland (2001, p. 60) assess that Russia has sought to influence Algerian exports to Europe in order to ensure that they do not encroach on its market share. Although there are some intended cooperation agreements between Russia and Algeria, these efforts have thus farnot produced concrete results.

One reason may be related to the wider geopolitical interests, which Algeria tries to achieve with the help of its gas policy. Algeria is trying to consolidate its position as a key energy partner of the EU through various bilateral "special relationships". According to Darbouche (2007, p.3) the view in Algeria is that gas can constitute one strand of a bilateral strategic partnership which would govern EU-Algerian relations on its own terms rather than the EU Neighborhood Policy which is rejected. It is investing in new pipeline infrastructure linking Algeria to Spain and Italyas well as in new LNG terminals to increase EU downstream capacity. Algeria appears well aware of European intentions to reduce their dependence on Russian gas and

usesthis for its own benefit. In its search for market expansion Algeria even approaches traditional Russian consumers. For example, in 2007 it signed an LNG supply agreement with Poland (Darbouche 2007, p. 5).

A summary of Algeria's most important energy policies and their intrinsic values is presented below. As for Russia above, the values are weighted regarding its proper suit to the current changes in the international gas market of section two.

Table-3: Which of Algeria's gaspolicies is most effectivegiven the changes in the international gas market?

Algeria's gaspolicies	*Weight*
(A_1)Expanding flexible infrastructure	0.778
(A_2)Long-term contracts with oil-indexed gas prices	0.080
(A_3)Forming small number of key "special relationships"	0.142

Source: own calculations, for details please refer to the appendix

Algeria's flexible infrastructure consisting of both a solid pipeline network to Europe and a sophisticated LNG infrastructure puts it in a fortunate position. The weight of this indeed is so strong as to dwarf the other two policies. The preference for "special relationships" ranks second and is arguably a function of Algeria's flexible infrastructure which helps it to lock-in key EU member states with the purpose to avoid EU meddling in its domestic affairs. Due to both LNG and pipeline capacity, Algeria has the potential to further capitalize on the current sense of vulnerability in Europe stemming from high dependency on Russia.

5.3Qatar's interests

In contrast to Russia, but like Algeria, Qatar has been investing heavily in LNG facilities and by now it is the world's leading LNG exporter. Qatar's energy

policy appears to be dictated by the fundamentals of supply and demand. It ships worldwide on both long-term and spot contracts and avoids engagement in pipelines (Orttung and Overland 2011, p. 60).

Qatar's rapidly growing LNG export capacity is a major threat to Russia's position on European gas markets and could undermine Algerian exports as well. It has constantly increased its share in European imports, mainly because the shale gas revolution in the US means that Qatar has to seek new markets (Eurostat 2012).But also, like Algeria, Qatar has been able to take advantage of the European aim to diversify natural gas imports away from Russia and recently agreed on new supply relationships with Italy, Belgium, Spain, and France (Hulbert 2012).

With global energy consumption showing an increasing demand for LNG,the ability of Qatar to play an even greater role appears obvious. Being a small country, Qatar depends on relationships with other states to enhance its own security. Wright (2012, p. 308) assesses that although its energy policy may not necessarily translate into the hard-security relationships, which Qatar enjoys for example with the US, it provides a supplemental security diversification. That is, by providing a significant proportion of foreign countries' energy needs, Qatar is actively trying to create "stakeholders" in its own stability and security.

A summary of Qatar's most important gas policies and their intrinsic values with respect to the international market changes is presented below.

Table-4: Which of Qatar's gaspolicies is most effectivegiven the changes in the international gas market?

Qatar's gaspolicies	*Weight*
(Q_1)Expanding LNG export capacities	0.536
(Q_2)Mixture of long-term and spot-market contracts	0.273
(Q_3)Diversify security relationships	0.190

Source: own calculations, for details please refer to the appendix

Obviously, as the world's biggest LNG producer and exporter Qatar is in a unique position. Given the increasing demand in LNG, Qatar will be able to sell its gas to ever more countries, thereby increasing "stakeholders" in its own security. This is a major competition to Russia's gas policy ambitions. This is even aggravated considering that Qatar as a fairly small but wealthy country may not be as dependent on maximizing revenues in the same way as the classical "rentier states" of Russia and Algeria. This is why Qatar may be more flexible with respect to contract structures, the second clear benefit in light of changing market conditions.

In sum, this section showed that the three gas exporters Russia, Algeria, and Qatar have interests that do not necessarily align.To take just one example, Russia wants to preserve its market share and keep Europeans dependent on its pipeline gas, while Qatar would like Europeans to continue expanding their capacity to receive LNG, so that more Qatari gas can be shipped to Europe (Orttung and Overland 2011, p. 59). It is moreover noteworthy that the intrinsic values of gas policiesregarding changing conditions in international gas markets varies significantly across the players. Qatar and Algeria appear in abetter position with both possessing significant LNG export capacities and expertise, which Russia lacks.

Still, although seemingly not well fit for the changing market conditions, it may unreasonable to assume thatRussia in the near-term will change its policies. After all, it possesses a strong position on the European market as the predominant supplier and has substantialinvestments undertaken in additional pipelines. The same can be said about Qatar and Algeria, however, who next to appearing better economically prepared for market changes follow specificgeopolitical objectives in supplying the European market.

In that context, the decision to jointly cooperate will most likely depend ona country'sability to incorporate its currently practicedgas policies into that particular cooperative agreement. Therefore, the next section examines the various types of cooperation that could potentially come about and evaluates which ofa country's gas policiesmight best be arranged with each of these types of agreements.

In this context, the paper acknowledges that cooperation does not necessarily have to take the shape of a full-fledged cartel implying coordinated quota restrictions. Indeed, there are various instruments that, although not necessarily providing the direct pricing power of a real cartel, may implyabsolute gains to gas exporters.In total, four conceivable types of cooperation will be briefly discussed.

6. What are potential types of cooperation in the gas market?

Following the classical definition of a cartel, the imposition of gas production quotas on all countries is at the hard end of the spectrum of possible forms of cooperation. Production quotas would naturally be restricted to spot and short-term markets. These, however, accounted for only one-fifth of total LNG sales in 2010(IGU 2010, p. 4). Also, gas prices are rising since 2009 thus limiting the economic incentives to curtail supplies (BP 2012, p. 27).

An indirect measure to influence prices would be for Russia, Algeria, and Qatar to adjust their investment plans and calibrate their export strategies. For example, they could either cancel or postpone their investments in new capacity or lengthen maintenance downtimes to limit the amount of gas available (Orttung and Overland 2011, p. 63). This may be more reasonable than maintaining excess capacity because the costs involved withholding back capacity are very high due to the enormous fixed costs associated with gas projects (Jaffe and Soligo, p. 458). Thus, the active control and configuration of capacity expansion among members before they are built might indeed be a more preferable way if output restriction is the aim.

Another instrumentto increase market power may be to takea common stancewith respect tocustomer negotiations on future contract prices. Algeria and Qatar also sell gas on spot-markets, nevertheless they show a preference for long-term contracts just as Russia does (Orttung and Overland 2011, p. 63). Main reason, as has been mentioned above, can be traced to thesubstantial investments necessary to build either pipelines or regasification infrastructure, which only amortize in the long-term. Thus it might be in thecommon interest to all three players to preserve the

existing oil-price linkage in future gas contracts as a means to maintain long term profitability.

Apart from direct or indirect leverageson pricing, cooperation could consist of technology transfers as well as shared access to reserves and capital for national gas companies (NOCs). This, in turn, would mean restricting the investment and commercial opportunities for international oil and gas companies (IOCs). Indeed, some observers point to the fact that gas producing nations may be on a path to restrict access to both reserves and capital to ultimately break free from the technology dominance of the IOCs (Dargin 2007, p. 142).

To the extent of pure information exchange, the GECF has already agreed on such measures even beyond Russia, Algeria, and Qatar (Hallouche 2006, p. 47). Such measures, however, will not be considered in the analysis here as they lack the hard impact on prices or quotas that the other types of cooperation may provide.

The individual payoff matrices for Russia, Algeria, and Qatar are shown below. They portraythe synthesized results of this and the previous two sections,that is, the relative payoffs for each country's gas policy with respect to both their effectiveness under changed market conditions(implicit) and their utility in each of the potential cooperative settings; where

- the rows represent a country's gas policies as outlined in section five and weighted by their effectiveness regarding the changing market conditions of section four

  and

- the columns represent the potential types of cooperation with

  C_1 = production quotas on members

  C_2=calibration of investment plans

  C_3 =cooperation in future contract negotiations

  C_4 = transfer of technology and other skill sets

Table-5: Payoff matrix of gas policies and potential forms of cooperation for Russia

Russia	C_1	C_2	C_3	C_4
R_1	0.214	0.205	0.026	0.235
R_2	0.029	0.047	0.215	0.036
R_3	0.084	0.074	0.088	0.053

Source: own calculations, for details please refer to the appendix

Table-6: Payoff matrix of gas policies and potential forms of cooperation for Algeria

Algeria	C_1	C_2	C_3	C_4
A_1	0.577	0.506	0.188	0.354
A_2	0.008	0.009	0.054	0.034
A_3	0.023	0.033	0.012	0.016

Source: own calculations, for details please refer to the appendix

Table-7: Payoff matrix of gas policies and potential forms of cooperation for Qatar

Qatar	C_1	C_2	C_3	C_4
Q_1	0.125	0.044	0.087	0.060
Q_2	0.178	0.217	0.203	0.030
Q_3	0.022	0.024	0.018	0.148

Source: own calculations, for details please refer to the appendix

The next section analyzes these results by comparing the highest payoffsfor each player, both respectively and in mutual context.

7. Analysis of the results

The interpretation of the individual payoff matrices finally permits answering the central question of this study. That is, why hasa gas cartel not materialized yet?

When comparing the highest payoff for each player it is apparent that they all would lead to different forms of cooperation. Russia would gain most from cooperation intechnology transfersand skill-sets as it allows maintaining its preference for pipelines, i.e. $\{R_1, C_4\}$. On the contrary, Algeria would not be reluctant to commit itself to quota restrictions in line with a classical cartel, i.e. $\{A_1, C_1\}$. And Qatar would be most willing to calibrate investment plans given that it wants to avoid excess capacityand is more flexible with regard to contract structures, i.e.$\{Q_2, C_2\}$.

Russia, with its traditional preference for pipelines, only in 2005 began developing a LNG export potential, but so far lacks the liquefaction capacity of Algeria or Qatar(IGU 2010, p. 15). Markets, not only in Europe, but especially in Asia increase their capabilities to receive LNG. If Russia wants to consolidate its position in Europe and moreover penetrate the Asian market it needs to accommodate this LNG demand. Thus, it is dependent on enhancing its LNG technology and expertise and is looking for partnerships. On the other hand, it would not loose significantly by sharing its pipeline expertise with other producers. Quite the opposite, sharing its pipeline know-how could be a door-opener for Russia to get a grip on potential alternative pipelines to Europe. Russia's strive for bilateral agreements with Algeria, as mentioned before, fit well into this interpretation. In early 2006, Russia and Algeria signed intentions on recovering, processing and selling Algerian gas. And in 2007 Algeria's Sonatrach company agreed to work in Russia. As Darbouche (2007, p. 5) points out, the driver behind these agreements was Russia, arguably because of its hunger for Sonatrach's LNG expertise and participation in key pipeline projects, such as GALSI, a proposed submarine pipeline linking Algeria to Italy.

Algeria, however, seeks other gains from cooperation and this might well be the reason why theintended agreements with Russia so far have not bared fruit. In line with its tradition of being a "price hawk" and getting the most of its gas resources in terms of revenues,Algeria in 2010 called on fellow gas-exporters for a cut in gas production to raise spot-market prices (Hoyos 2010). On the one hand, this may show an increasingly aggressive attitude towards the growing pressure from buyers to move away from oil-linked gas pricing. More profoundly, this may indicate that Algeria, much more than its fellow gas producers, seems to be willing to maximize short-term value of its exports at the expense of losing market share. Russia trying itself to consolidate market share in Europe, in fact opposed such measures immediately (Orttung and Overland, p. 64). Qatar, as well, did not accept Algeria's efforts to impose production reductions, albeit arguably for different reasons.

Qatar has just invested enormous amounts in gas infrastructure. Now it is looking for markets to bring its LNG on line. As mentioned before, there is great pressure to produce at capacity in order to generate the most of the investments. The shale gas revolution in the United States means that this export market does not materialize as was originally planned. It thus needs other markets and might be willing to compromise volumes for price. Moreover, as Qatar's reserves and export potential are very high relative to its small population, the need to generate maximum revenues is not as urgent as perhaps for Russia and Algeria. Qatar thus might reasonably gain most fromregulated investment plans with other producers in order to avoid the high costs of excess capacity in the future.

In sum, the comparison of each player's individual payoffs confirms the hypothesis of diverging interests. Each player seeks different gains from cooperation preventing collective action to come about. In particular, there appears no common ground for joint initiatives regarding output restrictions in order to manipulate prices. Only Algeria would expect gains from such initiatives. Thus, the emergence of a full-fledged cartel has not materialized and moreover seems rather unlikely to appear in the near future.

8. Conclusion

The presented study developed a complex game-theoretic analysis which confirms the proposed hypothesis that cartelized cooperation in the European gas market did not materialize thus far because of diverging individual interests. The international gas market is changing mainly driven by the shale gas revolution in the United States, the rise in LNG production, the increase in spot-market pricing of gas, and a relocation of demand. The effect of larger LNG supplies and the increase in spot-market prices are shown to be most affecting the European market. The current gas policies of key players Russia, Algeria, and Qatar are unevenly well suited to cope with these changes,inducing them to seek different gains from cooperation. The findings are thus in line with previous studies that are skeptical about the emergence of a full-fledged cartel in the near future (e.g.Ehrman 2006; Hallouche 2006). The value of this paper is the particular focus on diverging interests among players. In particular, it adds quantitative substance to qualitative arguments on the topic.

The findings indicate that the increase in LNG demand in Europe as a means to diversify supply dependency away from Russia aggravates Russia's need to develop its LNG capacity and expertise, which Algeria and Qatar already possess. It thus seeks gains in terms of transfers of LNG technology and skillsfrom partnership with the other two players. Algeria, as a classical "rentier state", is strongly dependent on high gas rents and thus would be more willing to aggressively increase prices through quota restrictions. Its strategy to lock-in key EU member states in "special partnerships" with the help of its flexible infrastructure may aggravate this propensity. Such "real" cartelizing intentions are, however, not shared by its potential partners. Russia, above all, wantsto preserve its market share in Europe. It thusshows willingness to compromise on prices by shifting away from purely oil-indexed contracts for the sake of keeping customers.Qatar might be best suited for the changing conditions in the international gas market. Its vast LNG capacities enable Qatar to accommodate rising LNG demand wherever it arises. The fact that as a small and wealthy country Qatar is not as dependent on retrieving the highest possible gas rents helps the country to increase market shares through more flexible contract structures. This policy is moreover beneficial as it is in Qatar's interest to

diversify security relationships with a wide variety of actors. But the vast LNG capacities could prove to be a disadvantage in the face of increasing oversupply of gas leading to excess capacities.In terms of cooperation, it thus would gain most from calibrating investment plans with other exporters in order to avoid idle capacities in the future, which are costly.

The much higher costs of maintaining excess capacityin the gas industry as compared to the petroleum industry moreover imply that the role of a "swing producer", similar to Saudi Arabia in OPEC, is rather unattractive (Jaffe and Soligo, p. 458). Qatar would arguably be most suitable for this role, but its payoffs suggest that it rather wants to limit excess capacity. This further adds to the notion of this paper that the chances of a cartel in the gas market are rather slim for the time being. It remains to be seen, however, if Russia's recently more active involvement in the GECF as well as its apparent search for bilateral agreements with both Algeria and Qatar are paving the way for harder cooperation in the future with negative effects for consumers. For the near time being, however, the implications for European energy security are positive.

To conclude, it needs to be noted that any game-theoretic analysis is to some extent arbitrary. This is also true for the study conducted here. Although the use of the Analytical Hierarchy Process checks for consistency in the qualitative judgments of different options, the evaluations remain subjective. The analysis could thus be enhanced by include judgments of a greater number of experts or, even better, decision-makers in the gas industry and politics of the respective countries. It is, however, not certain that the results would be more useful, particularly in terms of predicting whether a gas-cartel could emerge in the future in game-theoretic context. After all, any game-theoretic analysis most profoundly assumes the rationality of actors. But because rationality is an assumption of theory and not necessarily the truth in reality, every analysis based on rational actors has the chance to be wrong.

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Appendix

The analysis of this study employs the Analytical Hierarchy Process (AHP) as the tool to determine numerical payoff matrices. The AHP consists of evaluative judgments between different criteria with respect to a certain objective. The evaluations are conducted by pairwise comparisons of each criterion on a scale from 1 to 9. The resulting pairwise comparison matrices allow calculating the respective "eigenvector", i.e. the weight (or preference) of each criterion regarding the respective objective. For details on the method of calculation and the determination of eigenvectors please refer to Saaty (2008b).

Below all single pairwise comparison matrices are listed as well as the calculated results of all single eigenvectors. Their combination leads to the determination of the payoff-matrices for Russia, Algeria, and Qatar as used in the study. All calculations are done with Microsoft Excel. The structure of the appendix follows the tables as presented in the main paper and begins on the next page.

1.) Which global market change does most significantly affect the European gas market?

M_1 = the shale gas revolution
M_2 = the rise in LNG production
M_3 = the increase in spot-market pricing
M_4 = the relocation of demand

	M_1	M_2	M_3	M_4	normalized principal eigenvector
M_1	1	1/7	1/5	3	0.082
M_2	7	1	3	9	0.626
M_3	5	1/3	1	7	0.236
M_4	1/3	1/9	1/7	1	0.056

2.) Which of Russia's gas policies is most effective given the changes in the international gas market?

R_1 = expanding pipeline infrastructure

R_2 = maintaining long-term contracts with oil-indexed gas prices

R_3 = using gas as a vehicle to reassert regional and global status

M_1	R_1	R_2	R_3	normalized principal eigenvector
R_1	1	1/3	1/5	0.116
R_2	3	1	1/3	0.234
R_3	5	3	1	0.650

M_2	R_1	R_2	R_3	normalized principal eigenvector
R_1	1	1/3	1/3	0.143
R_2	3	1	1	0.429
R_3	3	1	1	0.429

M_3	R_1	R_2	R_3	normalized principal eigenvector
R_1	1	7	5	0.742
R_2	1/7	1	1/3	0.096
R_3	1/5	3	1	0.162

M_4	R_1	R_2	R_3	normalized principal eigenvector
R_1	1	5	7	0.742
R_2	1/5	1	3	0.162
R_3	1/7	1/3	1	0.096

Calculation of composite vector showing gas policies weighted with respect to market changes:

	M_1	M_2	M_3	M_4		
	0.082	0.626	0.236	0.056		
			X			Table-2
R_1	0.116	0.143	0.742	0.742		0.316
R_2	0.234	0.429	0.096	0.162	=	0.319
R_3	0.650	0.429	0.162	0.096		0.365

3.) Which of Algeria's gas policies is most effective given the changes in the international gas market?

Where

A_1 = expanding flexible infrastructure

A_2 = long-term contracts with oil-indexed gas prices

A_3 = forming small number of key "special relationships"

M_1	A_1	A_2	A_3	normalized principal eigenvector
A_1	1	9	3	0.689
A_2	1/9	1	1/7	0.065
A_3	1/3	7	1	0.245

M_2	A_1	A_2	A_3	normalized principal eigenvector
A_1	1	9	7	0.794
A_2	1/9	1	1/3	0.082
A_3	1/7	3	1	0.124

M_3	A_1	A_2	A_3	normalized principal eigenvector
A_1	1	9	5	0.761
A_2	1/9	1	1/3	0.079
A_3	1/5	3	1	0.160

M_4	A_1	A_2	A_3	normalized principal eigenvector
A_1	1	9	7	0.794
A_2	1/9	1	1/3	0.082
A_3	1/7	3	1	0.124

Calculation of composite vector showing gas policies weighted with respect to market changes:

	M_1	M_2	M_3	M_4		
	0.082	0.626	0.236	0.056		
			X			Table-3
A_1	0.689	0.794	0.761	0.794	=	0.778
A_2	0.065	0.082	0.079	0.082		0.080
A_3	0.245	0.124	0.160	0.124		0.142

4.) Which of Qatar's gas policies is most effective given the changes in the international gas market?

Where

Q_1 = expanding LNG export capacities

Q_2 = mixture of long-term and spot market contracts

Q_3 = diversify security relationships through multitude of "stakeholders"

M_1	Q_1	Q_2	Q_3	normalized principal eigenvector
Q_1	1	1/7	1/3	0.096
Q_2	7	1	5	0.742
Q_3	3	1/5	1	0.162

M_2	Q_1	Q_2	Q_3	normalized principal eigenvector
Q_1	1	9	3	0.692
Q_2	1/9	1	1/3	0.077
Q_3	1/3	3	1	0.231

M_3	Q_1	Q_2	Q_3	normalized principal eigenvector
Q_1	1	1/3	5	0.242
Q_2	3	1	7	0.675
Q_3	1/5	1/7	1	0.083

M_4	Q_1	Q_2	Q_3	normalized principal eigenvector
Q_1	1	7	3	0.677
Q_2	1/7	1	1/3	0.092
Q_3	1/3	3	1	0.231

Calculation of composite vector showing gas policies weighted with respect to market changes:

	M_1	M_2	M_3	M_4		
	0.082	0.626	0.236	0.056		
			X			Table-4
Q_1	0.096	0.692	0.242	0.677		0.536
Q_2	0.742	0.077	0.675	0.092	=	0.273
Q_3	0.162	0.231	0.083	0.231		0.190

5.) Which of Russia's gas policies can best be arranged with the respective form of cooperation?

Where

C_1 = the shale gas revolution

C_2 = the rise in LNG production

C_3 = the increase in spot-market pricing

C_4 = the relocation of demand

C_1	R_1	R_2	R_3	normalized principal eigenvector
R_1	1	7	3	0.677
R_2	1/7	1	1/3	0.092
R_3	13	3	1	0.231

C_2	R_1	R_2	R_3	normalized principal eigenvector
R_1	1	5	3	0.651
R_2	1/5	1	1	0.146
R_3	1/3	1	1	0.203

C_3	R_1	R_2	R_3	normalized principal eigenvector
R_1	1	1/7	1/5	0.083
R_2	7	1	3	0.675
R_3	5	1/3	1	0.242

C_4	R_1	R_2	R_3	normalized principal eigenvector
R_1	1	7	5	0.744
R_2	1/7	1	1	0.112
R_3	1/5	1	1	0.144

Calculation of payoff matrix for Russia:

	C_1	C_2	C_3	C_4		
R_1	0.677	0.651	0.083	0.744		0.316
R_2	0.092	0.146	0.675	0.112	X	0.319
R_3	0.231	0.203	0.242	0.144		0.365

=

Payoff matrix for Russia

	C_1	C_2	C_3	C_4
R_1	0.214	0.205	0.026	0.235
R_2	0.029	0.047	0.215	0.036
R_3	0.084	0.074	0.088	0.053

6.) Which of Algeria's gas policies can best be arranged with the respective form of cooperation?

C_1	A_1	A_2	A_3	normalized principal eigenvector
A_1	1	7	5	0.742
A_2	1/7	1	1/3	0.096
A_3	1/5	3	1	0.162

C_2	A_1	A_2	A_3	normalized principal eigenvector
A_1	1	5	3	0.650
A_2	1/5	1	1/3	0.116
A_3	1/3	3	1	0.234

C_3	A_1	A_2	A_3	normalized principal eigenvector
A_1	1	1/3	5	0.242
A_2	3	1	7	0.675
A_3	1/5	1/7	1	0.083

C_4	A_1	A_2	A_3	normalized principal eigenvector
A_1	1	1	5	0.455
A_2	1	1	3	0.429
A_3	1/5	1/3	1	0.116

Calculation of payoff matrix for Algeria:

	C_1	C_2	C_3	C_4		
A_1	0.742	0.650	0.242	0.455		0.778
A_2	0.096	0.116	0.675	0.429	X	0.080
A_3	0.162	0.234	0.083	0.116		0.142

=

Payoff matrix for Algeria

	C_1	C_2	C_3	C_4
A_1	0.577	0.506	0.188	0.354
A_2	0.008	0.009	0.054	0.034
A_3	0.023	0.033	0.012	0.016

7.) Which of Qatar's gas policies can best be arranged with the respective form of cooperation?

C_1	Q_1	Q_2	Q_3	normalized principal eigenvector
Q_1	1	1/3	3	0.234
Q_2	3	1	5	0.650
Q_3	1/3	1/5	1	0.116

C_2	Q_1	Q_2	Q_3	normalized principal eigenvector
Q_1	1	1/9	1/3	0.082
Q_2	9	1	7	0.794
Q_3	3	1/7	1	0.124

C_3	Q_1	Q_2	Q_3	normalized principal eigenvector
Q_1	1	1/5	3	0.162
Q_2	5	1	7	0.742
Q_3	1/3	1/7	1	0.096

C_4	Q_1	Q_2	Q_3	normalized principal eigenvector
Q_1	1	1	1/7	0.111
Q_2	1	1	1/7	0.111
Q_3	7	7	1	0.778

Calculation of payoff matrix for Qatar:

	C_1	C_2	C_3	C_4		
Q_1	0.234	0.082	0.162	0.111		0.536
Q_2	0.650	0.794	0.742	0.111	X	0.273
Q_3	0.116	0.124	0.096	0.778		0.190

=

Payoff matrix for Qatar

	C_1	C_2	C_3	C_4
Q_1	0.125	0.044	0.087	0.060
Q_2	0.178	0.217	0.203	0.030
Q_3	0.022	0.024	0.018	0.148