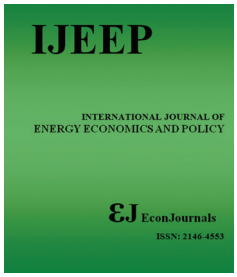

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Game Theoretic Assessment of Turkey's Role as a Transit Country amid a Changing EU's Energy Policy

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ABSTRACT

This paper examines how changes in the gas transportation network and trade volume influence relative bargaining power. We focus on the EU as a natural gas importer and Turkey as a key transit country connecting major gas producers — Russia, Azerbaijan, and Iran. Using network game theory, we analyze the bargaining power among these participants. Our findings highlight Turkey's critical role in the EU's natural gas sup-ply strategy amid the Ukraine crisis. Without Turkey, access to the European gas market would be significantly restricted for other regions. While the EU's diversification policy enhances its bargaining power, the increment remains relatively modest. Although constructing a new pipeline to bypass Turkey could strengthen the bargaining position of both the EU and gas-exporting countries, geographical and political challenges make such a project highly impractical.

Keywords: Energy Policy, Game Theory, Natural Gas Supply, Natural Gas Transportation System, Network Analysis
JEL Classifications: C70, F17, Q48

1. INTRODUCTION

Energy security has been a critical issue for the EU (European Union) considering their dependence on energy imports. Natural gas account for approximately 25% of the EU's energy mix in 2021, second only to oil at 33.5% (British Petroleum, 2023). The EU consumed 571.1 bcm (billion cubic meter) of natural gas, while imported 108.2 bcm of liquified natural gas (LNG) and 369.1bcm of natural gas through pipeline and its natural gas dependency rate was 83% in 2021 (British Petroleum, 2023). Since the first natural gas shipment to Austria in 1968 has commenced, Russia was critically important source of natural gas for the European countries (Maull and Vale, 1983, p.21).

Tensions between Moscow and Kiev over natural gas prices and transit fees have led to a natural gas supply disruption that has posed a serious threat to European energy security (Le Coq and Paltseva, 2012, p. 642). Some postulates, even though European countries have experienced gas transit crisis of 2006 and 2009 due to conflict between two countries, Russia's aim was not the EU but Ukraine. However, it is evident that the shutoff of gas shipment raised question about reliability of Russia and Ukraine as a supplier and transit route (Siddi, 2019, p. 128).

Recently, the EU is seeking for ways to cease its natural gas dependence on Russian after Russo-Ukraine War (Schattenberg, 2022, p.555). The president of European Commission claimed that the EU must become independent from Russian fossil fuel that directly threaten EU energy security and need to diversify European natural gas supply (European Commission, 2022). In fact, the natural gas imports from Russia to the EU has been significantly reduced in 2022 and its volume estimated 60 bcm (International Energy Agency, 2022, p.365).

Furthermore, Russian natural gas would not flow via Ukraine from 2025, as Kiev do not agree to extend gas-transit deal with Russia's Gazprom. After the outbreak of the War, European demand has mainly been compensated by a sharp increase in imports of

LNG from global market. Apart from LNG import, the EU well understands the needs of alternative sources of natural gas and considers the countries in the Caspian Regions as promising gas suppliers. Thus, infrastructure connecting the European gas market and these gas producing regions has the highest priority for energy security (European Commission, 2008).

The Nabucco project, the predecessor of the Southern Gas Corridor (SGC) is a great example of the EU-level project to deliver natural gas from the Caspian Regions. However, gas filed in Turkmenistan was less developed, build-up of trans-Caspian pipeline is slim, and Azerbaijan can supply only limited volume of natural gas (Baev and Overland, 2010, p. 1082). Finally, the EU's first efforts to deliver the Caspian natural gas was abolished in 2013 due to economic feasibility and geopolitical obstacles, and the EU launched SGC as a follow-up project. Since the War between Russia and Ukraine, the SGC has become strategically important to the EU as Russia weaponizes its energy capabilities to extract political leverage.

The SGC, connecting Azerbijan, Turkey and Europe, comprise for sections. The first section is the production site such as Shah Deniz-2 gas field and extraction facility in Azerbaijan. The second section comprises expansion of South Caucasus Pipeline (SCPX) linking Buku in Azerbaijan to Erzurum in Turkey. The third section includes Trans Anatolian Pipeline (TANAP) transmitting natural gas to the Greek-Turkish border and the last section is Trans Adriatic Pipeline (TAP) that sends natural gas to Greece, Albania and Italy (Siddi, 2019, p. 129). The construction of SGC has completed in 2020 and it commenced commercial operation in November delivering Azeri natural gas to European market.

The completion of SGC enable Turkey to expand its role as a key transit country. The 3500 km SGC delivers gas from Sangachal Terminal in Baku to Greek border, of which 2000km run on Turkish territory. Besides Azerbaijan, Turkmenistan, Iran and Iraq could be potential gas supplier for the EU, once they connect their gas deposit to SGC. In turn, the EU's natural gas diversification and reducing dependence on Russian natural gas may strengthen Turkey's geopolitical and geoeconomic position (Novikau and Muhasilović, 2023).

It should be noted that Turkey is an important transit country not only to realize SGC, but also to deliver Russian gas to Europe. Turkey is located in strategic position between two continents, and it has ambition of becoming an international physical hub coincide with the aim to meet domestic natural gas demand (Austvik and Rzayeva, 2017). Once Turkey becomes a transit country between exporting and importing countries, it guarantees constant gas flow on Turkish territory and allows Turkey's access to gas pipeline to withdraw the gas for its own demand which referred to as "off-taking." Thus, it is Turkey's priority to become a gas transit country and tool for the diversification.

Considering that natural gas is important fossil fuel in Turkey's energy mix, accounting for more than 30% of the energy mix (International Energy Agency, 2022), Turkey's efforts to increase domestic gas flows and diversify its sources are unstoppable. After the War, Russia also gradually cut gas supply to Europe in 2022, ending deliveries via the Nord Stream and Yamal-Europe gas pipelines. The Nord Stream and Nord Strema-2 pipeline were subsequently hit by a series of clandestine bombings on September 26, 2022 and reoperation of the pipeline system seems unclear.

Even if total Russia's gas exporting volume to the EU via pipeline decreases, Russia is keep transmitting the limited amount of natural gas to European customer via two operating pipeline system – Ukraine Gas Transmission System (UGTS) and TurkStream. Two main customers of the Russian gas via TurkStream are Serbia and Hungary which both still have close relations with Moscow. In addition, gas flow via TurkStream is destined to Romania, Greece, North Macedonia and Bosnia and Herzegovina which show relatively high dependency on Russian natural gas. Considering close relations and dependency on Russian natural gas, TurkStream has strategical significance for Russia, and it enables Turkey to become important transit country connecting Russia and European market.

2. LITERATURE REVIEW

2.1. Previous Study

In economics, a situation in which several economic players gather to make decision is called a game situation. The nature of a game situation is interdependence that the decisions of each player affect not only their own but the welfare of other economic players. Game theory has basically two approaches: "cooperative approach" and "non-cooperative approach". Compare to cooperative game Compared to cooperative approach, non-cooperative game theory has disadvantages in "double marginalization" and "asymmetric distribution of market power among players," while cooperative approach is compatible with comprehensive contracts and gives none of the players an a-priory strategic advantage (Hubert and Orlova, 2018). Considering most of the natural gas contracts, especially via pipeline gas trade, is based on long-term contracts that specify total quantity and price, the cooperative approach more suitable for analysis natural gas trade (Lee and Kim, 2023).

The research by Hubert and Ikonnikova is one of the original studies using cooperative approach and Sharpley value to investigate power structure between the gas trade participants (Hubert and Ikonnikova, 2011). The study calibrated allocation of the relative bargaining power among gas export states – Russia and gas transit countries – Belarus and Ukraine. The academic significance of this study is that it provides a basis for analyzing natural gas networks using cooperative games and Shapley values.

There is a study that investigate the change of the power structure derived from three new pipeline projects: "Nord Stream," "South Stream" and "the Nabucco project" which allow European countries to access gas produced in Russia, Middle East and Central Asia. Their study adopted a disaggregated quantitative model for the analysis of the Eurasian natural gas networks (Hubert and Cobanli, 2012). They measured the interdependencies among the trade participants players by network circumstance or coalitions.

The same authors' another study also illuminated the changes of power structure in the Eurasian gas network (Hubert and Cobanli, 2015). This study identified that "Nord Stream" and "South stream" are Russia's effort to bypass transit countries, and the last project "Nabbuco" is the EU's ambition to diversifying natural gas import enabling access to gas deposit in the Caspian regions. By analysis the effect of three gas pipeline, the study proved that "Nord Stream" has strategic priority that can justify multibillion-dollar investment for Germany and Russia, while South Stream and the Nabucco were unable to create substantial leverage which contradict the empirical study (Huburt and Cobanli, 2015).

The study with assumption of liberalized European gas market and its impact on the relative bargaining power between natural gas importers and outside suppliers, such as Russia and Norway (Hubert and Orlova 2018). The result of analysis appears counter intuitive in that liberalized market circumstance fail to increase customers' gains and market efficiency, while external natural gas suppliers – Russia and Norway, could enjoy increased market power by controlling their production facility and avoiding the jurisdiction of the EU.

A study more focused on the Caspian Region as natural gas supplier both for Europe and China also exists. The study assumes situation that a competition occurs between two gas importing regions (Cobanli, 2014). However, this study concluded that there will not be competition for the natural gas quantity as the Caspian Regions has ample deposits. Also, shipping the Caspian natural gas to Europe could yield small benefits to the EU customers illuminating cooperative game approach.

Jafarzadeh et al. (2021) calibrated the value of the coalitions in the Caspian countries using cooperative approach. It assumes the scenarios that Azerbaijan, Iran, Iraq and Turkmenistan export natural gas to EU natural gas markets. The result of this study supports that Turkey would become the key player in the gas pipeline networks linking between the Caspian Regions and Europe, as no country is able to access to European market. This is clearly show that the existence of gas pipeline and guaranteed volume of gas transmission would strengthen the relative bargaining power of one country.

Among the studies adopted cooperative approaches, some of them use another solution concept "Link-Based Flexible Network Allocation Rules (LBFN)" instead of Sharpley Value by Jackson (Jackson, 2005). Basically, the concept is similar to Sharpley value, a new methodology allows us to concentrate more on the value created by "link" and "edge." In other words, while Sharpley value investigate the value by coalitions, LBFN consider value created by "nodes" and "edges." To prove methodological suitability, a paper by Nagayama and Horita (2014) includes the same situations with previous study by Hubert and Ikonnikova (2011). Also, unlike previous studies, they set up another game assuming European countries as a strategic player and allocate them to the relative bargaining power.

A study of Lee and Kim (2023) calculated power structure among players using LBFN to trace the change of power structures by adding Russia's diversionary gas exporting routes that bypass its traditional transit countries. This study not only assumed situations that Russia delivers via three diversionary routes – "Nord Stream," "Turk Stream," and "Nord Stream-2," but put into calculation that the EU choose external source of LNG instead of operating permission of Nord Stream-2. According to the paper, Russia's effort to make bypassing pipelines effectively reduce the relative bargaining power of Ukraine. However, if the EU begin to import LNG from the United States, Russia will suffer losses in its relative bargaining power.

2.2. Concept of "Link-Based Flexible Network Allocation Rule (LBFN)"

As above stated, this paper adopted "Link-Based Flexible Network Allocation Rule" instead of Shapley value, which is firstly proposed by Jackson and Wolinsky in 2003. According to them, the game can be classified by its network formation. When numerable number of participants N = {A,B,C} exists, the structure of networks is object of analysis by its connecting formation among participants (Jackson and Wolinsky, 2003). Also, network analysis using LBFN can explain network structure not only that exist but might have emerged or change in the future (Jackons, 2005).

The concept "node" and "edge" are the basic concept that comprise network game. "Node" means a vertex open to any direction. There are two nodes, and they are connected, it makes line called "edge." The "edge" is sometimes called "line" or "link" by context.

When a group of "vertices" and "edges" comprise a structure and all connections among the nodes are defined, it is called "graph". When two nodes i and j are connected, they comprise graph g, and it is expressed $\{i,j\} \in g$. Simply, i, j present the edge $\{i,j\}$, and thus $\{i,j\} \in g$ refers i and j are comprise "edge" under the network g (Jackson, 2005).

When a finite set of N exists, the graph is a pair (N, g). All graphs which sometimes called networks exist in the set N is expressed $G = \{g|g \subseteq g^N\}$, here, g^N is the set of all subsets of N of size 2 (Jackson, 2005). The g satisfying the condition of g can be a subset of g^N. The g^N means the graph which all connections are considered, and the graph is considered a set (Lee and Kim, 2023).

Also, adding or deleting of a certain edge ij on the network denoted $g + ij$ and $g\text{-}ij$ respectively. By definition of LBFN, the value created by connecting the "nodes" is allocated to all participants (Nagayama and Horita, 2014).

Accordingly, the function of LBFN is

Y, Y maps G cross V to R^N which is notated Y: $G \times V \rightarrow R^N$. The value function calibrates value over the network is expressed $\sum Y_i (g,v) = v(g)$.

$$Y_i^{LBFN}(g,v) = \frac{v(g)}{\hat{v}(g^N)} \sum j \neq i \left[\sum_{g \in g^N - ij} \frac{1}{2}\left(\hat{v}(g+ij) - \hat{v}(g)\right) \left(\frac{\#g!\left(\left[n(n-1)/2\right] - \#g - 1\right)!}{\left[n(n-1)/2\right]!} \right) \right]$$

The value function for graph g is function v: G⟶ R and the set of all possible value function is written V (Jackson, 2005). G ⟶ R means sets of the graphs (Lee and Kim, 2023). A value function specifies the total value created by given network structure (Jackson, 2005). Also, this function converts a set of graphs into real number. Value function can entail cost and benefit and can be interpreted flexibly (Jackson, 2005). Applying this flexibility utility functions u: G(N) ⟶ R for each edge are defined and the value function is the sum of the utility functions.

$$v(g) = \sum_{ij} u_{ij}(g)$$

A network game is a pair (N, v), of a set of players and v is a value function on networks among the players (Jackson, 2005). Since efficient networks has value-maximining properties, the value function adopted a notion of monotonicity and monotonic cover $\hat{v}$ is defined as $\hat{v} = \max_{g' \subset g} v(g')$.

Utility function for the calibration is borrowed from the previous study (Hubert and Ikkonikova, 2011; Nagayama and Horita, 2014).

$$u_{ij}(g) = (p - T_{ij})\, x_{ij}$$

In the utility function, p indicates the natural gas price in US dollar per thousand cubic meters (hereinafter tcm), and T_{ij} is the transportation cost per unit (tcm) through a certain pipeline. x_{ij} (tcm) represents the volume of natural gas transportation through a certain pipeline.

Several previous studies have assumed inversed demand function (Hubert and Ikkonikova, 2011; Cobanli, 2014), however another study set a specific price assuming the gas prices are highly political and arbitrary (Nagayama and Horita, 2014). Also, in many cases, natural gas prices and trade volume are determined by negotiation and contract between the parties. Thus, this study also assumes the fixed price and trade volume. Furthermore, there is possibility that calculated Relative Bargaining Power affect the price negotiations. According to previous studies (Hubert and Ikkonikova, 2011; Nagayama and Horita, 2014), the transportation cost per unit can be broken down as follows.

$$T_{ij} = \frac{\left(m_{ij} + \beta_{ij} \times MC_0\right)\left(e^{\beta_{ij} \times \mu_{ij}}\right)}{\beta_{ij}}$$

m_{ij} ($/tcm/100 km] represents maintenance cost that is proportionally increased by distance and gas transport volume. Referring previous study (Nagayama and Horita, 2014), we set m_{ij} to 0.1 for the onshore gas pipelines and 0.2 for the offshore gas pipelines. β_{ij} (%/100 km) is the quantity of gas consumed at the compressor stations along the pipeline and this value is 0.25 for the onshore gas pipelines, and 0.5 for the offshore gas pipelines. μ_{ij} (100 km) indicates total length of a certain pipeline, and MC_0 is production cost of the natural gas per unit ($/tcm). Since the gas consumption at compressor stations shows exponential increases by length of pipelines, this study uses base of natural logarithm e.

Referring the paper published by Oxford Institute for Energy Studies, this study assumes that cost of production of Azeri natural gas is $50/mcm (Pirani, 2021, p.4). The average Russian natural gas production cost is about 1.8 mmbtu, which equals to $65/mcm (Razlomalin et al., 2018, p.4). The value of variables for specific gas pipelines is given in Table 1.

Gas delivery distance (pipeline length) from Azerbaijan to Turkey sets 2000 km as the most gas consumption region located in western of Turkey, although the distance from Azeri gas production site to the Turkish border is about 500 km. As a matter of fact, 100 km of the TAP has 100 km of offshore section, however, this study deems the pipeline is onshore because it merely account for 2% of total length of SGC.

2.3. Game Set-up

In this study, we set the EU is gas importer, Turkey is transit country and Russia and Caspian countries are gas exporters for the calibration of the relative bargaining power. The calibration includes three situations that natural gas trade among participants in 2021 and 2022 to identify the impact and changes after the War in Ukraine in 2022. Also, this study assumes the scenario that all existing pipelines are operated in its full capacity and Iran commence gas supply to the EU as the European countries experience gas supply shortage. Thus, the scope of analysis is limited to four natural gas pipelines: TurkStream, Blue Stream, the Southern Gas Corridor (SGC), and the Tabriz–Ankara gas pipeline. The lengths of these pipelines and their respective volumes under each annual scenario are presented in Table 2.

TurkStream, which lengthen about 930 km, consists of two strings that one string directly connects gas deposits in Russia to Turkish gas transportation network and the other directly destines to Bulgaria at Strandzha 2 entry point at the country's border with Turkey (S&P Global, 2022a). Each string of TurkStream can supply 16.5 bcm of natural gas to Turkey and Southern Europe respectively.

Blue Stream is a 1213 km-long natural gas pipeline with capacity of 16 bcm per year that connects between Russia and Turkey through underwater of the Black Sea. This is the first Gazprom's

Table 1: Variable used by pipelines

Pipeline	Pipeline type	M_{ij} (100 km)	β_{ij} (%/100 km)	μ_{ij} (100 km)	MC_0 ($/mcm)
Blue Stream	offshore	0.2	0.5	12.1	65
TurkStream (EU)	offshore	0.2	0.5	9.3	65
TurkStream (TUR)	offshore	0.2	0.5	9.3	65
SGC (TUR)	onshore	0.1	0.25	20.0	50
SGC (EU)	onshore	0.1	0.5	34.0	50
Tabriz-Ankara	Onshore	0.1	0.5	26.0	50

direct gas exporting route not relying on transit countries.

SGC consists of three sections of pipeline that supplies natural gas produced in Azerbaijan to Europe via Turkey, and its length is about 3500 km. Turkey is natural gas importer itself and perform the critical role as a transit country. Turkey offtakes Azeri natural gas to meet its domestic demand and transmits gas to westward in accordance with transit-deal.

The Tabriz-Ankara pipeline plays crucial role for Iranian gas export to Turkey. At this moment, Turkey is importing Iranian natural gas to the amount of 10 bcm per year under the long-term contract. The maximum throughput of the pipeline is 14 bcm per year in 2021 (Liakopoulou, 2021). Considering political issue, it may be not easy to make a full-scale natural gas supply agreement between Iran and the EU. However, continuing conflict between Moscow and Kiev make Russian gas supply to the EU make unstable and there is possibility of several European country would have interest in Iranian natural gas. If Tabriz-Ankara pipeline is connected to the SGC, it allows Iran to access the European gas market. This study makes bold assumption that European countries import Iranian natural gas for stable gas supply.

2.3.1. Russian supply

Russia supplied 26.32 bcm of natural gas to Turkish gas market in 2021 (Rzeyeva, 2022, p.11) and Gazprom sent 15.98 bcm of natural gas to Turkey via Blue Stream in 2021 marking the highest annual export since commissioning in 2003 (Ceenergy news, 2022). Rest amount of natural gas is delivered via TurkStream. According to long-term contract with Russia, Turkey is supposed to import 10.75 bcm via TurkStream and 16 bcm via Blue Stream (Rzeyeva, 2022, p. 22). However, Turkey's import volume frequently fluctuates every year, and it imported total amount of 21.65 bcm of natural gas from Russia in 2022. As specific throughput data by pipelines in 2022 is not available, this study assumes that Turkey imported the same amount of natural gas as the previous year through Blue Stream and rest amount of the gas were imported via TurkStream.

Even though Russian natural thorough-put to the EU is decreasing after the War in 2022, its export volume to Turkish market will remain robust within an expected range of 20-25 bcm a year (Yermakov, 2023, p.12). However, Moscow tries to expand its export to Turkey and this study expect that Russia can supply maximum 30 bcm of natural gas to Turkey soon and the amount of allocation will be 15 bcm for each pipeline.

In addition to Turkey, Southern European market heavily depends on Russian natural gas. Initially, Russian natural gas via TurkStream was to either consumed in Bulgaria or transmitted to Greece, North Macedonia, and Romania. However, as Russia has only two remaining gas exporting routes to the European market, UGTS and TurkStream, significance and reliance of TurkStream continue to increase. Since early 2021 Russian gas injected into TurkStream is now destined to Serbia, Bosnia and Herzegovina, and Hungary also receives Russian natural gas through this route since October 2021 (S&P Global, 2022b). Total gas deliveries into Southeast Europe via TurkStream in 2021 amounted to 11.6 bcm. Russian pipeline gas exported to the European Union was more than a half over the last year to an estimated total of 60 bcm in 2022 (International Energy Agency, 2022), and most of natural gas was delivered via UGTS. Regarding Russian natural gas export, we refer to the expectation of previous work, and it's volume will be 16.5 bcm per year via TurkStream (Chyong et al., 2023).

2.3.2. Azeri supply

While Turkey imported 8 bcm of Azeri natural gas in 2021, its volume in 2022 increased by 8.7 bcm (Loskot-Strachota, 2023, p.3). After the completion of TAP, Azerbaijan can access to European market. In 2021, Europe received 8 bcm of gas from Azerbaijan, which increased to 11.4 bcm in 2022. Also, Azerbaijan announced that natural gas supply to European market would reach 12 bcm in 2013 and is expected to reach 20 bcm by 2027 (Caspian News, 2023).

Natural gas export of Azerbaijan varies by year due to unstable and declining production at the Shah Deniz-1 gas filed. However, Azerbaijan's gas production will be overtaken by Shah Deniz-2, from which, in addition to the 6 bcm/year for Turkey, 10 bcm/year has been contracted for sale in Europe (Pirani, 2021). Another research suggested that Azerbaijan's natural gas production in two Shah Deniz gas fields will be ranged from 22 to 28 bcm and its additional capability to supply to Europe and Turkey could be 12.6 bcm (Pirani, 2018).

Amid growing uncertainties regarding European energy security, Azerbaijan plans to increase gas flow to westward consumers including Turkey and the European countries. Newly signed memorandum of understanding (MOU) between Azerbaijan and European Commission in July 2022 plans to expanding the Trans-Anatolian Natural Gas Pipeline's (TANAP) capacity from 16 to 32 bcm and the TAP capacity from 10 to 20bcm by 2027(Caspian Policy Center, 2023).

In 2022, Azerbaijan supplied 11.4 bcm of natural gas to Europe and 8.4 bcm of gas to Turkey (Interfax, 2023). A total of 5.6 bcm of gas were supplied to Turkey in the reporting period through the TANAP pipeline. Thus, this study assumes Azerbaijan can export 12 bcm gas to Turkey and 20 bcm of gas to the EU. Since the EU continues to reduce its reliance on Russian natural gas and the Caspian Region has priority for its natural gas supply, this study consider the EU has sufficient demand.

2.3.3. Iranian supply

Iran is the second-largest natural gas exporting country for Turkey only after Russia, delivering approximately 10 bcm of natural gas annually. Botas and National Iranian Gas Company signed 25-year deal in 2001 (RUDAW, 2022). The Iranian natural gas is transported to Turkey via a 2577 km pipeline stretching from Tabriz in North-West Iran to Ankara in Turkey. Tabriz-Ankara Pipeline is connected to SGC in Turkish territory. In fact, Iranian natural gas is collected in Turkey and transmitted to the EU via pipeline. If the political issue is resolved, Iran can also deliver natural gas Europe via Turkey (Jafarzadeh et al., 2021). Thus, Iran can be the gas supply options for the EU. Whereas Turkmenistan is unable to supply natural gas to Europe without construction of

Trans-Caspian Pipeline (TCP), Iranian natural gas already has access to SGC. Thus, we set Iran is potential gas supplier for European customer.

3. RESULTS

This study assumes several gas supply options by gas through-put from Russia, Azerbaijan and Iran to the EU. Breakout of Russo-Ukraine War in 2022 affect not only Russia-European relation, but natural gas market. Russia has reduced gas supplies to the EU, and Nord Stream, the direct link between Russia and Europe, has been damaged and rendered inoperable. At the same time, the EU seeks for the way to end its dependence on Russian natural gas and considers the Caspian Region promising gas supplier by completion of SGC. The result of calibration is presented in Table 3.

The first scenario is the status in 2021. Turkey shows high demand for natural gas in 2021. This is partly due to the expiration of legacy long-term contracts with Gazprom at the end of December, which totaled 8bcm, considering uncertainty over contract extension and concerns over stable gas supply in the summer when demand surged due to extremely hot weather and a harsh winter in 2021/2022 (Rzeyeva, 2022). Turkey import Russian natural gas via Blue Stream and TurkStream which amount to 15.98 bcm and 10.34 bcm respectively. The total volume of natural gas shipped to Southern Europe via TurkStream was 11.6 bcm and via SGC was approximately 10 bcm in 2021. Apart from Azerbaijan and Russia, Iran is another important natural gas supplier for Turkey and its annual contract quantity is 9.6 bcm per year.

In 2021, Russia enjoyed the position as the biggest gas supplier in the network, obtained 22.5% of relative bargaining power. Turkey as an important transit country and importer, it gained 29.8% of relative bargaining power. Iran supplied 10 bcm of natural gas only to Turkey and acquired 13.9% of relative bargaining power while Azerbaijan gained 16.6% of relative bargaining power. This is because Azerbaijan exported more natural gas than Iran and delivered not only to Turkey but to EU.

Table 2: Trade volume (bcm) by scenario

Pipeline (destination)	Edge involved	2021	2022	After 2022
Blue Stream (Tur)	RU-TUR (1200 km)	15.98	15.98	15
TurkStream (Tur)	RU-TUR (930 km)	10.34	5.62	15
TurkStream (EU)	RU-EU	11.6	16.5	16.5
SGC (Tur)	AZ-TUR	8.8	8.4	12
SGC (EU)	AZ-TUR-EU	8	11.4	20
Tabriz-Ankara (EU)	IR-TUR-EU	0	0	7
Tabriz-Ankara (TUR)	IR-TUR	9.6	9.6	14

Table 3: Allocation of relative bargaining power

Country	2021 (%)	2022 (%)	Exp (%)
Russia	22.5	21.7	20.6
Azerbaijan	16.6	17.0	18.0
Iran	14.0	13.7	13.0
Turkey	29.9	28.6	30.2
European Union	17.0	18.9	18.1

Total volume of Russian natural gas delivered to Europe had dropped through 2022, ending gas supply via the Yamal-Europe and Nord Stream pipelines. However, this study only covers Russian natural gas export to Europe via TurkStream. As Russia became more reliant upon TurkStream after the explosion of Nord Stream, Russia allocated more natural gas into European section of TurkStream and showed increase export to Europe in this network setting. The increment of Russian gas export to Europe could compensate for the decrease in Turkish market, and Russian total gas export slightly increased compared to 2021. However, Russia lost 0.8% point of relative bargaining power. This is partly due to decreased Russian role as a gas exporter in this network. Europe gained <2% point relative bargaining power even though it has increased by 8 bcm from 19.6 bcm to 27.9 bcm in 2021 from Russia and Azerbaijan.

Azerbaijan exported total 20.4 bcm natural gas which destined to Europe and Turkey 11.4 bcm and 8.4 bcm respectively. Its export volume increase by more than 15%, but its relative bargaining power increased only 0.4% point. Turkey's transit volume of Azeri gas increased by 3.4 bcm, but its natural gas importing volume decreased by 6 bcm, which resulting in 1.2% point decrease in relative bargaining power compared to 2021. Azerbaijan's relative bargaining power slightly increased by 0.4% point due to the increase in export volume, while Iran's relative bargaining power decreased by 0.2% point due to a 1 bcm decrease to Turkey.

The last scenario assumes a situation where all existing pipelines are operating at or near full capacity. In this scenario Russia annually exports 15 bcm of natural gas to Turkish market via Blue Stream, and it supplies 15 bcm and 16.5 bcm of natural gas to Turkey and Europe through two strings of Turkey Stream, respectively.

This study assumes that the capacity of SGC connecting Azerbaijan-Turkey-Europe can be expanded to deliver total 32 bcm of natural gas per year, as Azerbaijan hope to expand its gas export. In this situation, Turkey imports 12 bcm of natural gas, and Europe expected to import 20 bcm of Azeri natural gas to replace Russian natural gas.

It is assumed that the Tabriz-Ankara pipeline connecting Turkey and Iran is fully operational with 14 bcm of installed capacity, of which Turkey imports 9 bcm of natural gas from Iran and the remaining 5 bcm of natural gas from Europe. Under these circumstances, Russia exports a total of 46.5 bcm of natural gas, more than any other exporting countries. Azerbaijan exports a total of 32 bcm of natural gas and Iran exports 14 bcm of natural gas. And the gains of relative bargaining power of these three countries was 20.5%, 18.2%, and 13.0%, respectively.

Turkey imports a total of 51 bcm of natural gas, while the EU imports 41.5 bcm of natural gas in the scenario. However, the relative bargaining power of the two countries is 30.2% and 18.1%, respectively, showing quite big difference of 12 percentage points. The reason of difference in the relative bargaining power comes from Turkey's role as a transit country.

4. CONCLUSION

Using network game approaches, this study calibrates the relative bargaining power among participants. There are several ways to measure the relative bargaining power. we focus how the structural changes in network and their trade volume affect the allocation of the relative bargaining power.

The result shows Russia's slight loss in its relative bargaining power as the EU bring more gas from the Caspian region. It is certain that Russia is an important gas supplier, but as more Azeri natural gas flow into the region, Russia's status has been somewhat weakened. However, it seems that Russia's direct exporting route between Russia and Turkey, called Blue Stream and TurkStream, helps to maintain its relative bargaining power not relying on a transit country. This can explain the reason for Russia's continuous efforts to build a direct link rather than a transit pipeline.

In the same vein, direct link of Azerbaijan and Iran to export energy without going through Turkey will allow them to enjoy a stable supplier position. However, due to geographical constraints, it is practically impossible for Azerbaijan to export natural gas without a transit country, and in the case of Iran, LNG may be an alternative.

Although the EU imports more natural gas from the Caspian Region, its relative bargaining power has not increased. In current network settings, Europe has only two options: to receive natural gas via Turkey or from Russia. As European countries are dependent on transit country, its relative bargaining power is not able to increase significantly.

Russia's loss of relative bargaining power when all pipelines are running at full capacity reflects Russia's current position as a dominant supplier in this network. In other words, Turkey and European countries are still more reliant on Russian natural gas despite other alternatives – Azerbaijan and Iran.

Likewise, it is possible to explain why European countries try to diversify its supply to reduce dependence on Russian natural and how reducing dependence on Russia weaken Russia's position. However, in the three scenarios, increasing natural gas imports from other countries, Azerbaijan and Iran, does not significantly increase the European relative bargaining power, and even some cases may decrease. This can partly support the opinion that pointed out the problem of the Nabucco Project, the predecessor of the SGC, that Caspian region's natural gas imports were driven by political rather than economic considerations.

Overall, Turkey gains more relative bargaining power compared to loss of the value of the EU. In addition, Azerbaijan gains small share of the relative bargaining power compared to the gain of Turkey. It implies that Turkey could be the top beneficiary of the project linking the Caspian region and European countries. This can explain why Turkey's Government set TANAP as international gas corridor even it only passes through Turkey's territory. Also, Turkey's ambition to be an international natural gas hub will not only guarantee a stable gas supply for its domestic demand but will also have a positive effect on Turkey's bargaining power.

This study analyzed the changes of relative bargaining power assuming the EU's gas supply diversification under the threat of Russia's energy weaponization. However, considering the increasing uncertainty of Russian natural gas supply to European market, it is difficult to fully explain the strategic significance of Caspian natural gas only by using quantified methods. Also, as more European countries try to participate in LNG trade, there is possibility to reduce natural gas import from the Caspian region. However, the scope of study is limited to European natural gas diversification via Turkey, excluding considerations of LNG trade, this omission constitutes a potential limitation of the study.

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