Pipeline Power

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Abstract

Using the Shapley Value we analyze the impact of three controversial pipeline projects on the power structure in the Eurasian trade of natural gas. Two of them, Nord Stream and South Stream, allow Russian gas to bypass transit countries, Ukraine and Belarus. Nord Stream's strategic value turns out to be huge, justifying the high investment cost for Germany and Russia. The additional leverage obtained through South Stream, in contrast, appears small. The third project, Nabucco, has received strong support from the EU Commission. It aims at diversifying Europe's gas imports by accessing producers in Middle East and Central Asia. Nabucco curtails Russia's power, but the benefits accrue mainly to Turkey, while the gains for the EU members are negligible.

Keywords: Bargaining Power, Networks, Trade Links, Energy Policy, Natural Gas
JEL class.: L5, L9, O22

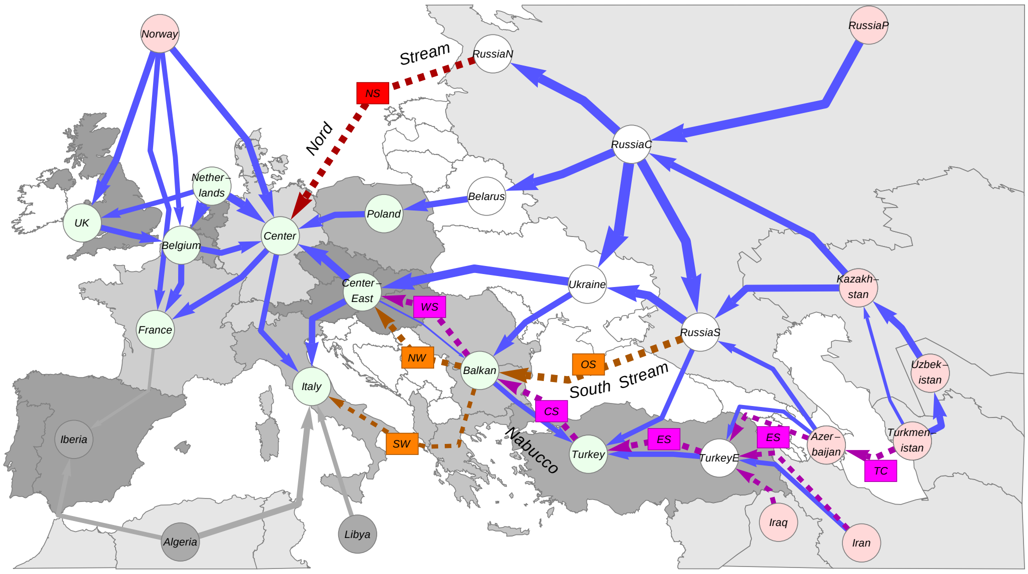
1 Introduction

Gas from the Russian Federation accounts for a quarter of the consumption in the European Union and for more than 40% of its imports. In 2010 essentially all of these imports depended on transit through either Belarus or Ukraine, both being major importers of Russian gas themselves. On both routes conflicts over transit fees and gas prices led to several interruptions of supply, the most serious one in January 2009 when transport through Ukraine was shut down for three weeks with dire consequences for heating and power supply in the Balkan.[1] European policy makers are struggling to find a coherent response to these challenges. On the one hand, new pipeline links with Russia are needed to diversify transit routes for Russian gas. On the other hand, such pipelines have the potential to further increase the dependency on Russian gas and reduce the viability of investments securing supplies from alternative sources. In addition, the interests of the EU member states often diverge and coalitions accounting for the regional particularities have to be formed in order to establish a common policy.

In this paper we analyze three controversial pipeline projects, which have the potential to thoroughly transform the Eurasian supply system for natural gas (for an illustration see figure 1). In the North, the offshore twin-pipeline *Nord Stream* establishes a direct link between Russia and Germany through the Baltic Sea. In spite of strong opposition from Poland and some Baltic states, it received EU support as a strategic infrastructure project. The first pipeline was inaugurated in late 2011 and the second is scheduled for completion in 2013. Further to the South, Italy and Russia discuss another offshore pipeline through the Black Sea, *South Stream*. If realized, it would provide a direct connection between Russia and Bulgaria, from where gas should flow to Central Europe, Italy and Turkey. By bypassing the transit countries, Belarus and Ukraine, both projects diversify transit routes for Russian gas. However, critics argue that they will also increase Europe's dependency on Russian exports and safeguard Russia's dominance in European markets by preempting investments into alternative gas supplies. Due to these concerns EU support for South Stream has been lukewarm. The Commission clearly favors a third project, *Nabucco*, aiming at diversifying gas imports. It would open a southern corridor through Turkey connecting Europe to new suppliers in the Middle East and the Caspian region. Nabucco also offers a new transit option to producers in Central Asia, which currently ship gas through Russia. The EU made Nabucco

[1] For a comprehensive account of major conflicts over transit through Belarus and Ukraine see Bruce (2005) and Pirani et al. (2009), respectively.

Figure 1: The Network



Those pipelines under construction or planning, which we consider in detail are dashed: Nord Stream in red (NS), South Stream in Orange (OS, NW, SW), and Nabucco in Magenta (TC, ES, CS, WS). Light red nodes represent producers. Transit nodes are white. Light blue points represent regions where we have a major transit node, which is linked to local production and local customers (the nodes are not shown separately). Solid arrows represent the main pipelines as existing in 2010. Grey nodes and pipelines are account for but not associated with a player in our analysis.

a major strategic project under its Trans-European Energy Networks (TEN-E), and the European Bank for Reconstruction and Development, the European Investment Bank, and IFC (a member of the World Bank Group) tentatively earmarked 4 billion € for funding.[2] However, raising firm support from national governments and funding from the private sector turned out to be difficult. South Stream and Nabucco are still at the planning stage and often portrayed as competing projects, because South Stream might drain Nabucco of potential gas supplies in Central Asia.

The size of these projects appears out of range with both production possibilities and market demand. With 55 bcm/a and 63 bcm/a, respectively, Nord Stream and South Stream will increase transport capacities for Russian gas by 63% from app. 186 bcm/a to almost 304 bcm/a. If compared to the peak of actual gas deliveries in 2008, the increase is almost 80% (BP (2011)). Given growing domestic consumption and slow progress in developing new fields in Western Siberia, Russia will not be able to produce enough gas to make use of the additional offshore transport capacity any time soon (Stern (2005)). Taken together all three pipelines would

[2]For the position of the EU see EU (2006), EU (2007), and EurActiv (2011).

increase the European import capacity by 150 bcm/a or 47%. While declining production in the EU makes an increase of imports a likely scenario, pipeline gas faces stiff competition from liquefied natural gas (LNG), which experienced a sharp drop in prices due to decreasing cost and competing supplies of non-conventional shale gas. Hence, we consider it as very unlikely that demand could take up so much additional pipeline gas in the foreseeable future.[3]

In this paper the focus is on the *strategic* role of the pipelines. Even if not needed to transport *additional* gas, pipelines may have a substantial impact on the balance of power in the network. By opening new options for trade they can decrease the value of established links if substitutable, or increase their value if complementary. To assess the pipelines' impact on bargaining power, we develop a regionally disaggregated quantitative model of the Eurasian gas network. The interdependencies among the players (regions) are represented by a game in characteristic function form, which is solved using the Shapley value. The power index thus obtained reflects the production possibilities, market size and the architecture of the transport network. When the latter is changed trough a new pipeline, we obtain a different game entailing gains for some and losses for other players. If the gains of the beneficiaries are larger than the cost of the pipeline, the project is a viable strategic option, even if the impact on total consumption and production is negligible. This does not necessarily imply that the pipeline will be built. First, those players which would benefit, have to succeed in setting up a consortium, sharing costs and gains etc, which might be difficult, if the gains spread over many regions. Second, those players who are set to loose power, might dissuade those who will gain from carrying out the project. Though this might also require a substantial amount of cooperation. In any case, a viable pipeline option is at least a credible threat, which might be used to extract concessions.

Our analysis shows that Nord Stream's strategic value is huge, justifying the high investment cost for Germany and Russia. It severely curtails the power of the transit countries, Belarus and Ukraine, outside producer Norway, and the EU's main producer, Netherlands. Overall, the members of the EU gain, but the project's regional impact is rather heterogeneous. In principle, South Stream fulfills a similar

[3]It is misleading to relate the projects to import needs projected for 2030 or later. While a pipeline might last more than 40 years, the decision to invest at a given time should be based on a much shorter forecasting range. Once the 'go ahead' is given, it will take 3-7 years before the pipeline is ready to deliver gas. Hence, if demand forecasted for a decade ahead is too low or too uncertain to justify the project, the investment should be *delayed* but not necessarily scrapped. For the option like nature of sunk investment under uncertainty see Dixit & Pindyck (1994).

strategic role. However, with Nord Stream already in place, the additional leverage obtained through South Stream is too small to make the project viable for its main beneficiaries; Russia, Germany and some central European countries. Nabucco has a large potential to curtail Russia's power, but the benefits accrue mainly to Turkey, which will diversify its gas imports and become a major potential hub. The gains for the EU members, in contrast, are negligible. With financial support from Turkey (and Iraq) some sections appear viable but our results cast doubts on the prospects of raising the necessary funds within the EU. Somewhat surprisingly, South Stream has little effect on Nabucco's attractiveness. The EU Commission's concern (or Russian hopes) that South Steam might pre-empt the investment in a southern corridor through Turkey appears unfounded.

The paper can be related to various strands of literature. Grais & Zheng (1996), Boots et al. (2004), von Hirschhausen et al. (2005) and Holz et al. (2008) use a non-cooperative approach to model strategic interaction in quantitative models of the Eurasian gas system. While this approach has computational advantages when solving large disaggregated models, we do see several conceptional shortcomings. First, the literature ignores that most pipeline gas is delivered under negotiated, comprehensive price-quantity-contracts. Instead it adopts counterfactual assumptions from the standard Cournot or Bertrand set up. In combination with market power, these restrictions on the strategy space lead to inefficiencies, which can be avoided by the contracts, which do exists in the real world.[4] Second, the power distribution is largely determined by ad hoc assumptions on the nature of strategic interaction at the various stages (production, transport, distribution) and on the sequencing of actions, hence, the ability to commit, and not derived from the underlying economic environment. To avoid these problems, Hubert & Ikonnikova (2011a) propose a cooperative model. They assume that players make efficient use of the existing network and derive the power structure endogenously from the actor's role in gas production, transport and consumption. Their regional scope however is very narrow. Here we extend their model to include several competing producers and transit countries such as Turkey. We also allow importers in the EU to act strategically. With these modifications we can assess the pipelines' impact on all major market participants. In a closely related paper Hubert & Orlova (2012) use the same quantitative model of the gas industry to analyze mergers and the

[4]The European pipeline system was developed under long–term agreements with so called 'take–or–pay' provisions. Contracts stipulate prices *and* quantities to ensure the efficient usage of the capacities and to avoid double marginalization (see Energy Charter Secretariat (2007) for details). Contracts with transit countries also cover tariffs *and* quantities.

liberalization of access rights within the EU.

On a more abstract level, the Eurasian pipeline network can be seen as just one example of a network, which enables the parties to trade. Its architecture determines not only the actual trade flows but also the power of the parties, i.e. how they will share the gains from trade. The more difficult it is to substitute for the resources which a player controls, the more powerful he will be. Hence, the actors will try to shape the network to their own advantage. That the formation or severance of trade links can be used to enhance the power of a nation has been recognized long ago (Hirschman (1969)). The Eurasian gas network, however, provides a rather unique opportunity to develop this notion in a quantitative model. More recent theoretical research developed formal models of strategic network formation (e.g. Jackson & Wolinski (1996), for a review see Jackson (2008)). In this paper we quantify the impact of particular link on the power structure and relate it to its cost, but we do not try to predict the equilibrium network structure (for a first attempt along these lines see Hubert & Ikonnikova (2011b)).

2 The Model

The Eurasian gas network consists of a set of nodes R, which may be production sites R_P , customers R_C or transit-connections R_T, and a set of directed links L representing pipelines (see figure 1 for a simplified illustration). A link $l = \{i, j\},\ i \neq j \in R$ connects two nodes. Gas flows are denoted x_{ij} where negative values indicate a flow from j to i. For those links, which connect a producer to the network or the network to a customer, flows have to be positive ($x_{ij} \geq 0,\ \forall\, i \in R_P$ or $j \in R_C$). For each link $\{i, j\}$ we have a capacity limit k_{ij} and link specific transportation costs $T_{ij}(x)$, which include production costs in case of $i \in R_P$. For capacities which already exist, transportation costs consist only of operation costs, because investment cost are sunk. Each customer is connected through a single dedicated link to the network. So consumption at node $j \in R_C$ is equal to x_{ij}. The inverse demand is $p_j(x_{ij})$.

The set of strategic players is denoted N. The interdependencies among the players are captured by a game in value function form (N, v), where the value (or characteristic) function $v : 2^{|N|} \to R_+$ gives the maximal payoff, which a subset of players $S \subseteq N$ can achieve. The legal and regulatory framework determines the access rights of the various players. So for any coalition $S \subseteq N$ we have to determine to which links $L(S) \subseteq L$ the coalition S has access. Access to the link $\{i, j\},\ i \in R_P$ is equivalent of having access to production at p. Access to $\{i, j\},\ j \in R_C$ yields access to customer j. The value function is obtained by maximizing the joint surplus of the players in S using the gas-flows in the pipelines:

$$v(S) = \max_{\{x_{ij}|\{i,j\}\in L(S)\}} \left\{ \sum_{\{i,j\}\in L(S),\, j\in R_C} \int_0^{x_{ij}} p_j(z)dz - \sum_{\{i,j\}\in L(S)} T_{ij}(x_{ij}) \right\} \tag{1}$$

subject to the node-balancing constraints $\sum_i x_{it} = \sum_j x_{tj},\ \forall\, t \in R_T(S)$, the capacity constraints of the network $|x_{ij}| \leq k_{ij},\ \forall\, \{i, j\} \in L(S)$ and non-negativity constraints $x_{ij} \geq 0,\ \forall\, i \in R_P$ or $j \in R_C$. The value function captures the essential economic features, such as the geography of the network, different cost of alternative pipelines, demand for gas in the different regions, production cost, etc. It also reflects institutional features, such as ownership titles and access rights.

Finally, we calculate the Shapley value, $\phi_i,\ i \in N$, which is player i's weighted contribution to possible coalitions:

$$\phi_i(v) = \sum_{S : i \notin S} P(S)\, [v(S \cup i) - v(S)] \tag{2}$$

where $P(S) = |S|!\,(|N| - |S| - 1)!/|N|!$ is the weight of coalition S. The Shapley value assigns a share of the surplus from cooperation to each player, which will be also referred to as his 'power'.

The impact of pipeline investment on bargaining power is measured as follows. First we generate the value function v^o for the initial network. Then we add pipelines or pipeline segments to obtain a new network generating v^1. The gross impact of the pipelines on the surplus of player i is then given by $\phi_i(v^1) - \phi_i(v^o)$. Finally we compare this difference in payoffs to the investment cost of the pipeline.

To obtain a detailed representation of the various customers, owners of pipelines, gas producers, etc. we would like to consider a large set of players. Unfortunately, computational complexity increases fast in the number of players, as we have to solve $2^{|N|}$ optimization problems to calculate the value function. It is for computational reasons that we restrict the geographical scope by aggregating customers into large markets and leaving out producers which appear to be of minor strategic relevance.

As to producers, we focus on Russia, the supplier for Nord Stream and South Stream, its main competitor Norway, and those countries in the Middle East and Central Asia which have a potential to serve Nabucco: Iraq, Iran, Azerbaijan, and Turkmenistan. The player "Turmenistan" embraces all production and transport in Central Asia (Uzbekistan, Kazakhstan, Turmenistan). Transit countries are Belarus, Ukraine and Georgia. Turkey is a major consumer and a potential transit

Table 1: Consumers

Regions	Consumption [a] [bcm]	Own gas [b] [bcm]	Import Dependency [a] [c] [%]	Import Dep. on Russia[d] [%]
Balkan[e]	19.4	11.3	41.9	83.0
Belgium	17.7	0.0	100	0.0
Center[f]	102.5	23.4	77.2	40.2
Center-East[g]	33.2	4.9	85.2	86.4
France	44.6	0.9	98.0	18.8
Italy	78.0	8.0	89.7	29.7
Netherlands	49.0	78.7	−60.8	–
Poland	15.9	5.9	63.0	71.6
Turkey	35.1	0.7	98.1	50.1
UK	90.8	62.5	31.2	0.0

[a] Compiled from OECD/IEA (2011) for 2009.

[b] "Own gas" includes own production, LNG-imports and in some cases net-imports from pipelines, which are not considered to be strategic in this analysis. Compiled from OECD/IEA (2011).

[c] Net imports/consumption

[d] Imports from Russia for 2009 (BP (2010))/net imports for 2009 (OECD/IEA (2011))

[e] Romania, Bulgaria and Greece

[f] Germany, Denmark, Switzerland and Luxembourg

[g] Austria, Hungary, Czech Republic and Slovakia

country for Middle Eastern and Caspian gas. We aggregate customers and producers within the EU into eight regional players. Each controls local production, access to local customers, and possibly transit through the region. France, Italy, Poland, Netherlands, and Belgium correspond their respective countries. In each of these countries a national champion dominates imports and local supply (GDF, ENI, PNGiG, Gasunie and Botas, respectively). We collect Austria, Czech Republic, Slovakia and Hungary in one region called "Center-East". South Stream and Nabucco will end in Center-East, from where gas will be distributed to other European consumers. The countries in the region exhibit similar consumption and import dependency patterns. With very little alternative supplies the region depends with almost 90 % of its consumption on imports from Russia. The pipeline networks are largely privatized. The Austrian OMV can be seen as the dominant private supplier in the region. Germany, Switzerland, Denmark and Luxembourg are bundled to "Center". In terms of consumption the region is clearly dominated by Germany, which is also home of large gas suppliers, E.ON-Ruhrgas and Wintershall. The region covers more than three quarters of gas consumption by imports, but its imports are well diversified between Russia (40.2%), Norway (38.1%) and

Netherlands (29.3%).[5] Finally, we collect Romania, Bulgaria and Greece in a region called "Balkan". The region has only weak links to other European regions and its imports depend largely on Russian gas.

We aggregate all pipelines and interconnection points between any two players into one link. The arrows in figure 1 indicate the direction of net flows between regions according to IEA (2010). The new projects Nord Stream, South Stream and Nabucco are shown as dashed arrows. Their arrows display the direction of flow after the completion of the project, namely from East to West. As to access rights, we assume that outside EU every country has unrestricted control over its pipelines and gas fields. For the regions within the EU, in contrast, we assume that common market rules ensure open third party access to the international high pressure transport pipelines. Hence, regions within the EU cannot derive bargaining power from blocking gas transit. Since this is an idealization of the current state of regulation, we discuss the robustness of our results in Section 4. EU regions control local production and access to the local customers. Within EU only Netherlands is a major net exporter of gas. The other regions are mainly customers, who use Russian, Norwegian and Dutch gas to complement their own production and other imports, which are taken as given.

We assume a stationary environment with constant demand, technology, production cost, etc. The value of a coalition, nevertheless, depends on the temporal scope of the model. In the very short run, the pipeline network is essentially static. The longer one projects into the future, however, the more options to invest in pipes, compressors etc. can be exploited, hence the more flexible the transport system becomes. Here, we adopt a rather short horizon assuming that all pipelines can be made bi-directional, but capacities cannot be increased.

The details of the numerical calibration are given in a technical appendix. Here we outline only the main idea. We calibrate the model using data for 2009 from IEA (2010a) on consumption and production in the regions and flows between the regions from November 2009 to October 2010 taken from IEA (2010b). We assume constant production cost and linear demand functions with the same intercept for all regions. The slope parameters are then estimated as to replicate the consumption in 2009, given our assumption on production and transportation cost. The most important implication of our calibration of demand in relation to cost is that the pipeline system as existing in 2009 is efficient. Given the willingness to pay and the cost of producing gas, it is able to deliver the efficient amount of gas into the different con-

[5] BP (2010), OECD/IEA (2011).

sumption nodes. Thus, none of the expensive pipeline projects considered in this paper can be justified in narrow economic terms. The Grand coalition of all players, or a benevolent central planner maximizing welfare, would not invest in any of the projects. Only a subgroup of players might find investment beneficial because it increases their bargaining power at the cost of the others.

This approach also ensures that the main difference between the regions is consumption and how it relates to own production on which we have solid information and not our assumption on demand intercepts on which information is poor. The main difference between producers is production capacity and pipeline connections to the markets, for which data are reasonably good, and not differences in wellhead production cost, which are difficult to estimate.

A critical part of the calibration is the relation of demand intercept and production cost, which largely determines the overall surplus from gas trade. The relative shares of different players tend to be rather robust with respect to an aggregate increase of demand in relation to production cost. However, the absolute values of their shares will increase, and as a result more pipeline projects will become strategically viable for given investment cost. As previous research has revealed strong incentives to invest for strategic reasons (Hubert & Ikonnikova (2011b)), we use a conservative approach. We annualize investment cost using a rather high discount rate of 15% to account for depreciation and the real option nature of the investment. At the same time, we use a rather low estimate for the difference between demand intercept and supply cost of 500 €/tcm in our base line scenario, which, in principle, makes it difficult to justify investments on strategic grounds.

3 Results for Pipelines

We assess the impact of a new pipeline by comparing the Shapley Value for two games, one without and another with the pipeline in place. Since a player's Shapley Value is the weighted sum of his contributions to the values of possible coalitions of other players, any change can be traced back to changes of these contributions. The value of a coalition depends on its access to pipelines, markets and gas fields. Hence, a player can increase the coalition value by providing additional markets, additional supply or by improving connections through transit. In any case, the value of his contribution will depend on how well his resources complement what is already at the coalition's disposal. Adding a market to other markets with no access to production helps little compared to making the same market available to several producers, which are short of customers. Generally speaking, a pipeline may benefit a player by improving his access to complementary inputs and hurt him by improving his competitors access to such resources. The trade-off between access and competition is complicated by the fact that some countries play multiple roles. While in our model Russia is a pure producer, and Belarus and Ukraine are pure transit regions; Balkan is all, a gas producer, a customer and a transit region for Russian gas. Moreover, the role of a player depends on the coalition against which he is evaluated. For example, Turkey is an importer when all players are in the coalition. However, it becomes a transit country for Russian gas in a smaller coalition, for which neither transit through Belarus nor Ukraine is available. Multiple and changing roles make it sometimes difficult to predict what the overall impact of a new pipeline on a player will be.

Given our calibration of demand, the new pipeline projects do not create value. They can only change the power structure. The redistribution of bargaining power is most clearly seen in the change of the players' percentage shares in the total surplus. As the change of these shares is quite robust with respect to different calibrations of demand, hence surplus, we focus on this measure. Finally, we compare the absolute gains of those players, whose power is increased, to the investment cost of the pipeline to assess the strategic viability of the pipeline.

3.1 Nord Stream

Nord Stream bypasses the transit countries in the Northern corridor and connects Russia via a twin offshore pipeline through the Baltic Sea to Germany. The project was initiated by Russian Gasprom and German EON-Ruhrgas and Wintershall in 2005. Later French GDF Suez and Dutch Gasunie joined the consortium. The first pipeline was put into service in late 2011. The pipeline is expected to be fully operational with 55 bcm/a by 2013. Published figures on investment cost have been revised several times. We estimate total cost including complementary pipelines in Russia and Germany at 12 billion €.

Table 2 exhibits Nord Stream's effect on the players' relative power. For each player we report the Shapley value in percent of the total surplus with and without the pipeline as well as the difference between the two measuring the project's impact. The benchmark case without Nord Stream is presented in the first column. The sum of all figures gives the total surplus of the grand coalition, when all players cooperate regarding the production and transport of pipeline gas. The shares of suppliers re-

Table 2: Nord Stream's Impact on Bargaining Power

Players[a]	Shapleyvalue [%] without Nord Stream	with Nord Stream	difference
Russia	10.	13.3	3.3
Ukraine	4.3	1.4	−2.9
Belarus	1.3	0.4	−0.9
Norway	11.3	9.1	−2.3
Netherlands	8.4	7.2	−1.2
UK	2.1	2.	−0.1
Center	20.5	22.1	1.6
Center-East	12.4	13.3	0.9
Italy	3.7	4.	0.3
Poland	2.1	2.2	0.2
France	8.7	9.4	0.7
Belgium	3.8	4.1	0.3
Balkan	0.9	0.9	0.
Turkey	8.3	8.3	0.

[a]Turkmenistan, Iraq, Iran, Azerbaijan, and Georgia are omitted because they are not affected by the project. For full results see the technical appendix.

flect their production capacities as well as their dependency on the transit countries to access to consumer markets. Although Russia exports more gas than Norway to the European markets, Norway's surplus (11.3%) is larger than Russia's (10.0%), since Norway has direct access to the European pipeline network, while Russia depends on transit countries, Ukraine and Belarus, to ship gas to the European markets. Different transport capacities in Ukraine and Belarus are reflected in their shares 4.3% and 1.3%, respectively. The largest European producer, Netherlands obtains 8.4%. The other European regions are net importers, hence their benefits tend to increase with the size of their markets and their dependence on pipeline gas. The figures reflect the gains from trading gas, not the gains from consuming gas. A country whose own production or LNG imports are large enough to cover demand will gain little from participating in the gas trade even if its gas market is large. The EU as a whole obtains 62.6%, with Center, Center-East and France having the largest shares. Turkey benefits from its consumption of pipeline gas as well as its potential transit position between Balkan and the suppliers; Russia, Iran and Azerbaijan.

The last column in Table 2 presents Nord Stream's impact on the players' surplus in terms of the differences. Russia gains 3.3 percentage points, an increase of one third of its share in the benchmark case. Increased transport competition mitigates the power of Ukraine and Belarus, which loose 2.9 and 0.9, respectively. The transit countries together lose two thirds of their relative power in the benchmark case, since their monopoly in transportation of Russian supplies to Europe is broken. Due to intensified supply competition in the European markets, Norway and Netherlands suffer losses of 2.3 and 1.2 points, respectively. The European players together benefit from increased transport and supply competition gaining 2.7 points. With 1.6 points Center has the largest increase in the EU.

Nord Stream's total strategic value for the initiators of the consortium, Wintershall and EON Ruhrgas of Germany and Gazprom of Russia (in our model Center and Russia), is huge. Even in our low surplus baseline scenario a gain of 4.9 percentage points translates into a gain of 2.2 bn €/a, which clearly exceeds the project's cost of 1.8 bn €/a (for similar results see Hubert & Ikonnikova (2003), Hubert & Ikonnikova (2011a), Hubert & Suleymanova (2008)). It is worth stressing that the project appears profitable only because it increases the bargaining power of the consortium vis-a-vis other players. Given our calibration of demand, the pipeline is not needed to transport additional gas. Our results also suggest that it is in the interest of the EU to support the project since the gains of the EU and Russia (2.7 bn €/a) is larger than the annualized cost of the project.

After Russia and Germany kicked off the project, the consortium was joined by Gasunie of Netherlands and GDF Suez of France, each with a share of 9%. In view of our results the participation of Gasunie is surprising, since Netherlands supplies 15% of the EU's consumption and is set to loose from intensified supply competition. Our interpretation is the following. Not being able to prevent Nord Stream Gasunie joined in anticipation of its changing role in the system. Due to rapidly declining reserves Netherlands will become a net importer around 2025. The country also intents to become a gas hub in Northwestern Europe transiting Russian gas from Germany to UK (Netherlands Ministry of Economic Affairs, Agriculture and Innovation (2010)).

3.2 South Stream

South Stream can be seen as the Black Sea twin of Nord Stream. Russia pushes the project to obtain direct access to its customers in the Southeast, bypassing Ukraine. It consists of three sections: offshore, northwestern and southwestern.

OS: The offshore section runs through Turkey's economic zone in Black Sea and connects Russia directly with Bulgaria with a capacity of 63 bcm/a. The consortium for the offshore section is composed by Gazprom of Russia, Eni of Italy and EDF of France. Onshore the pipeline splits in two routes.

NW: The northwestern route runs from Bulgaria to Baumgarten in Austria via Serbia and Hungary with a capacity of 30 bcm/a.

SW: The southwestern route connects Bulgaria to Italy via Greece and a short offshore pipeline through Adriatic Sea. It has a capacity of 10 bcm/a.

Each section of northwestern and southwestern routes in the participating countries will be undertaken by a joint-venture between Gazprom and national gas company of the corresponding country.

The offshore and the onshore pipeline sections are expected to cost 10 billion € and 5.5 billion €, respectively. Thus, South Stream has total investment cost of 15.5 billion € (South Stream (2010)). According to press releases, the first line of the project with a capacity of 16 bcm/a should be operational at the end of 2015. The project will be in service with full capacity at the end of 2018.

Russia enjoys a very strong bargaining position in Southeastern Europe. Competing producers such as Norway or Netherlands cannot reach this region, since the transport capacities between Balkan and Central Europe are very small (1.7 bcm/a).[6] The northwestern section improves the connection between Center and Balkan; thus, it has a potential to increase competition for Russian gas in Balkan and Turkey. However, we assume that the consortium will seek exemption from the third party access (TPA) rules so that Gazprom can prevent its competitors from using the pipeline.[7]

[6] In January 2009, the gas dispute between Russia and Ukraine severely hit the Balkan countries, because of this bottleneck between Balkan and Central Europe preventing alternative supplies from Northwestern Europe being made available.

[7] To incentivize new investment in infrastructure projects, the EU allows for so called regulatory holiday under EU (2009). We also analyzed what happens if South Stream's Northwestern section is not exempted from rules on free third party access. In this case, Russia would loose interest in the project because the strategic gains from bypassing Ukraine are largely offset by the losses of increased competition from Dutch and Norwegian gas.

Table 3: South Stream's Impact on Bargaining Power

	without Nord Stream				*with Nord Stream*			
	Shapley value[%]	Impact of pipeline sections[a] *(difference to column 2 table 2)*			Shapley value[%]	Impact of pipeline sections *(difference to column 3 table 2)*		
		OS	OS+NW	OS+NW+SW		OS	OS+NW	OS+NW+SW
Russia	13.1	0.5	2.7	3.1	14.2	0.3	0.8	0.9
Ukraine	1.5	−0.4	−2.3	−2.7	0.5	−0.3	−0.8	−0.9
Belarus	0.6	0.	−0.6	−0.7	0.2	0.	−0.2	−0.2
Norway	9.5	−0.1	−1.5	−1.8	8.5	0.	−0.5	−0.6
Netherlands	7.4	0.	−0.8	−1.	6.9	0.	−0.2	−0.3
UK	2.	0.	−0.1	−0.1	2.1	0.	0.	0.
Center	21.8	0.1	1.	1.3	22.6	0.	0.4	0.5
Center-East	13.1	0.	0.6	0.8	13.5	0.	0.2	0.2
Italy	4.	0.	0.2	0.3	4.2	0.	0.1	0.1
Poland	2.2	0.	0.1	0.1	2.3	0.	0.	0.
France	9.3	0.	0.5	0.6	9.6	0.	0.1	0.2
Belgium	4.1	0.	0.2	0.3	4.2	0.	0.1	0.1
Balkan	1.1	0.2	0.2	0.2	1.1	0.2	0.2	0.2
Turkey	8.4	0.1	0.1	0.1	8.4	0.1	0.1	0.1
Iraq	0.	0.	0.	0.	0.	0.	0.	0.
Iran	1.2	−0.2	−0.2	−0.2	1.2	−0.2	−0.2	−0.2
Azerbaijan	0.3	−0.1	−0.1	−0.1	0.3	0.	0.	0.
Georgia	0.3	−0.1	−0.1	−0.1	0.3	0.	0.	0.
Turkmenistan	0.1	0.	0.	0.	0.1	0.	0.	0.

[a] OS: offshore section with 63 bcm/a and investment cost of 8.6 billion €.
NW: Northwestern section with 30 bcm/a and investment cost of 3.5 billion €.
SW: Southwestern section with 10 bcm/a and investment cost of 3.4 billion €.

Nord Stream will be fully operational, before the construction of South Stream is expected to start. So, the impact of South Stream has to be assessed for a network which already includes Nord Stream (the right panel of Table 3). Nevertheless, it is instructive to study the counterfactual case first, which is presented in the left panel of Table 3. The comparison of left panel's last column in Table 3 and the last column in Table 2 shows that South Stream and Nord Stream alter the power structure in a similar way. It does not matter much whether Russian gas is injected in Center or in Balkan if third party access to the existing European network assured, while Russia's dominance in Southeastern Europe remains protected. As in the case of Nord Stream, Russia enjoys the biggest increase in bargaining power, worth 3.1 points, while competing suppliers and transit countries loose.

Now we turn to the realistic scenario, in which Nord Stream is already in operation (the right panel of Table 3). We start with the impact of the offshore section alone (the column headed 'OS'). The leverage gained is very small, since the gas could only be transported to Balkan, a small market, and Turkey, which is already accessible through Blue Stream. Without substantial onshore investments the offshore section is of little strategic use. If both complementary sections are added the picture, we obtain a scaled down version of the counterfactual case. Russia gains 0.9 points, while Ukraine and Belarus suffer from transit competition and Netherlands and Norway from intensified supply competition. Surprisingly, Center, which does not participate in the consortium obtains the largest gains in the EU. It is also worth noting that the southwestern section has very little impact on the power structure. With Nord Stream and the North Western section in place, there is already a large amount of spare capacity to transport Russian gas to Central Europe and Italy.[8] Adding a 10 bcm/a link through the Adriatic Sea makes hardly a difference.

Finally, we again ask whether the project is worth the cost. As an *alternative* to Nord Stream, the more expensive South Stream would be viable for the members of the consortium (Russia, Italy, France, Center-East and Balkan), if the offshore section is combined with the northwestern section. Even in our low-surplus scenario the gains of 2.0 bn €/a justify the cost of 1.8 bn €/a. Though, the incremental gains of the southwestern section (0.3 bn €/a) would not be worth the additional cost (0.5 bn €/a). With Nord Stream in place, however, South Stream's impact on bargaining power is much diminished which casts doubts on its strategic viability. In the baseline scenario the consortium gains 1.0 bn €/a, which is less than half of

[8]The northwestern and offshore sections of South Stream and Nord Stream together increase pipeline capacity between Russia and Europe (except Balkan) from 140 bcm/a to 225 bcm/a, while in 2008 the demand for Russian gas in the area was 108.3 bcm (BP (2009)).

the total project cost of 2.3 bn €/a.

In summary, considered as an alternative, both South Stream and Nord Stream have similar effects on the power structure, since both projects bypass the transit countries and allow Russia to compete more effectively with Norway and Netherlands, without loosing its strong position in the Southeast. However, in the presence of Nord Stream's large capacities, South Stream provides much less additional leverage. The gains for the consortium appear too small to compensate for the project's high cost.

3.3 Nabucco

Plans for a new 'southern corridor' have been discussed for almost two decades. In the late nineties the US government pushed for a 'Trans-Caspian Pipeline' from Central Asia through the Caspian Sea, Azerbaijan and Georgia into Turkey and further on to Southern Europe. The strategic aim was twofold: to reduce Turkey's and Europe's dependency on Russian gas and to decrease Russia's leverage in the newly independent former Soviet republics. However, US energy companies dragged their feet over uncertain economic prospects. These worsened when Russia started to contract large volumes of gas from Turkmenistan in 2002 at much higher prices than before. With the US' support withering the Europeans took over the initiative. A consortium lead by OMV of Austria and Botas of Turkey (later joined by German RWE) coined the new name 'Nabucco'.[9] The focus of the new project has shifted, in the East from Central Asia towards suppliers in the Middle East and in the West towards extending the pipeline into the heart of Europe. The project has been postponed several times and is currently scheduled to become operational in 2017.

For the assessment of the pipeline's impact it is useful to divide Nabucco into four sections: Trans-Caspian, the eastern section, the central section and the western section.

TC: Trans-Caspian, for the purpose of this paper, is narrowly defined as the offshore pipeline between Turkmenistan and Azerbaijan. With 30 bcm/a capacity it is estimated to cost 2.3 billion €. RWE of Germany and OMV of Austria, both also members of Nabucco's overall consortium, have the initiative.

[9] The consortium also included companies from transit countries: Bulgargaz of Bulgaria, Transgaz of Romania, and MOL of Hungary.

ES: The Eastern section consists of several pipelines connecting Turkey with potential suppliers, Azerbaijan, Iran and Iraq. We include Iran even though at present this appears to be very unlikely for political reasons. The country has the second largest gas reserves in the world and Turkey already imports gas from Iran. Even though none of the parties involved in the project will openly admit, Iran is an important potential supplier for Nabucco. For the calculation we assume that the existing capacity of each feeder pipeline between Turkey and the suppliers is increased by 15 bcm/a, and the section from Turkey's East to the West is enlarged by 30 bcm/a. We estimate the cost as 12.2 billion €.

CS: The central section connects western Turkey with Balkan. It is important to note that existing pipelines with a capacity of app. 16 bcm/a are currently used to pump Russian gas into the opposite direction, from Balkan into Turkey. Nabucco will reverse the direction of the flow through the central section and expand its capacity by 30 bcm/a to an estimated total of 46 bcm/a. We estimate the cost of the central section at 1.9 billion €.

WS: The western section connects Balkan to Center with a planned capacity of 30 bcm/a and an estimated cost of 3.5 billion €. At present, Southeastern Europe is isolated from Central Europe since existing transport capacities between these regions are small (1.7 bcm/a). As a result, Russia faces no competition from Norway and Netherlands in the Southeast. The Nabucco consortium rallied political support in the EU arguing that it would help to integrate the region to other European markets by eliminating the bottleneck. The pipeline is designed for bidirectional use and shall be open for gas transport for all interested parties. So, we assume that every player has access to Nabucco's western section, whereas we assumed exclusive access for South Stream's northwestern section.

Nabucco's expected total cost is 17.6 billion € (19.9 incl. TC). Since none of the potential suppliers is a member of either Nabucco's or Trans Caspian's consortium, producers are not expected to contribute to investment cost.[10]

It is worth emphasizing, that Nabucco's commercial prospects are built on reversing flows in the present network. Currently, gas flows in small quantities from Center

[10] In principle, the suppliers can compensate the members of the consortium for investment cost by providing cheap gas under long term contracts. We doubt, however, that countries like Azerbaijan and Iraq, not to speak of Iran, can credibly make such long term commitments.

to Balkan and in substantial quantities from Balkan to Turkey. These flows have to be reversed before anybody will pay transport fees to Nabucco's owners. Considering the pipeline in isolation, it is easy to underestimate how much additional gas in Turkey is needed to justify its capacity. Let's consider the central section of Nabucco. First, some 10 bcm/a are needed to substitute for the current flow from Balkan to Turkey. Second, existing capacities can be made bidirectional at modest cost to pump some 16 bcm/a from Turkey to Balkan without new pipelines. Third, 30 bcm/a are needed to fill the additional pipeline capacities. In total it would require app. 55 bcm/a additional gas in Turkey to make fully use of the new pipeline. As with Nord Stream and South Stream, many observers raised serious doubts as to whether such quantities can be provided anytime soon. We, rather optimistically, assume that Irak, Azerbaijan and Central Asia can supply an additional 36.5 bcm/a and Iran another 21.5 bcm/a compared to the output in 2009. Since Nabucco's project cost do not account for investment in new fields such as Shah Deniz II in Azerbaijan or South Pars in Iran, such an increase would have to be achieved from current production capacities.

In Table 4 we report selected results for the strategic impact of Nabucco. We focus on a scenario where Nord Stream is already completed and then Nabucco is added to the system (left panel). The first column shows the Shapley values for the completion of all sections in percent of the total surplus. It should be compared to column 2 in Table 2. The difference between the two i.e. the impact of the whole project is shown in column 4 under the header 'TC+ES+CS+WS'.

By bringing in new suppliers in the East and connecting them with the center of Europe's network Nabucco weakens the bargaining power of all old suppliers, but in particular Russia (-3.1 points). The lion's share of the benefits, however, accrues to Turkey (+2.9 points) and Iraq (+0.7 points) while the impact on regions within the EU is surprisingly small. Balkan is the only one with a significant gain (0.3 points). Nabucco and the Trans Caspian Pipeline also do little to improve the position of Central Asian producers (here represented by Turkmenistan). We attribute this to the fact, that the new supply route has three transit countries of which Azerbaijan is also a competing producer.

In our baseline scenario, these percentage points amount to a gain of 1.3 bn €/a for Turkey and 0.3 bn €/a for the European members of the consortium together, which cannot cover the annualized investment cost of app. 2.7 bn €/a (incl. TC 3.0 bn €/a). In view of these results, the EU's support of the project makes little strategic sense. Nabucco appears oversized given the current gas flows in the

Table 4: Nabucco's Impact on Bargaining Power

	without South Stream				*with South Stream*	
	Shapley value [%]	Impact of pipeline sections[a] *(difference to column 3 table 2)*			Shapley value [%]	Impact[b]
		TC+ES	WS	TC+ES+ CS+WS		TC+ES+ CS+WS
Russia	10.2	−1.8	−0.7	−3.1	10.8	−3.3
Ukraine	0.9	−0.2	−0.2	−0.5	0.3	−0.1
Belarus	0.4	0.	0.	−0.1	0.2	0.
Norway	8.7	−0.1	0.6	−0.3	8.2	−0.3
Netherlands	7.1	−0.1	0.4	−0.1	6.8	−0.1
UK	2.	0.	0.	−0.1	2.	−0.1
Center	22.2	0.	−0.3	0.1	22.7	0.1
Center-East	13.4	0.	−0.1	0.1	13.6	0.1
Italy	4.	0.	−0.1	0.	4.2	0.
Poland	2.2	0.	0.	0.	2.3	0.
France	9.5	0.	−0.1	0.1	9.7	0.1
Belgium	4.1	0.	0.	0.	4.2	0.
Balkan	1.3	0.2	0.3	0.3	1.3	0.2
Turkey	11.2	1.5	1.1	2.9	11.1	2.7
Iraq	0.7	0.8	0.	0.7	0.7	0.7
Iran	1.2	−0.2	−0.5	−0.1	1.2	0.
Azerbaijan	0.3	−0.1	−0.1	0.	0.3	0.
Georgia	0.3	−0.1	−0.1	0.	0.3	0.
Turkmenistan	0.2	0.1	0.	0.1	0.2	0.1

[a] The sections are:

TC (Trans Caspian) with 30 bcm/a and investment cost of 2.3 bn €.

ES (eastern section) pipelines between east Turkey and Azerbaijan, Iran and Iraq, each increased by 15 bcm/a. East to West Turkey enlarged by 30 bcm/a. Total investment cost 12.2 billion €.

CS (central section) with 30 bcm/a and investment cost of 1.9 billion €.

WS (western section) with 30 bcm/a and investment cost of 3.5 billion €.

[b] difference to column 6 table 3

system.

It is also instructive to consider the effect of the different sections separately. Suppose only the sections in the east are built (TC and ES), which connect Turkey to the producers in the Middle East and Central Asia (second column). As increased supply competition harms other producers, in particular Russia, it benefits Turkey and to a much lesser extend Balkan. The effects on other EU regions are negligible, which is not surprising in view of the bottleneck between Balkan and the rest of Europe. Taken altogether, the pipelines in the east appear to have little effect on the power of the various (potential) producers in the region, such as Azerbaijan, Iran, Iraq, but this is because they are being played off against each other. We also carried out an even more disaggregated analysis to reveal the strategic incentives to invest in every single trunk pipeline (Turkey-Iraq, Turkey-Iran etc.) assuming that the Central and Western sections of Nabucco fail to materialize. Given our conservative assumptions about demand and surplus, the only viable option is a new pipeline to Iraq as it promises large rewards for Turkey and Iraq and has little cost. Even if Iran could increase production from current fields by 15 bcm/a, the cost of the pipeline exceeds the gain in bargaining power. We obtain a similar result for a pipeline to Azerbaijan, where we have two options: either develop offshore production in Azerbaijan or continue through the Caspian Sea to reach fields in Central Asia. For both options the cost outweigh the strategic gains.

Next, we consider only the western section (WS) connecting Balkan and Central Europe (column three). This pipeline with a capacity of 30 bcm/a will hardly be used. Nevertheless, the option to move gas from Northwest to Southeast intensifies competition for customers in the Southeast which benefits Turkey and Balkan as well as producers in Northwest at the cost of Russia and producers in the Middle East and Caspian region. Some regions in the EU, such as Center, Center-East and France are slightly harmed from increased demand competition, since Norway and Netherlands will gain better access to other markets. Again the effect on the EU as a group is negligible. With a total gain of 1.0 bn €/a and cost of 0.5 bn €/a the section would be a viable option for producers in Northwest together with Turkey and Balkan. But it is difficult to envisage how such diverse players can implement a project, which has little potential to generate direct revenues. The 'returns of the investment' come only indirectly with Turkey paying less for gas from Russia and Iran and Central Europe paying more for gas from Norway and Netherlands.

Finally, we return to the perception that South Stream and Nabucco are competing projects and the concern that the former might preempt investment into the latter. In the right panel of Table 4 we show the strategic impact of Nabucco in a situation, where South Stream and Nord Stream will be fully operational. Comparing the second column of the right and the fourth column of the left panel, we find very little difference. Hence, South Stream has almost no impact on the strategic viability of Nabucco.

3.4 Robustness

The previous results depend on a number of parameter assumptions and we will briefly discuss, how robust they are (for more details see appendix).

The power index, as measured by the relative Shapley Value depends largely on architecture of the current network and access rights and is quite robust with respect to a proportional increases of surplus in all regions or a uniform increase in cost of production of all producers. Our conclusion about the strategic viability of additional pipelines, however, compares absolute cost to absolute gains. To check robustness we tripled the surplus by uniformly raising the demand intercept for the customers while adjusting the slope to replicate consumption in the reference year. More pipelines and pipeline section become strategically viable, but the relative merits of the different projects do not change much. The benefit to cost ratio remains by far highest for Nord Stream, both from the perspective of the consortium and from the viewpoint of the EU. For the EU it is lowest for Nabucco and from the viewpoint of the respective consortium, South Stream remains the least attractive proposition.

Next, we reconsider our assumption of free third party access within the European Union. When the European Commission started its policies to ensure a common market for natural gas in the late nineties, the situation was indeed very different. Most countries had a ‘national champion’ who monopolized the high pressure transportation grid, hence long distance transport, and one might argue that it is still a long way to overcome this fragmentation of the market. In a fragmented market, a region in the EU enjoys exclusive access to its trunk-pipes and can derive power by blocking gas shipments. As a rule, European regions, which neighbor a producer or a transit country, gain transit power, while importers without Non-European borders suffer in a fragmented market compared to an integrated one (see Hubert & Orlova (2012) for a detailed analysis). While the impact of a change of access rights on the relative bargaining power of the players is quite substantial, the effect of additional pipelines in the new setting is similar and most of our conclusions regarding the strategic viability of the various projects remain valid. There is one minor exception. The incremental gain through the central and western sections of Nabucco are amplified. In an otherwise fragmented market, these sections of Nabucco, which will be open for access by third parties, have a stronger impact on the power structure.

Finally, we consider an increase of demand accompanied by a decrease in European production capacities. In accordance with predictions for 2030, we increase each consumer’s demand by 20%. By that time Netherlands’ production is expected to decrease by 30 bcm/a, making the region a net importer. By keeping LNG imports constant, we rule out that the growth of demand can be satisfied by alternative sources of gas. Regarding the production capacity of Russia, we study two cases: In the first, Russia's production capacity remains unchanged. In the second it is increased by 30 bcm/a to compensates for the decrease in Netherlands' production.

Overall, these high demand scenarios create environments, which are very favorable for pipeline investments. Nevertheless, with Nord Stream in place the narrowly defined economic benefits of additional pipelines are still a tiny fraction of project cost in all scenarios.[11] The strategic effect, however, is amplified. Even with Nord Stream providing already a massive direct link, South Stream's additional leverage for Russia and European customers yields gains which clearly outweigh the projects cost. Only the Southwestern section through the Adriatic Sea remains an unattractive proposition. The increase in demand also enhances the strategic attractiveness of Nabucco. The value of the central and western section is raised enough to justify the investment cost. While the main benefits still accrue to Turkey and eastern producers, European importers would also improve their leverage. These results do not depend much on whether Russia can raise production capacities over present day levels or not.

4 Concluding Remarks

In the previous sections we analyze the strategic impact of three large pipeline projects, Nord Stream, South Stream and Nabucco. Starting with a disaggregated quantitative model of the Eurasian network for natural gas, consisting of its main producers, trunk-pipelines and areas of consumption, we calculate the value function to characterize the interdependencies among the main actors in the current system. Then we solve the game with the Shapley Value, which is taken as the index for the bargaining power of the different players. Adding a new pipeline changes the network, hence the value function and as a result the Shapley value. This allows us to identify those players who are set to gain in bargaining power and those who will be harmed. Moreover, we obtain quantitative estimates of the size of these effects, which can be compared to the cost of the link.

If the gains of the winners outweigh the project's cost, then we call it strategically viable. Such a pipeline is a potential threat when bargaining over compensation for gas and transport services in the existing system. Though it still requires coor-

[11] The increase in total surplus is 0.04 (0.03) bn €/a for South Stream and 0.16 (0.18) bn €/a for Nabucco if Russia can (cannot) increase production, while project cost are 2.3 and 1.7, respectively.

dinated action on part of the winners, i.e. the establishment of a investment consortium, sharing of cost etc. to make the threat fully credible. To prevent the threat from being carried out, those who are expected to loose bargaining power will have to dissuade the winners by granting them better terms for access to gas, transport services or customers than those which would reflect their power in the existing network. Again this might require a cooperative effort. If some players focus too much on their short run bargaining power or lack the ability to make credible long term commitments, then the threat might not be enough to extract concessions and a pipeline might be built for strategic reasons (Hubert & Ikonnikova (2011b)).

If considered as an alternative, both South Stream and Nord Stream have very similar effects on the power structure in the Eurasian transport network for natural gas. The pipelines bypass the transit countries Belarus and Ukraine and allow Russia to compete more effectively with Norway and Netherlands. Nord Stream's strategic impact can hardly be overstated. For the initiators of Nord Stream, Russia and Germany, the gains in bargaining power clearly justify the cost of investment even in our conservative baseline scenario. Russia had a very rocky relationship with both transit countries throughout the nineties and several attempts for a long-term solution covering transit fees, prices for gas imports and control of trunk-pipes failed. In view of our results, it is not surprising that in 2005 more cost efficient pipeline projects such as Yamal II have been abandoned in favor of the expensive direct offshore link. We predict that upon the completion of Nord Stream transit revenues for Ukraine and Belarus will drop and prices for gas imports increase substantially.

The main beneficiaries of South Stream are Russia, Germany and some Central European countries. However, once Nord Stream's large capacities become operational, South Stream's additional leverage is much reduced and the gain in power cannot compensate for the high cost. As a result, we are sceptical as to the implementation of this project. This is especially true for the southern branch through the Adriatic Sea to Italy, which will remain non-viably even when demand is substantially increased.

Nabucco opens a southern corridor through Turkey connecting Europe to new suppliers in the Middle East and the Caspian region. It also offers a new option to the producers in Central Asia, which currently ship gas through Russia. The EU made Nabucco a major strategic project under its Trans-European Energy Networks (TEN-E) and substantial public funds have been earmarked for the project. In view of our results, this policy is difficult to rationalize. The project has large potential to decrease Russia's power, but the benefits would accrue mainly to Turkey, which could diversify its gas imports and become a major potential hub. The gains for the members of the EU, in contrast, are negligible. In view of substantial gains for Turkey we expect investments in pipelines connecting Irak and Azerbaijan to Western Turkey. However, we doubt that the central and western parts of Nabucco will be implemented any time soon, mainly because of insufficient support from private investors in central Europe.[12]

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[12]Recent developments lend credibility to this sceptical assessment. While Austrian OMV's and German RWE's support for Nabucco is crumbling Botas of Turkey and Socar of Azerbaijan agreed on a Trans-Anatolian pipeline from Shah Deniz gas field to Turkey's West, which corresponds to the eastern sections of Nabucco but has half of its capacity, 16 bcm/a (Businessweek (2011)).

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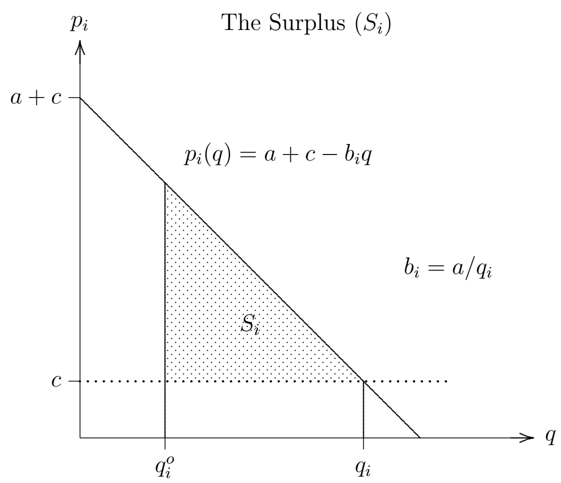
A Appendix

A.1 Calibration

In this section we describe the functions and parameters used for the calculation of the value function (equation (1) in the main text). Let x^*_{ij}, $\{i, j\} \in L(N)$ denote the solution to the program in (1) when solved for the grand coalition, which has access to all resources. To calibrate the model, we have to determine p_i and T_{ij} such that x^*_{ij} are reasonably close to observed consumption and flows. As we assume that the players cooperate effectively, they will make efficient use of the existing network. Hence, in each region the marginal willingness to pay for gas, $p_i(q)$ will be equal to the local marginal cost of supplying gas, the nodal cost $c_i(q)$, which take into account the physical constraints of the system. We use this feature to calibrate first inverse demand and then supply cost using data on consumption and flows compiled from IEA (2010).

Demand

Transport costs within Europe are small compared to the cost of producing gas and transporting it to Europe's borders. As a first approximation, we neglect the small differences among local cost and assume a common constant supply cost c.[13] For each consumption region we assume a linear inverse demand function. To reduce the number of parameters we assume the same intercept $a+c$ for all regions. Efficiency requires $p_i(q) = a + c - b_i q = c$ for each region i. The slope parameters b_i are then calibrated as to replicate the consumption in 2009: $b_i = a/q_i$, where q_i is the consumption of gas in region i compiled from IEA (2010).[14]



[13]For none of the links within Europe the capacity constraints was binding in 2009/10. So nodal cost differ only by the variable transportation cost between connected nodes which are small.

[14]All quantities are quoted in bcm/a. All prices or cost are quoted in mio €/bcm (giving the same

Table 5: Consumers

	Consumption[a]	Own Gas [a b]	Slope		
			Baseline	High Surplus	High Demand
	[bcm/a]	[bcm/a]			
			$a = 500$	$a = 1500$	$a = 500$
	q_i	q_i^o	b_i	b_i	b_i
Balkan[c]	20.2	11.6	24.8	74.3	20.6
Belgium	16.9	3	29.6	88.9	24.7
Center[d]	104.6	23.7	4.8	14.3	4.0
Center-East[e]	36.8	0.6	13.6	40.7	11.3
France	44.1	9.9	11.3	34	9.4
Italy	75.6	45.2	6.6	19.8	5.5
Netherlands	48.3	55.7	10.4	31.1	8.6
Poland	16	5.8	31.3	93.8	26.1
Turkey	36.4	6.8	13.7	41.2	11.5
UK	90.5	72.2	5.5	16.6	4.6

[a]The data are compiled for 2009 from IEA (2010).

[b]"Own gas" includes own production, LNG-imports and in some cases net-imports from pipelines, which are not considered to be strategic in this analysis (e.g. France to Spain, Center East to Serbia).

[c] Romania, Bulgaria and Greece

[d] Germany, Denmark, Switzerland and Luxembourg

[e] Austria, Hungary, Czech Republic and Slovakia

As illustrated in the figure, the surplus, which a customer obtains from participating in the trade of pipeline gas depends on the three parameters, the a, its consumption in the base year q_i, and its independent supply of 'own gas' q_i^o, which includes regional production, LNG-imports and in some cases net-imports from pipelines, which are not considered to be strategic in this analysis. The common supply cost c acts as a shift parameter, which does not affect the surplus. An increase of a, with b_i being adjusted, affects all regions proportionally. Such a change has little impact on the *relative* Shapley value (measured in per cent of the total), hence, will have little effect on our index for bargaining power. What matters for the relative size of the surplus is 'own gas' q_i^o, and 'consumption' q_i, for which we have reliable data. See table 5 for the resulting parameter values.

However, a determines the absolute size of the surplus, which is of relevance if we compare the changes in bargaining power to the cost of a pipeline project. It is difficult to support any assumption for a by hard data. Obviously, it will depend a lot on how much time we give customers to substitute to other sources of energy. So we are forced to make bold assumptions and check the robustness of our

figure as the more common €/tcm.

results. In our baseline variant we assume that a is equal to 500 Mio€/bcm (or equivalently 500 €/tcm) yielding a total surplus from consuming gas of 126.2 bn €/a, which is rather conservative. In such a low surplus scenario it will be difficult to justify pipeline investment on strategic grounds. We also consider a 'high-surplus' scenario with $a = 1500$.[15] In addition, we consider a 'high-demand' (low-surplus) scenario. Here we calculate the slope as $b_i = a/(1.2 \cdot q_i^o)$, which implies an increase of demand by 20% if evaluated at $p_i(q) = c$.

The parameter c acts as a shift parameter for the demand system. It is supposed to reflect the typical production and transportation cost reasonably well. Accordingly, we decomposed it as $c = c^P + \bar{c}^T$, where c^P reflects a common production cost parameter and $\bar{c}^T$ an adjustment made for typical transportation cost. These values determine the patterns of production and transport to which we turn next.

Production

Our focus is on imported pipeline gas, which is considered to be the marginal source of gas. The big producers outside EU often also have substantial own consumption and exports to regions, which we do not account for in our analysis. For simplicity we treat treat them as pure producers. We consider only production capacities which could be made available for exports to Europe and Turkey (column 2 in table 6) after accounting for own consumption and exports to other markets. These capacities can be compared to the relevant export flows. As can be seen from table 6 column 3, all producers have some slack capacity.

The differences in the operating cost of producing from existing fields are small compared to differences in the cost of developing new fields. In addition, meaningful information on wellhead production cost are difficult to obtain. As with demand we make a bold assumption by introducing a common supply cost parameter c^P to which we make only minor adjustments for regional differences, Δ_i. We decrease supply cost slightly for Central Asian producers and increase it slightly for Iran (were cost of transport to Eastern Turkey are included). Since it is more difficult to produce at maximal capacity k_{ij}, we assume production cost to be piecewise linear : $T_{ij}(q) = (c^P + \Delta_i)(\min[q, 0.75 * k_{ij}] + 1.2 \max[q - 0.75 * k_{ij}, 0])$. These adjustments help to get more realistic flows for the network, but have only a negligible impact on our estimate of bargaining power. Since the demand system is adjusted to any choice

[15]The results for the low-surplus scenario are given in 9 to 16. The results for the high surplus scenario are in tables 17 to 22.

Table 6: Pipeline Network: Production outside EU

Links from	Links to	Capacity[a] k_{ij} [bcm/a]	Flow[b] [bcm/a]	Cost[c] $c_p + \Delta_i$ [€/tcm]	needed for access
RussiaP	RussiaC	167.7	144.2	c_p	Russia
NorwayP	Norway	90	80.4	c_p	Norway
AzerbaijanP	Azerbaijan	9	5.0	c_p	Azerbaijan
KazakhstanP	Kazakhstan	15	9.8	$c_p - 4$	Turkmenistan[d]
TurkmenistanP	Turkmenistan	20	10.7	$c_p - 4$	Turkmenistan[d]
UzbekistanP	Uzbekistan	15	11.9	$c_p - 4$	Turkmenistan[d]
Iran	TurkeyE[e]	13.7	7.2	$c_p + 6$[f]	Iran, Turkey
Iraq	TurkeyE[e]	0	0	c_p[f]	Iraq, Turkey

[a] Estimated capacities which could be made available for export to Europe and Turkey.

[b] Only exports to Europe and Turkey. The data are compiled from IEA (2010) and BP (2010).

[c] The global parameter c_p is set equal to 20.

[d] To reduce the number of players, Turkmenistan stands for all Central Asian countries.

[e] We assume that production can be increased by 15 bcm/a to supply Nabucco.

[f] Including transportation to TurkeyE.

of c^P, its absolute value is rather irrelevant and arbitrarily set as $c^P = 20$.

For the players within the EU, own gas production is lumped together with LNG-imports and the (small) net imports through pipelines which are connected to areas outside of our regional scope. For these sources we assume that production/net-imports are fixed at the level of the calibration year (see table 5). We also ignore any cost of using ‘own gas’.

Transport

The total cost of transporting gas consists, in principle, of operating cost and capacity cost. Since capacity costs of existing pipelines are sunk, we do not take them into account. This simplification is based on the assumption that bargaining among rational players should not be influenced by sunk cost. The operating cost is composed by management & maintenance cost and energy cost, which are proportional to the length of the pipeline as well as to the quantity of gas transported. Since it is difficult to run a pipeline throughout the year at maximal capacity, we assume a piecewise linear function: $T_{ij}(q) = c^T_{ij} * (\min[q, 0.75 * k_{ij}] + 1.2 * \max[q - 0.75 * k_{ij}, 0])$, where k_{ij} denotes maximal capacity. Per unit transportation costs are constant, but only up to three quarter of the pipe capacity and increased by 20% for the remaining quarter.

Table 7: Pipeline Network: Transit

Links from	Links to	Capacity[a] [bcm/a]	Flow[b] [bcm/a]	Operating[c] Cost: c_{ij}^T [€/tcm]	needed for access
Transit outside EU[d]					
RussiaC	Belarus	–[d]	31.3	2.1	Russia, Belarus
RussiaC	RussiaN	–[d]	0	2.3	Russia
RussiaC	RussiaS	–[d]	8.9	3.6	Russia
RussiaC	Ukraine	–[d]	93.4	2.0	Russia, Ukraine
Azerbaijan	RussiaS	13	0	3.8	Azerbaijan, Russia
Kazakhstan	RussiaC	49	32.3	1.5	Russia, Turkmenistan[e]
Turkmenistan	Kazakhstan	5	0	2.7	Turkmenistan[e]
Turkmenistan	Uzbekistan	44	10.7	1.7	Turkmenistan[e]
Uzbekistan	Kazakhstan	44	22.5	1.8	Turkmenistan[e]
Azerbaijan	TurkeyE	8.8	4.5	2.4	Azerbaijan, Turkey, Georgia
RussiaS	Turkey	16	8.9	3.6	Russia, Turkey
TurkeyE	Turkey	20	11.8	2.4	Turkey
Transit into (out of) EU					
Belarus	Poland	33	31.3	1.4	Belarus, Russia
Norway	Belgium	15	12.2	6.3	Norway
Norway	France	18.3	15.0	4.4	Norway
Norway	Center	46	29.2	4.5	Norway
Norway	UK	46.4	24.0	4.9	Norway
Ukraine	Balkan	31.3	16.5	3.4	Russia, Ukraine
Ukraine	Center-East	105.8	77.0	4.4	Russia, Ukraine
Balkan	Turkey	16.3	8.9	1.8	Turkey
Transit within EU					
Belgium	France	30	14.9	0.8	In the standard variant we assume free access to transit pipelines within the EU. With exclusive access both players of the left side are needed.
Belgium	Center	26	1.0	0.6	
Center-East	Balkan	1.7	1	3.3	
Center-East	Center	77.8	18.4	2.4	
Center-East	Italy	37.0	21.3	2.7	
Center	France	28	4.3	1.4	
Center	Italy	20.2	9.1	3.5	
Netherlands	Belgium	53	10.7	0.5	
Netherlands	Center	80	11.7	0.6	
Netherlands	UK	15.3	7.0	0.7	
Poland	Center	31.4	24.4	3.2	
UK	Belgium	25.5	7.5	0.7	

[a] The data are compiled from ENTSOG (2010) and public sources.

[b] The data are compiled from IEA (2010).

[c] We give the unit cost for flows up to 75% of the capacity. For the remaining 25% of capacity the numbers are increased by 25%.

[d] Pipelines outside EU are also used to transport gas to other areas and local markets. Hence, figures for capacities are often much larger, than what is actually used to transport gas for the EU and Turkey. The flows however, refer to gas which is delivered to EU and Turkey.

[e] To reduce the number of players, Turkmenistan stands for all Central Asian countries.

Table 8: Pipeline Network: New Pipelines

Links from	Links to	Capacity[a] old + new [bcm/a]	Flow[b] [bcm/a]	Operation Cost [€/tcm]	Capacity Cost[c] [bn€]	Capacity Cost[c] [bn€/a]	required for for access
Nord Stream							
RussiaN	Center	$0+55$	0	6.9	12	1.8	Russia
South Stream							
RussiaS	Balkan	$0+63$	0	5.6	8.6	1.3	Russia
Center-East	Balkan[d]	$1.7+30$	1	3.3	3.5	0.5	Russia
Balkan	Italy	$0+10$	0	3.9	3.4	0.5	Russia
Nabucco							
Turkmenistan	Azerbaijan[e]	$0+30$	0	0.9	2.3	0.3	Azerbaijan, Turkmenistan
Azerbaijan	TurkeyE	$8.8+15$	4.5	2.4	2.5	0.4	Azerbaijan, Turkey, Georgia
Iran	TurkeyE	$13.7+15$	7.2	26.[f]	5.4	0.8	Iran, Turkey
Iraq	TurkeyE	$0+15$	0	21.8[f]	1.8	0.3	Iraq, Turkey
TurkeyE	Turkey	$20+31$	11.8	2.4	2.5	0.4	Turkey
Balkan	Turkey[g]	$16.3+31$	8.9	1.8	1.9	0.3	Turkey
Center-East	Balkan[d]	$1.7+30$	1	3.3	3.5	0.5	

[a] Existing capacity as compiled from ENTSOG (2010) and public sources + planned capacity

[b] Data are compiled from IEA (2010).

[c] Capacity expenditure (left column) is converted to annualized capacity-cost (right column) using a discount rate of 15%.

[d] Currently gas flows from Center-East to Balkan. The projects plan to revert the flow.

[e] This part of the project is referred to as Trans-Caspian.

[f] Incl. cost of production.

[g] Currently gas flows from Balkan to Turkey. The project plans to revert the flow.

To calculate the link specific cost parameter c_{ij}^T, we assume universal operating cost of 0.3 €/tcm/100km for onshore pipelines. For offshore pipelines we assume operating cost to be 50% higher to account for higher pressure and increased difficulties of maintenance. These coefficients are then multiplied with the distance between the nodes to obtain the link specific operating cost shown in table 7 column 3.

Having specified production cost by c^P and Δ_i and link specific transportation cost by c_{ij}^T, the only free parameter is the ‘typical’ transport cost $\bar{c}^T$. To determine a value, we run the optimization program (1) for the grand coalition to find that $\bar{c}^T = 8$, yields a solution x_{ij}^* which closely replicates the empirical data on consumption and flows in the system.

New Projects

For new projects and enlargement of existing pipeline networks we refer to public sources for costs estimates of the project consortia, which are supplemented by own estimates if figures are unavailable, outdated or subject to review to obtain the total cost shown in (table 8). We use a rather high discount rate of 15% to translate capital expenditures into annualized capacity cost. This rate is a common hurdle rate in the gas industry and reflects the real option nature of the investment and depreciation.

A.2 Results in Tableform

Baseline scenario

Table 9: Nord Stream's Impact (absolut)

	Shapleyvalue [bn €/a]		
	without Nord Stream	with Nord Stream	difference
Russia	4.6	6.1	1.5
Ukraine	2.	0.6	−1.3
Belarus	0.6	0.2	−0.4
Norway	5.2	4.2	−1.
Netherlands	3.9	3.3	−0.6
UK	1.	0.9	0.
Center	9.4	10.1	0.7
Center-East	5.7	6.1	0.4
Italy	1.7	1.9	0.2
Poland	0.9	1.	0.1
France	4.	4.3	0.3
Belgium	1.7	1.9	0.1
Balkan	0.4	0.4	0.
Turkey	3.8	3.8	0.
Iran	0.6	0.6	0.
Azerbaijan	0.2	0.2	0.
Georgia	0.2	0.2	0.
project cost[a]			1.5

[a]Investment cost annualized with an interest of 15%.

Table 10: Nord Stream's Impact (relative)

Players[a]	Shapleyvalue [%] without Nord Stream	with Nord Stream	difference
Russia	10.	13.3	3.3
Ukraine	4.3	1.4	−2.9
Belarus	1.3	0.4	−0.9
Norway	11.3	9.1	−2.3
Netherlands	8.4	7.2	−1.2
UK	2.1	2.	−0.1
Center	20.5	22.1	1.6
Center-East	12.4	13.3	0.9
Italy	3.7	4.	0.3
Poland	2.1	2.2	0.2
France	8.7	9.4	0.7
Belgium	3.8	4.1	0.3
Balkan	0.9	0.9	0.
Turkey	8.3	8.3	0.

[a]Turkmenistan, Iraq, Iran, Azerbaijan, and Georgia are omitted because they are not affected by the project. For full results see the technical appendix.

Table 11: South Stream's Impact (absolut)

	without Nord Stream				*with Nord Stream*			
	Shapley value [bn €/a]	Impact of pipeline sections[a] *(difference to column 2 table 2)*			Shapley value [bn €/a]	Impact of pipeline sections *(difference to column 3 table 2)*		
		OS	OS+NW	OS+NW+SW		OS	OS+NW	OS+NW+SW
Russia	6.	0.2	1.3	1.4	6.5	0.2	0.4	0.4
Ukraine	0.7	−0.2	−1.1	−1.3	0.2	−0.2	−0.4	−0.4
Belarus	0.3	0.	−0.3	−0.3	0.1	0.	−0.1	−0.1
Norway	4.4	0.	−0.7	−0.8	3.9	0.	−0.2	−0.3
Netherlands	3.4	0.	−0.4	−0.5	3.2	0.	−0.1	−0.1
UK	0.9	0.	0.	0.	1.	0.	0.	0.
Center	10.	0.	0.5	0.6	10.4	0.	0.2	0.2
Center-East	6.	0.	0.3	0.3	6.2	0.	0.1	0.1
Italy	1.8	0.	0.1	0.1	1.9	0.	0.	0.1
Poland	1.	0.	0.1	0.1	1.	0.	0.	0.
France	4.3	0.	0.2	0.3	4.4	0.	0.1	0.1
Belgium	1.9	0.	0.1	0.1	1.9	0.	0.	0.
Balkan	0.5	0.1	0.1	0.1	0.5	0.1	0.1	0.1
Turkey	3.9	0.	0.	0.	3.9	0.	0.	0.
Iran	0.6	−0.1	−0.1	−0.1	0.6	−0.1	−0.1	−0.1
Azerbaijan	0.2	0.	0.	0.	0.2	0.	0.	0.
Georgia	0.1	0.	0.	0.	0.1	0.	0.	0.
Turkmenistan	0.	0.	0.	0.	0.	0.	0.	0.
project cost[b]		1.3	1.8	2.3		1.3	1.8	2.3

[a] OS: offshore section with 63 bcm/a and investment cost of 8.6 billion €.
NW: Northwestern section with 30 bcm/a and investment cost of 3.5 billion €.
SW: Southwestern section with 10 bcm/a and investment cost of 1.5 billion €.

[b] Investment cost annualized with an interest of 15%.

Table 12: South Stream's Impact (relative)

	without Nord Stream				*with Nord Stream*			
	Shapley value[%]	Impact of pipeline sections[a] *(difference to column 2 table 2)*			Shapley value[%]	Impact of pipeline sections *(difference to column 3 table 2)*		
		OS	OS+NW	OS+NW+SW		OS	OS+NW	OS+NW+SW
Russia	13.1	0.5	2.7	3.1	14.2	0.3	0.8	0.9
Ukraine	1.5	−0.4	−2.3	−2.7	0.5	−0.3	−0.8	−0.9
Belarus	0.6	0.	−0.6	−0.7	0.2	0.	−0.2	−0.2
Norway	9.5	−0.1	−1.5	−1.8	8.5	0.	−0.5	−0.6
Netherlands	7.4	0.	−0.8	−1.	6.9	0.	−0.2	−0.3
UK	2.	0.	−0.1	−0.1	2.1	0.	0.	0.
Center	21.8	0.1	1.	1.3	22.6	0.	0.4	0.5
Center-East	13.1	0.	0.6	0.8	13.5	0.	0.2	0.2
Italy	4.	0.	0.2	0.3	4.2	0.	0.1	0.1
Poland	2.2	0.	0.1	0.1	2.3	0.	0.	0.
France	9.3	0.	0.5	0.6	9.6	0.	0.1	0.2
Belgium	4.1	0.	0.2	0.3	4.2	0.	0.1	0.1
Balkan	1.1	0.2	0.2	0.2	1.1	0.2	0.2	0.2
Turkey	8.4	0.1	0.1	0.1	8.4	0.1	0.1	0.1
Iraq	0.	0.	0.	0.	0.	0.	0.	0.
Iran	1.2	−0.2	−0.2	−0.2	1.2	−0.2	−0.2	−0.2
Azerbaijan	0.3	−0.1	−0.1	−0.1	0.3	0.	0.	0.
Georgia	0.3	−0.1	−0.1	−0.1	0.3	0.	0.	0.
Turkmenistan	0.1	0.	0.	0.	0.1	0.	0.	0.

[a] OS: offshore section with 63 bcm/a and investment cost of 8.6 billion €.
NW: Northwestern section with 30 bcm/a and investment cost of 3.5 billion €.
SW: Southwestern section with 10 bcm/a and investment cost of 3.4 billion €.

Table 13: Nabucco's Impact (absolut)

	without South Stream				*with South Stream*	
	Shapley value[bn €/a]	Impact of pipeline sections[a] *(difference to column 2 in table 9)*			Shapley value [bn €/a]	Impact[b]
		TC+ES	WS	TC+ES+ CS+WS		TC+ES+ CS+WS
Russia	4.7	−0.8	−0.3	−1.4	5.	−1.5
Ukraine	0.4	−0.1	−0.1	−0.2	0.1	−0.1
Belarus	0.2	0.	0.	0.	0.1	0.
Norway	4.	−0.1	0.3	−0.1	3.8	−0.1
Netherlands	3.2	0.	0.2	−0.1	3.1	0.
UK	0.9	0.	0.	0.	0.9	0.
Center	10.2	0.	−0.1	0.1	10.5	0.1
Center-East	6.2	0.	−0.1	0.1	6.3	0.1
Italy	1.9	0.	0.	0.	1.9	0.
Poland	1.	0.	0.	0.	1.1	0.
France	4.4	0.	−0.1	0.	4.5	0.
Belgium	1.9	0.	0.	0.	1.9	0.
Balkan	0.6	0.1	0.1	0.1	0.6	0.1
Turkey	5.1	0.7	0.5	1.3	5.1	1.2
Iraq	0.3	0.4	0.	0.3	0.3	0.3
Iran	0.6	−0.1	−0.2	−0.1	0.5	0.
Azerbaijan	0.2	0.	−0.1	0.	0.1	0.
Georgia	0.1	0.	−0.1	0.	0.1	0.
Turkmenistan	0.1	0.	0.	0.1	0.1	0.1
project cost[c]		2.2	0.5	3.0		3.0

[a]TC: Trans Caspian with 30 bcm/a and investment cost of 2.3 bn €.
ES (eastern section). Pipelines between east Turkey and Azerbaijan, Iran and Iraq, each increased by 15 bcm/a. East to West Turkey enlarged by 30 bcm/a. Total investment cost 12.2 billion €.
CS (central section) with 30 bcm/a and investment cost of 1.9 billion €.
WS (western section) with 30 bcm/a and investment cost of 3.5 billion €.

[b] difference to column 5 in table 11

[c]Investment cost annualized with an interest of 15%.

Table 14: Nabucco's Impact (relative)

	without South Stream				*with South Stream*	
	Shapley value [%]	Impact of pipeline sections[a] *(difference to column 3 table 2)*			Shapley value [%]	Impact[b]
		TC+ES	WS	TC+ES+ CS+WS		TC+ES+ CS+WS
Russia	10.2	−1.8	−0.7	−3.1	10.8	−3.3
Ukraine	0.9	−0.2	−0.2	−0.5	0.3	−0.1
Belarus	0.4	0.	0.	−0.1	0.2	0.
Norway	8.7	−0.1	0.6	−0.3	8.2	−0.3
Netherlands	7.1	−0.1	0.4	−0.1	6.8	−0.1
UK	2.	0.	0.	−0.1	2.	−0.1
Center	22.2	0.	−0.3	0.1	22.7	0.1
Center-East	13.4	0.	−0.1	0.1	13.6	0.1
Italy	4.	0.	−0.1	0.	4.2	0.
Poland	2.2	0.	0.	0.	2.3	0.
France	9.5	0.	−0.1	0.1	9.7	0.1
Belgium	4.1	0.	0.	0.	4.2	0.
Balkan	1.3	0.2	0.3	0.3	1.3	0.2
Turkey	11.2	1.5	1.1	2.9	11.1	2.7
Iraq	0.7	0.8	0.	0.7	0.7	0.7
Iran	1.2	−0.2	−0.5	−0.1	1.2	0.
Azerbaijan	0.3	−0.1	−0.1	0.	0.3	0.
Georgia	0.3	−0.1	−0.1	0.	0.3	0.
Turkmenistan	0.2	0.1	0.	0.1	0.2	0.1

[a] The sections are:

TC (Trans Caspian) with 30 bcm/a and investment cost of 2.3 bn €.

ES (eastern section) pipelines between east Turkey and Azerbaijan, Iran and Iraq, each increased by 15 bcm/a. East to West Turkey enlarged by 30 bcm/a. Total investment cost 12.2 billion €.

CS (central section) with 30 bcm/a and investment cost of 1.9 billion €.

WS (western section) with 30 bcm/a and investment cost of 3.5 billion €.

[b] difference to column 6 table 3

Baseline scenario with exclusive access

Table 15: Nord Stream's Impact with Exclusive Access

	Shapleyvalue[a] [bn €/a]		
	without Nord Stream	with Nord Stream	difference
Russia	4.6	6.1	1.6
Ukraine	2.3	1.3	−0.9
Belarus	0.5	0.3	−0.2
Norway	4.9	3.8	−1.1
Netherlands	3.7	3.	−0.7
UK	0.9	0.8	−0.1
Center	11.1	12.7	1.6
Center-East	4.9	4.7	−0.3
Italy	1.2	1.3	0.1
Poland	0.9	0.8	−0.2
France	3.4	3.6	0.2
Belgium	2.4	2.4	0.
Balkan	0.5	0.4	0.
Turkey	3.6	3.6	0.
Iraq	0.	0.	0.
Iran	0.7	0.7	0.
Azerbaijan	0.1	0.1	0.
Georgia	0.1	0.1	0.
Turkmenistan	0.1	0.1	0.
project cost[b]			1.5

[a]Every European player has only exclusive access to his own trunk pipeline network. There is no free third party access in the European Union.

[b]Investment cost annualized with an interest of 15%.

Table 16: South Stream's Impact with Exclusive Access

	without Nord Stream				*with Nord Stream*			
	Shapley value	Impact of pipeline sections[a] *(difference to column 1 table 15)*			Shapley value	Impact of pipeline sections *(difference to column 2 table 15)*		
		OS	OS+NW	OS+NW+SW		OS	OS+NW	OS+NW+SW
Russia	4.6	0.1	1.4	1.5	6.1	0.1	1.1	1.2
Ukraine	2.3	−0.2	−1.4	−1.5	1.3	−0.2	−1.	−1.
Belarus	0.5	0.	−0.1	−0.1	0.3	0.	0.	0.
Norway	4.9	0.	−0.3	−0.4	3.8	0.	−0.2	−0.2
Netherlands	3.7	0.	−0.2	−0.2	3.	0.	−0.1	−0.1
UK	0.9	0.	0.	0.	0.8	0.	0.	0.
Center	11.1	0.	−0.2	−0.2	12.7	0.	−0.4	−0.5
Center-East	4.9	0.	1.	0.8	4.7	0.	0.7	0.6
Italy	1.2	0.	0.	0.2	1.3	0.	0.	0.1
Poland	0.9	0.	−0.1	−0.1	0.8	0.	0.	0.
France	3.4	0.	0.1	0.1	3.6	0.	0.	0.
Belgium	2.4	0.	0.	0.	2.4	0.	0.	0.
Balkan	0.5	0.1	−0.1	0.1	0.4	0.1	−0.1	0.1
Turkey	3.6	0.	0.	0.	3.6	0.	0.	0.
Iraq	0.	0.	0.	0.	0.	0.	0.	0.
Iran	0.7	−0.1	−0.1	−0.1	0.7	−0.1	−0.1	−0.1
Azerbaijan	0.1	0.	0.	0.	0.1	0.	0.	0.
Georgia	0.1	0.	0.	0.	0.1	0.	0.	0.
Turkmenistan	0.1	0.	0.	0.	0.1	0.	0.	0.
project cost[b]		1.3	1.8	2.3		1.3	1.8	2.3

[a] OS: offshore section with 63 bcm/a and investment cost of 8.6 billion €.
NW: Northwestern section with 30 bcm/a and investment cost of 3.5 billion €.
SW: Southwestern section with 10 bcm/a and investment cost of 3.4 billion €.

[b] Investment cost annualized with an interest of 15%.

High surplus

Table 17: Nord Stream's Impact with High Willingness to Pay

	Shapleyvalue[a] [bn €/a]		
	without Nord Stream	with Nord Stream	difference
Russia	14.2	19.1	4.8
Ukraine	6.1	1.9	−4.2
Belarus	1.8	0.5	−1.3
Norway	16.	12.6	−3.4
Netherlands	10.2	8.5	−1.7
UK	3.	2.9	−0.1
Center	28.6	31.	2.3
Center-East	17.3	18.5	1.3
Italy	5.3	5.8	0.5
Poland	2.9	3.1	0.3
France	12.2	13.2	1.1
Belgium	5.3	5.8	0.4
Balkan	1.3	1.3	0.
Turkey	11.7	11.7	0.
Iran	2.	1.9	0.
Azerbaijan	0.5	0.5	0.
Georgia	0.5	0.5	0.
Turkmenistan	0.	0.1	0.
project cost[b]			1.5

[a] The demand intercept is increased from 500 to 1500 to present higher willingness to pay. The total surplus of the grand coalition triples in accordance with the demand intercept.

[b] Investment cost annualized with an interest of 15%.

Table 18: Nord Stream's Impact with High Willingness to Pay

	Shapleyvalue[a] [%]		
	without Nord Stream	with Nord Stream	difference
Russia	10.2	13.7	3.5
Ukraine	4.4	1.4	−3.
Belarus	1.3	0.4	−0.9
Norway	11.5	9.1	−2.4
Netherlands	7.3	6.1	−1.3
UK	2.2	2.1	0.
Center	20.6	22.3	1.7
Center-East	12.4	13.3	0.9
Italy	3.8	4.2	0.4
Poland	2.1	2.3	0.2
France	8.7	9.5	0.8
Belgium	3.8	4.1	0.3
Balkan	0.9	1.	0.
Turkey	8.4	8.4	0.
Iran	1.4	1.4	0.
Azerbaijan	0.4	0.4	0.
Georgia	0.4	0.4	0.
Turkmenistan	0.	0.	0.
project cost[b]			1.5

[a] The demand intercept is increased from 500 to 1500 to present higher willingness to pay. The total surplus of the grand coalition triples in accordance with the demand intercept.

[b] Investment cost annualized with an interest of 15%.

Table 19: South Stream's Impact with High Willingness to Pay

	without Nord Stream[a]				*with Nord Stream*			
	Shapley value [bn €/a]	Impact of pipeline sections[b] *(difference to column 1 in table 17)*			Shapley value [bn €/a]	Impact of pipeline sections *(difference to column 2 in table 17)*		
		OS	OS+NW	OS+NW+SW		OS	OS+NW	OS+NW+SW
Russia	18.9	0.7	4.	4.6	20.4	0.5	1.2	1.3
Ukraine	2.1	−0.7	−3.5	−4.1	0.5	−0.5	−1.3	−1.4
Belarus	0.8	0.	−0.9	−1.1	0.2	0.	−0.3	−0.3
Norway	13.2	−0.1	−2.3	−2.8	11.7	−0.1	−0.7	−0.9
Netherlands	8.8	−0.1	−1.2	−1.4	8.	0.	−0.4	−0.4
UK	2.9	0.	−0.1	−0.1	3.	0.	0.	0.
Center	30.5	0.1	1.5	1.9	31.7	0.1	0.6	0.8
Center-East	18.4	0.	0.9	1.1	18.8	0.	0.3	0.3
Italy	5.8	0.	0.3	0.4	6.	0.	0.2	0.2
Poland	3.1	0.	0.2	0.2	3.2	0.	0.1	0.1
France	13.	0.	0.7	0.9	13.5	0.	0.2	0.3
Belgium	5.7	0.	0.3	0.4	5.9	0.	0.1	0.1
Balkan	1.6	0.3	0.3	0.3	1.6	0.3	0.3	0.3
Turkey	11.8	0.1	0.1	0.1	11.8	0.1	0.1	0.1
Iraq	0.	0.	0.	0.	0.	0.	0.	0.
Iran	1.7	−0.3	−0.3	−0.3	1.7	−0.2	−0.2	−0.2
Azerbaijan	0.4	−0.1	−0.1	−0.1	0.4	−0.1	−0.1	−0.1
Georgia	0.4	−0.1	−0.1	−0.1	0.4	−0.1	−0.1	−0.1
Turkmenistan	0.1	0.	0.	0.	0.1	0.	0.	0.
project cost[c]		1.3	1.8	2.3		1.3	1.8	2.3

[a] The demand intercept is increased from 520 to 1520 to present higher willingness to pay. The total surplus of the grand coalition triples in accordance with the demand intercept.

[b] OS: offshore section with 63 bcm/a and investment cost of 8.6 billion €.
NW: Northwestern section with 30 bcm/a and investment cost of 3.5 billion €.
SW: Southwestern section with 10 bcm/a and investment cost of 3.4 billion €.

[c] Investment cost annualized with an interest of 15%.

Table 20: South Stream's Impact with High Willingness to Pay

	without Nord Stream[a]				*with Nord Stream*			
	Shapley value[%]	Impact of pipeline sections[b] *(difference to column 1 in table 18)*			Shapley value[%]	Impact of pipeline sections *(difference to column 2 in table 18)*		
		OS	OS+NW	OS+NW+SW		OS	OS+NW	OS+NW+SW
Russia	13.6	0.5	2.9	3.3	14.7	0.4	0.9	1.
Ukraine	1.5	−0.5	−2.5	−2.9	0.3	−0.4	−0.9	−1.
Belarus	0.6	0.	−0.6	−0.8	0.1	0.	−0.2	−0.2
Norway	9.5	−0.1	−1.7	−2.	8.4	0.	−0.5	−0.6
Netherlands	6.3	0.	−0.9	−1.	5.8	0.	−0.3	−0.3
UK	2.1	0.	−0.1	−0.1	2.1	0.	0.	0.
Center	21.9	0.1	1.1	1.3	22.8	0.	0.5	0.5
Center-East	13.2	0.	0.7	0.8	13.5	0.	0.2	0.2
Italy	4.1	0.	0.2	0.3	4.3	0.	0.1	0.1
Poland	2.2	0.	0.1	0.2	2.3	0.	0.	0.1
France	9.4	0.	0.5	0.6	9.7	0.	0.2	0.2
Belgium	4.1	0.	0.2	0.3	4.2	0.	0.1	0.1
Balkan	1.1	0.2	0.2	0.2	1.1	0.2	0.2	0.2
Turkey	8.5	0.1	0.1	0.1	8.5	0.1	0.1	0.1
Iraq	0.	0.	0.	0.	0.	0.	0.	0.
Iran	1.2	−0.2	−0.2	−0.2	1.2	−0.2	−0.2	−0.2
Azerbaijan	0.3	−0.1	−0.1	−0.1	0.3	−0.1	−0.1	−0.1
Georgia	0.3	−0.1	−0.1	−0.1	0.3	−0.1	−0.1	−0.1
Turkmenistan	0.	0.	0.	0.	0.	0.	0.	0.

[a] The demand intercept is increased from 520 to 1520 to present higher willingness to pay. The total surplus of the grand coalition triples in accordance with the demand intercept.

[b] OS: offshore section with 63 bcm/a and investment cost of 8.6 billion €.
NW: Northwestern section with 30 bcm/a and investment cost of 3.5 billion €.
SW: Southwestern section with 10 bcm/a and investment cost of 3.4 billion €.

Table 21: Nabucco's Impact with High Willingness to Pay

	without South Stream[a]				*with South Stream*	
	Shapley value[bn €/a]	Impact of pipeline sections[b] *(difference to column 2 in table 17)*			Shapley value[bn €/a]	Impact[c]
		TC+ES	WS	TC+ES+ CS+WS		TC+ES+ CS+WS
Russia	14.7	−2.5	−0.9	−4.4	15.7	−4.8
Ukraine	1.2	−0.2	−0.3	−0.7	0.2	−0.2
Belarus	0.5	0.	0.	−0.1	0.1	−0.1
Norway	12.2	−0.2	0.8	−0.4	11.4	−0.4
Netherlands	8.2	−0.1	0.5	−0.2	7.8	−0.2
UK	2.9	0.	0.	−0.1	2.9	−0.1
Center	31.2	0.1	−0.4	0.3	32.	0.3
Center-East	18.7	0.	−0.2	0.2	19.1	0.2
Italy	5.9	0.	−0.1	0.	6.1	0.
Poland	3.2	0.	0.	0.	3.2	0.
France	13.4	0.	−0.2	0.1	13.6	0.2
Belgium	5.8	0.	−0.1	0.1	5.9	0.1
Balkan	1.8	0.2	0.4	0.5	1.9	0.3
Turkey	15.8	2.1	1.6	4.1	15.6	3.8
Iraq	1.	1.1	0.	1.	0.9	0.9
Iran	1.8	−0.3	−0.7	−0.2	1.7	0.
Azerbaijan	0.4	−0.2	−0.2	−0.1	0.4	−0.1
Georgia	0.4	−0.2	−0.2	−0.1	0.4	−0.1
Turkmenistan	0.2	0.1	0.	0.1	0.2	0.1
project cost[d]		2.2	0.5	3.0		3.0

[a]The demand intercept is increased from 520 to 1520 to present higher willingness to pay. The total surplus of the grand coalition triples in accordance with the demand intercept.

[b]TC: Trans Caspian with 30 bcm/a and investment cost of 2.3 bn €.
ES (eastern section). Pipelines between east Turkey and Azerbaijan, Iran and Iraq, each increased by 15 bcm/a. East to West Turkey enlarged by 30 bcm/a. Total investment cost 12.2 bn €.
CS (central section) with 30 bcm/a and investment cost of €1.9 bn.
WS (western section) with 30 bcm/a and investment cost of €3.5 bn.

[c] difference to column 5 in table 19

[d]Investment cost annualized with an interest of 15%.

Table 22: Nabucco's Impact with High Willingness to Pay

	without South Stream[a]				*with South Stream*	
	Shapley value[%]	Impact of pipeline sections[b] *(difference to column 2 in table 18)*			Shapley value[%]	Impact[c]
		TC+ES	WS	TC+ES+ CS+WS		TC+ES+ CS+WS
Russia	10.6	−1.8	−0.7	−3.2	11.3	−3.4
Ukraine	0.8	−0.2	−0.2	−0.5	0.2	−0.2
Belarus	0.3	0.	0.	−0.1	0.1	−0.1
Norway	8.8	−0.1	0.6	−0.3	8.2	−0.3
Netherlands	5.9	−0.1	0.4	−0.2	5.6	−0.1
UK	2.1	0.	0.	−0.1	2.1	0.
Center	22.4	0.	−0.3	0.2	23.	0.2
Center-East	13.5	0.	−0.1	0.1	13.7	0.2
Italy	4.2	0.	−0.1	0.	4.4	0.
Poland	2.3	0.	0.	0.	2.3	0.
France	9.6	0.	−0.1	0.1	9.8	0.1
Belgium	4.2	0.	0.	0.	4.3	0.
Balkan	1.3	0.2	0.3	0.3	1.3	0.2
Turkey	11.3	1.5	1.1	2.9	11.2	2.7
Iraq	0.7	0.8	0.	0.7	0.7	0.7
Iran	1.3	−0.2	−0.5	−0.1	1.2	0.
Azerbaijan	0.3	−0.1	−0.1	−0.1	0.3	0.
Georgia	0.3	−0.1	−0.1	−0.1	0.3	0.
Turkmenistan	0.1	0.1	0.	0.1	0.1	0.1

[a]The demand intercept is increased from 520 to 1520 to present higher willingness to pay. The total surplus of the grand coalition triples in accordance with the demand intercept.

[b]TC: Trans Caspian with 30 bcm/a and investment cost of 2.3 bn €.
ES (eastern section). Pipelines between east Turkey and Azerbaijan, Iran and Iraq, each increased by 15 bcm/a. East to West Turkey enlarged by 30 bcm/a. Total investment cost 12.2 bn €.
CS (central section) with 30 bcm/a and investment cost of €1.9 bn.
WS (western section) with 30 bcm/a and investment cost of €3.5 bn.

[c] difference to column 5 in table 20

High demand scenario

Table 23: Nord Stream's Impact with High Demand and Different Production Capacities

	Shapleyvalue[a] [bn €/a]		
	without Nord Stream	with Nord Stream	difference
Russia	9.9	13.1	3.2
Ukraine	5.5	2.8	−2.7
Belarus	1.5	0.6	−0.9
Norway	10.	7.8	−2.2
Netherlands	1.5	1.2	−0.3
UK	1.4	1.7	0.3
Center	9.5	11.	1.6
Center-East	5.4	6.2	0.8
Italy	2.1	2.7	0.6
Poland	1.	1.2	0.2
France	3.9	4.7	0.8
Belgium	1.7	2.	0.3
Balkan	0.6	0.6	0.
Turkey	4.7	4.6	0.
Iraq	0.	0.	0.
Iran	0.8	0.8	0.
Azerbaijan	0.2	0.2	0.
Georgia	0.2	0.2	0.
Turkmenistan	0.	0.1	0.1
project cost[b]			1.5

[a]Demand increases by 20%. Netherlands becomes a net importer, since its production decreases by 30 bcm/a. Through investments in new fields Russia increases its production capacity by 30 bcm/a and compensates the decrease in Netherlands' production.

[b]Investment cost annualized with an interest of 15%.

Table 24: Nord Stream's Impact with High Demand and Different Production Capacities (2)

	Shapleyvalue[a] [bn €/a]		
	without Nord Stream	with Nord Stream	difference
Russia	9.9	13.	3.1
Ukraine	5.5	2.7	−2.8
Belarus	1.5	0.6	−0.9
Norway	10.	7.9	−2.1
Netherlands	1.5	1.2	−0.3
UK	1.4	1.6	0.3
Center	9.5	11.	1.5
Center-East	5.4	6.2	0.8
Italy	2.1	2.6	0.5
Poland	1.	1.2	0.2
France	3.9	4.7	0.7
Belgium	1.7	2.	0.3
Balkan	0.6	0.6	0.
Turkey	4.6	4.6	−0.1
Iraq	0.	0.	0.
Iran	0.8	0.8	0.
Azerbaijan	0.2	0.3	0.
Georgia	0.2	0.2	0.
Turkmenistan	0.1	0.3	0.2
project cost[b]			1.5

[a] Demand increases by 20%. Netherlands becomes a net importer, since its production decreases by bcm/a. Investment in Russian fields is only enough to compensate production decrease in mature fields and increasing domestic demand. Russia's production capacity remains unchanged.

[b] Investment cost annualized with an interest of 15%.

Table 25: South Stream's Impact with High Demand and Different Production Capacities

	without Nord Stream				*with Nord Stream*			
	Shapley[a] value	Impact of pipeline sections[b] *(difference to column 1 in table 23)*			Shapley value	Impact of pipeline sections *(difference to column 2 in table 23)*		
		OS	OS+NW	OS+NW+SW		OS	OS+NW	OS+NW+SW
Russia	12.8	0.5	2.5	2.9	14.3	0.4	1.	1.2
Ukraine	2.9	−0.6	−2.2	−2.7	1.1	−0.5	−1.5	−1.7
Belarus	0.8	0.	−0.5	−0.6	0.3	0.	−0.2	−0.3
Norway	8.4	0.	−1.3	−1.6	7.	0.	−0.7	−0.8
Netherlands	1.2	0.	−0.2	−0.2	1.1	0.	−0.1	−0.1
UK	1.6	0.	0.1	0.2	1.8	0.	0.1	0.1
Center	10.6	0.	0.9	1.2	11.7	0.	0.5	0.6
Center-East	6.1	0.	0.6	0.7	6.5	0.	0.2	0.3
Italy	2.6	0.	0.4	0.5	2.9	0.	0.2	0.2
Poland	1.1	0.	0.1	0.2	1.3	0.	0.1	0.1
France	4.5	0.	0.5	0.6	4.9	0.	0.2	0.2
Belgium	1.9	0.	0.2	0.2	2.1	0.	0.1	0.1
Balkan	0.8	0.2	0.2	0.2	0.8	0.2	0.2	0.2
Turkey	4.7	0.1	0.1	0.1	4.7	0.1	0.1	0.1
Iraq	0.	0.	0.	0.	0.	0.	0.	0.
Iran	0.7	−0.2	−0.1	−0.1	0.7	−0.1	−0.1	−0.1
Azerbaijan	0.2	0.	0.	0.	0.2	0.	0.	0.
Georgia	0.2	0.	0.	0.	0.2	0.	0.	0.
Turkmenistan	0.1	0.	0.	0.	0.2	0.	0.	0.
project cost[c]		1.3	1.8	2.3		1.3	1.8	2.3

[a] Netherlands becomes a net importer, since her production decreases by 30 bcm/a. Through investments in new fields Russia increases its production capacity by 30 bcm/a and compensates the decrease in Netherlands' production.

[b] OS: offshore section with 63 bcm/a and investment cost of 8.6 billion €.
NW: Northwestern section with 30 bcm/a and investment cost of 3.5 billion €.
SW: Southwestern section with 10 bcm/a and investment cost of 3.4 billion €.

[c] Investment cost annualized with an interest of 15%.

Table 26: South Stream's Impact with High Demand and Different Production Capacities (2)

	without Nord Stream				*with Nord Stream*			
	Shapley[a] value	Impact of pipeline sections[b] *(difference to column 1 in table 24)*			Shapley value	Impact of pipeline sections *(difference to column 2 in table 24)*		
		OS	OS+NW	OS+NW+SW		OS	OS+NW	OS+NW+SW
Russia	12.8	0.5	2.4	2.9	14.2	0.4	1.	1.1
Ukraine	2.8	−0.6	−2.2	−2.7	1.	−0.5	−1.5	−1.7
Belarus	0.8	0.	−0.5	−0.7	0.3	0.	−0.2	−0.3
Norway	8.5	0.	−1.2	−1.6	7.3	0.	−0.5	−0.6
Netherlands	1.2	0.	−0.2	−0.2	1.1	0.	−0.1	−0.1
UK	1.6	0.	0.1	0.2	1.7	0.	0.1	0.1
Center	10.6	0.	0.9	1.1	11.5	0.	0.5	0.6
Center-East	6.1	0.	0.6	0.7	6.4	0.	0.2	0.2
Italy	2.6	0.	0.3	0.5	2.8	0.	0.1	0.2
Poland	1.1	0.	0.1	0.1	1.2	0.	0.	0.1
France	4.5	0.	0.4	0.5	4.9	0.	0.2	0.2
Belgium	1.9	0.	0.2	0.2	2.1	0.	0.1	0.1
Balkan	0.8	0.2	0.2	0.2	0.8	0.2	0.2	0.2
Turkey	4.7	0.1	0.1	0.1	4.7	0.1	0.1	0.1
Iraq	0.	0.	0.	0.	0.	0.	0.	0.
Iran	0.7	−0.2	−0.1	−0.1	0.7	−0.1	−0.1	−0.1
Azerbaijan	0.2	0.	0.	0.	0.2	0.	0.	0.
Georgia	0.2	0.	0.	0.	0.2	0.	0.	0.
Turkmenistan	0.2	0.	0.1	0.2	0.3	0.	0.	0.
project cost[c]		1.3	1.8	2.3		1.3	1.8	2.3

[a]Netherlands becomes a net importer, since her production decreases by 30 bcm/a. Investment in Russian fields is only enough to compensate production decrease in mature fields and increasing domestic demand. Russia's production capacity remains unchanged.

[b] OS: offshore section with 63 bcm/a and investment cost of 8.6 billion €.
NW: Northwestern section with 30 bcm/a and investment cost of 3.5 billion €.
SW: Southwestern section with 10 bcm/a and investment cost of 3.4 billion €.

[c] Investment cost annualized with an interest of 15%.

Table 27: Nabucco's Impact with High Demand and Different Production Capacities

	without South Stream				with South Stream	
	Shapley[a] value	Impact of pipeline sections[b] (difference to column 2 in table 23)			Shapley value	Impact[c]
		TC+ES	WS	TC+ES+ CS+WS		TC+ES+ CS+WS
Russia	14.1	−1.4	0.1	−2.2		
Ukraine	2.7	−0.3	−0.1	−0.9		
Belarus	0.6	0.	−0.1	−0.1		
Netherlands	0.8	0.	0.1	0.		
Center	4.4	0.	−0.1	0.1		
Center-East	5.6	0.	−0.1	0.2		
Italy	2.3	0.	0.	0.1		
Poland	1.1	0.	0.	0.		
France	1.5	0.	0.	0.		
Belgium	0.9	0.	0.1	0.		
Balkan	0.6	0.2	0.1	0.1		
Turkey	4.6	1.1	0.2	1.7		
Iraq	0.	0.5	0.	0.6		
Iran	0.8	0.	−0.1	0.3		
Azerbaijan	0.2	0.	0.	0.1		
Georgia	0.2	0.	0.	0.1		
Turkmenistan	0.	0.1	0.	0.1		
Kazakhstan	0.1	0.	0.	0.		
Uzbekistan	0.	0.	0.	0.		
project cost[d]		2.2	0.5	3.0		3.0

[a]Demand increases by 20%. Netherlands becomes a net importer, since its production decreases by 30 bcm/a. Through investments in new fields Russia increases its production capacity by 30 bcm/a and compensates the decrease in Netherlands' production.

[b]TC: Trans Caspian with 30 bcm/a and investment cost of 2.3 bn €.
ES (eastern section). Pipelines between east Turkey and Azerbaijan, Iran and Iraq, each increased by 15 bcm/a. East to West Turkey enlarged by 30 bcm/a. Total investment cost 12.2 bn €.
CS (central section) with 30 bcm/a and investment cost of €1.9 bn.
WS (western section) with 30 bcm/a and investment cost of €3.5 bn.

[c] difference to column 5 in table 25

[d]Investment cost annualized with an interest of 15%.

Table 28: Nabucco's Impact with High Demand and Different Production Capacities (2)

	without South Stream				*with South Stream*	
	Shapley[a] value	Impact of pipeline sections[b] *(difference to column 2 in table 24)*			Shapley value	Impact[c]
		TC+ES	WS	TC+ES+ CS+WS		TC+ES+ CS+WS
Russia	14.	−1.3	0.1	−2.1		
Ukraine	2.7	−0.3	−0.1	−0.9		
Belarus	0.5	0.	0.	−0.1		
Netherlands	0.8	0.	0.1	0.		
Center	4.3	0.1	−0.1	0.2		
Center-East	5.6	0.1	−0.1	0.2		
Italy	2.3	0.	0.	0.1		
Poland	1.1	0.	0.	0.		
France	1.5	0.	0.	0.1		
Belgium	0.9	0.	0.1	0.		
Balkan	0.6	0.2	0.1	0.1		
Turkey	4.6	1.2	0.2	1.8		
Iraq	0.	0.5	0.	0.6		
Iran	0.8	0.	−0.1	0.3		
Azerbaijan	0.3	0.	0.	0.1		
Georgia	0.2	0.	0.	0.1		
Turkmenistan	0.	0.	0.	0.1		
Kazakhstan	0.3	−0.2	0.	−0.2		
Uzbekistan	0.1	−0.1	0.	−0.1		
project cost[d]		2.2	0.5	3.0		3.0

[a]Demand increases by 20%. Netherlands becomes a net importer, since its production decreases by 30 bcm/a. Investment in Russian fields is only enough to compensate production decrease in mature fields and increasing domestic demand. Russia's production capacity remains unchanged.

[b]TC: Trans Caspian with 30 bcm/a and investment cost of 2.3 bn €.
ES (eastern section). Pipelines between east Turkey and Azerbaijan, Iran and Iraq, each increased by 15 bcm/a. East to West Turkey enlarged by 30 bcm/a. Total investment cost 12.2 bn €.
CS (central section) with 30 bcm/a and investment cost of €1.9 bn.
WS (western section) with 30 bcm/a and investment cost of €3.5 bn.

[c] difference to column 5 in table 26

[d]Investment cost annualized with an interest of 15%.