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ASSESSING ENERGY SECURITY IN THE CASPIAN REGION: THE GEOPOLITICAL IMPLICATIONS FOR EUROPEAN ENERGY STRATEGY

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Abstract

Following the collapse of the Soviet Union, Western countries have signed several agreements regarding the use of hydrocarbon resources in the Caspian Basin, with the aim of diversifying their energy suppliers. However, recession in the world economy and persistently low oil prices have profoundly affected the economies of the Caspian states, whose gross domestic product and exports are dominated by oil and oil products. Strongly dependent on export revenues from oil and gas, the economic growth of these states has slowed since 2014. Although limited energy resources have stimulated an emphasis on security of supply, fundamentally understood as a continued and low-risk strategy of interruption of energy import flows, low oil prices have also maintained focus on the challenge of security of demand faced by energy-producing economies in terms of stable energy export revenues. However, geopolitical developments around the world, especially local armed conflicts, highlight the importance of secure routes, as they present a threat to energy transportation. Using an indicator-based approach and country-level data over the period 2000–2017, this paper assesses the security of demand for the oil and gas of three countries in the Caspian region: Azerbaijan, Kazakhstan, and Turkmenistan, over a 16-year period, capturing the geopolitical situation and contributing to a greater understanding of the impact of energy-transporting countries' geopolitical situation on energy transportation to the European Union (EU).

The results demonstrate that risk of energy security of demand is greater when political risk in energy-transporting countries is included within a measure of energy security of demand, i.e., risky external energy demand. The sharp decline in political stability and absence of violence or terrorism ratings in Ukraine and Turkey has increased the risk of security of energy demand in Azerbaijan, Kazakhstan, and Turkmenistan. The results highlight the importance of cooperation not only between the EU and the Caspian region, but also with energy-transporting countries, such as Ukraine, Georgia, and Turkey. Alternatively, routes may be found that bypass countries with low levels of political stability, such as through the Trans-Caspian Pipeline.

Keywords: energy security, energy-transporting countries, crude oil export, natural gas export, security of demand

JEL Classification: Q32, Q35, Q41, O13

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1. INTRODUCTION

Contradictory understandings of the energy security by energy exporting countries and energy importing countries is a significant challenge. While energy importers focus on security of supply, meaning "sustainable energy production and uninterrupted oil and gas deliveries from energy exporters, producers are concerned with security of demand, implying stable revenues and guarantees of demand security from energy consuming nations" (Yenikeyeff 2006: 1). However, in its 1961 Statute, the Organization of Petroleum Exporting Countries (OPEC), which has played an important role in turning fossil energy resources into the untraditional security issue of international relations, has defined energy security as a shared producer-consumer responsibility, based on the principle of the assurance of "an efficient, economic and regular supply" of petroleum from producers to consumers. The significance of enhanced energy security must be seen from both supply and demand perspectives, which are mutually supportive. Indeed, it has been claimed that the revenues that energy-producing developing countries receive from energy resource sales are essential to financing their economic and social development, and to an extent that may not be fully appreciated by industrialized nations, which tend to rely on fossil fuels (OPEC 2012). Therefore, market stability and supply security are always in the best interests of energy-producing countries, as well as ensuring steady, predictable demand. Thus, energy security is often overlooked by consumers, even though it is as fundamental to producers as security of supply. Security of demand goes hand in hand with security of supply.

The end of the Cold War stimulated new developments related to the energy policies of Western economies. Since the early 2000s, the United States and European countries have increasingly sought to use hydrocarbon resources in the Caspian Basin with the aim of reducing their heavy dependency on supplies from the Middle East while enhancing energy security (Baghat 2005). However, the energy agreements signed with the new independent Caspian states could not protect the European Union (EU) members from the aftermaths of the Russian-Ukrainian natural gas disputes of 2006 and 2009, and energy security has accordingly become part of the top agenda of European countries, as it had following the 1973 oil crisis. The ongoing Russian-Ukrainian crisis has raised questions regarding how much of the EU's energy supply is secure. Recent geopolitical developments, such as the annexation of Crimea and the prolonged Syrian war, have further increased the importance of Caspian energy resources for Europe, emphasizing once again the three long-established objectives of the EU's energy policy: security of supply, sustainability, and competitiveness. On the other hand, countries with vast fossil fuel resources located around the Caspian Sea, namely Azerbaijan, Kazakhstan, and Turkmenistan, whose economies are primarily dependent on exporting energy resources, are also interested in close cooperation with Europe. Although the Russian Federation and Iran possess major fossil resources and produce significant amounts of energy, they extract a small fraction of oil and gas in the Caspian basin than other countries that are located far away from the Caspian basin. Although the Russian Federation and Iran possess major fossil resources and produce significant amounts of energy, they extract a small fraction of oil and gas in the Caspian basin[1] than other

[1] For detailed information about the Russian Federation, see Gazprom (2019). Gas and Oil Production, http://www.gazprom.com/about/production/extraction/ (accessed 27 January 2019). For detailed information about Iran, see US Energy Information Agency (2018). Country Analysis Brief: Iran, http://www.ieee.es/en/Galerias/fichero/OtrasPublicaciones/Internacional/2018/EIA_Iran_9abr2018.pdf (accessed 27 January 2019).

countries and, thus, are less dependent on the region's energy potential than Azerbaijan, Kazakhstan, and Turkmenistan.

For Azerbaijan, Kazakhstan, and Turkmenistan, as for many other energy-exporting countries, energy security is mainly regarded from the security of demand and security of energy transportation. For these countries, security of demand signifies stable and regular incomes from energy exports as a result of trading between themselves and consumer states. However, security of transit means threats to energy infrastructure that may occur at all scales, from individual acts of crime, sabotage or terrorism and cyber-attacks, up to major interstate and regional wars; moreover, these threats are posed from the level of individual criminality, through non-state or sub-state actors, to state-led action, either covert or overt (Mills 2016). Given that energy transportation routes can include more than two countries (including energy-exporting and energy-importing countries) depending on the number of countries through which energy transportation route passes, and considering the vulnerability of geographic locations such as the South Caucasus and Central Asia, the security of transit routes through energy-transporting countries should be considered an important component of security of demand of Azerbaijan, Kazakhstan, and Turkmenistan.

Whereas the basis of Europe's economy is reliant on energy imports, the basis of the Caspian countries' economies depends on energy exports. Energy security in both Europe and the Caspian region is being challenged by the current geopolitical situation. Energy security in Europe suffers from a lack of reliable and sustainable access to energy, as well as dependence on Russian energy supply. Disputes between Ukraine (an energy-transporting country) and the Russian Federation have put energy supply from the latter at risk. Moreover, energy supply from Kazakhstan and Turkmenistan may be compromised because it is transported through the Russian Federation to the EU. Two new pipelines to transport energy from the Russian Federation to the EU while bypassing Ukraine have been initiated. Countries from both the Caspian region and Europe are interested in finding routes to transport energy more directly. A recent agreement between the five Caspian states concerning the legal status of the Caspian Sea provides some hope that this may achieved.[2] To this end, it is important to understand energy security not only in Europe, but also in the Caspian region.

This research considers the security of demand of the Caspian region. Energy demand is concentrated in Europe, while energy supply is concentrated in the Caspian region, including Azerbaijan, Turkmenistan, and Kazakhstan. The economy of Europe depends on energy imports, while the economy of the Caspian region depends on energy exports. Energy security is a central aim of energy policy (Houses of Parliament 2012) and necessary for European growth (European Commission 2010). Given that energy security has several more comprehensive dimensions, comprising the availability of resources (AV), the applicability of technologies in harnessing and utilizing energy resources (AP), the social and environmental acceptability of energy production (AC), and the affordability of energy resources (AF) (Yao and Chang 2014), the European

[2] On 12 August 2018, the Caspian littoral states signed the Convention on the Legal Status of the Caspian Sea. The key features of the Convention are as follows: The Convention establishes a 15-mile-wide sovereign waters zone, plus an additional 10 nautical miles of exclusive fishing zone, followed by common waters. The construction of underwater pipelines does not require parties' unanimity. A party proposing to construct a pipeline only needs to agree (on a bilateral basis) with the party through whose territory the pipeline will cross. However, the route of the pipeline must be communicated to the remaining signatories. The key condition for the construction of pipelines is compliance with environmental standards and requirements, including compliance with the Framework Convention for the protection of the Marine Environment of the Caspian Sea. The Caspian Sea is declared a zone of peace and only signatories can deploy military assets in the Caspian Sea. For detailed information, see Culver et al. (2018).

Commission (2010) has identified energy security as a first challenge to completing the European Research Area. Energy security in Europe may be strengthened by diversifying energy suppliers from the Caspian region (European Commission 2014), but in both Europe and the Caspian region it may be compromised by the current geopolitical situation in energy-transporting countries.

Using the indicator-based approach, this paper quantitatively measures the energy security of demand (i.e., the risky external energy demand, REED), of three major energy-exporting countries from the Caspian region: Azerbaijan, Turkmenistan, and Kazakhstan, over the period 2000–2017. Existing measures of energy security of demand are modified to include the geopolitical situation in energy-transporting countries by the help of newly derived indicators. The main contribution of this study is its incorporation of political risk in energy-transporting countries within an energy security of demand index. The results may prove useful for future studies as well as policy makers from both Europe and the Caspian region.

2. CONCEPTUAL BACKGROUND

The concept of energy security is usually tied to Winston Churchill and Georges Clemenceau, who perceived oil supply security as essential to fueling their armies for World War I (Energy Charter Secretariat 2015). Post-war reconstruction was supported by the technological developments of the 1950s and 1960s, increasing demand for fossil resources. A growing world population also raised the value of energy. However, the turning point was the 1973 oil crisis, as states agreed that energy security is not simply a commercial issue. Oil price shocks had significant disruptive impacts on the United States (US) and several other economies with considerable demand for oil, negatively affecting macroeconomic variables including gross domestic product (GDP) growth rate and inflation rate (Hamilton 1983, 1996; Taghizadeh-Hesary et al. 2013, 2016). Thus, since the 1970s, energy security has become one of the main targets of states' energy policies. Geopolitical developments in the world following the collapse of the Soviet Union has added a new dimension to energy security.

Energy security is usually defined as the reliable and sufficient supply or demand of energy at acceptable prices (APERC 2007; European Commission 2000; IEA 2014; UNDP 2004). Bielecki (2002) argues that a reliable and sufficient supply simply means an uninterrupted supply that fully meets the needs of the global economy, whereas acceptable or reasonable prices are less clear given that they change over time and are perceived differently by energy producers and consumers. However, in general, one may see prices as being cost-based and determined by the market based on supply/demand balances. Such a balance allows for mutual interdependence between energy consumers and energy producers. This is why the concept of energy security varies from state to state, depending on the needs and conditions of the country in question. Deeming existing definitions insufficient, Yao and Chang have suggested (2014) more comprehensive dimensions of energy security, specifically the availability of resources (AV), the applicability of technologies in harnessing and utilizing energy resources (AP), the social and environmental acceptability of energy production (AC), and the affordability of energy resources (AF). For Tippee (2012), energy security has different meanings in different places. For countries that are highly dependent on imported oil and gas, energy security concerns tend to focus on supply. In contrast, security of demand is primarily an issue for countries with economies based on exported oil and gas. In other words, energy security for energy-exporting countries refers to continuous access to international energy markets for the sale of energy resources, while energy security for importing countries refers to assured access to a continuous supply of energy at

affordable prices in order to maintain economic growth and social progress (Alsaad 2014). This is the most significant difference between the energy security perceptions of energy importers and energy exporters (Energy Charter Secretariat 2015). Simply put, energy security may imply stable energy flows for energy importers, but stable energy revenues for exporter countries. The oil crisis of the 1970s exemplified stability of energy flows, whereas the political and economic developments of the 2010s emphasized stability of energy incomes.

Related to the severe outcomes of the oil crisis of the 1970s, the concept of energy security has been largely defined from the energy consumer perspective in the literature. However, it is necessary to redefine the concept according to the energy price reductions of the 2010s. A fall in oil prices drove some energy-producing countries to the brink of poverty. Considering that most energy producers are developing countries, such a drop may trigger an escalation in internal political and economic instability, a substantial threat to secure supply in the long term.

Based on a review of the literature on security of supply, Winzer (2012) finds that the common concept behind all energy security definitions is the absence of protection from or adaptability to threats that are caused by or have an impact on the energy supply chain, including technical, human, and natural risks. The same risks may also be identified for the security of demand. However, as mentioned above, most of the existing literature has focused on energy supply security, whereas energy demand security remains one of the most neglected parts of energy studies.

Energy security is a central aim of energy policy (Houses of Parliament 2012). Policy makers in both energy-exporting and energy-importing countries require indicators to measure and assess the energy security of demand and supply. Indicators are tools for communicating energy issues to policy makers and the public (Vera and Langlois 2007). Considering that energy security has two dimensions – supply security and demand security – indicators related to supply security aim to measure the adequacy, reliability, quality, and guarantee aspects of energy resources and transporters.

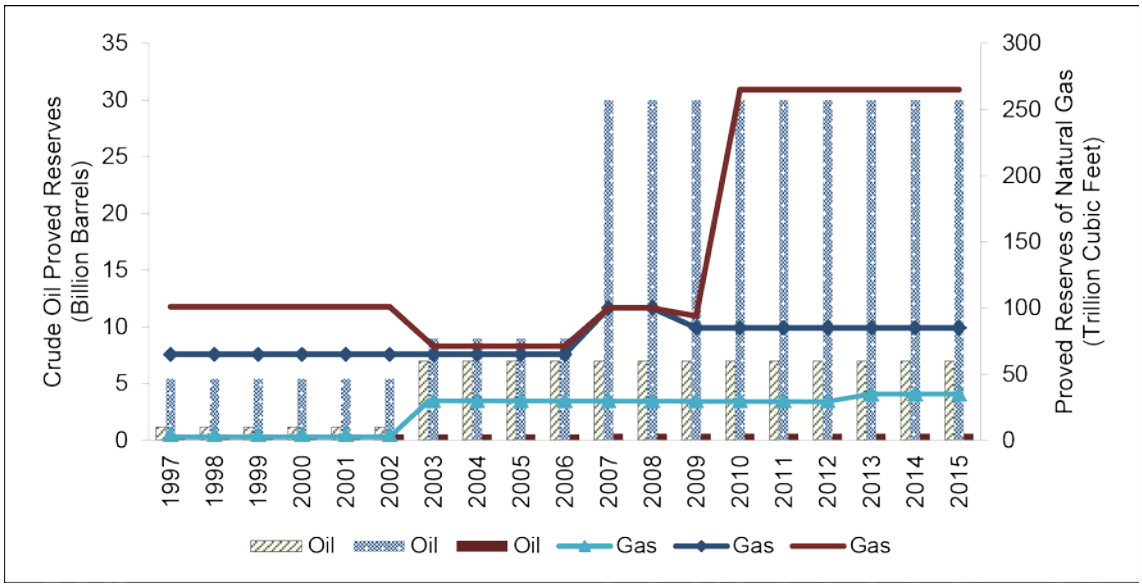
However, the energy demand security indicators seek to measure security from the consumer's perspective (Reddy and Ulgiati 2015), while few papers measure energy security of demand. Dike (2013) has offered indicators of security of demand for OPEC countries, and Kanchana and Unesaki (2015) have provided indicators of security of demand for Association of Southeast Asian Nations (ASEAN) member countries. Furthermore, using methodologies developed by Le Coq and Paltseva (2009) and Dike (2013), Akhmetov (2015) has measured the security of external energy supply and energy export demand in Central Asia.

3. ENERGY SECURITY IN THE CASPIAN REGION: AZERBAIJAN, KAZAKHSTAN, AND TURKMENISTAN

Although the Caspian Sea is surrounded by five states (the Russian Federation, Iran, Azerbaijan, Kazakhstan, and Turkmenistan), this paper concentrates only on the latter three. While the Russian Federation and Iran are major energy producers, they lack substantial oil and gas production in the Caspian region, and the energy incomes of the Caspian region are not vital for either state's economy. Despite the fact that the Basin does not hold a large share of global energy supply, representing 3.4% of total world oil supply and 5.9% of total world natural gas supply in 2017 (BP 2018), its importance as a source of global energy production is increasing due to current geopolitical developments. Similarly, oil and natural gas revenues as a result of exporting energy

resources play a vital role for the economies of the Caspian region (Kalyuzhnova 2001), especially for Azerbaijan, Kazakhstan, and Turkmenistan (Tables 2–4). At the end of 2016, Azerbaijan's oil reserves of 7 billion barrels (bbl) (Figure 1) accounted for 0.4% of global reserves, ranking it 21st in the world. Azerbaijan has an estimated 35 trillion cubic feet (tcf) of proven natural gas reserves (Figure 1), and at more than 1,000 billion cubic meters (bcm) the Shah Deniz gas field is one of the world's largest (IEA 2018). At the end of 2016, Kazakhstan's proven oil reserves were 30 bbl (Figure 1). This amounts to 1.8% of the world's total liquid reserves and puts Kazakhstan in 12th place worldwide. Kazakhstan is also rich in natural gas deposits, with 85 tcf of proven reserves at the end of 2016 (Figure 1). Turkmenistan is rich in gas and, to a lesser extent, oil. The country has an estimated 265 tcf of natural gas reserves (Figure 1). Crude oil reserves are more modest (below the global top 20) at 0.6 bbl of crude oil resources in 2016 (Figure 1).

Figure 1: Proven Crude Oil Reserves in the Caspian Region



Source: Author's own using U.S. Energy Information Administration (2017a, 2017b).

The area's significant oil and natural gas reserves enabled Azerbaijan, Kazakhstan, and Turkmenistan to sign international contracts with leading energy companies immediately after declaring their independence in the 1990s. However, its political regime, risky investment climate and need to improve relevant legislation and regulations prevented Western oil and gas companies from accessing Turkmenistan, despite their enthusiasm for the enormous investment opportunities the country offered. High crude oil prices during growing crude oil exports from all three countries have enabled them to rapidly develop economically and increase their real GDP growth rates (Table 1).

Table 1: GDP Growth in the Caspian Region (annual %)

Countries	1991	1995	2000	2005	2010	2013	2014	2015	2016	2017
Azerbaijan	–0.7	–11.8	11.1	26.4	4.9	5.8	2	1.1	–3.1	0.1
Kazakhstan	–11	–8.2	9.8	9.7	7.3	6	4.2	1.2	1.1	4
Turkmenistan	–4.6	–7.2	5.5	13.04	9.2	10.2	10.3	6.5	6.2	6.5

Source: Authors' own using World Bank (2018a).

Table 2: Oil Revenue in the Caspian Region

Countries	2012	2013	2014	2015	2016
Azerbaijan, % of GDP	28.22	23.57	19.54	11.03	17.46
Kazakhstan, % of GDP	16.34	13.77	13.46	6.66	10.05
Turkmenistan, % of GDP	13.76	12.08	10.03	5.05	5.52

Source: Authors' own using World Bank (2018a).

Table 3: Natural Gas Revenue in the Caspian Region

Countries	2012	2013	2014	2015	2016
Azerbaijan, % of GDP	3.41	2.81	2.55	2.18	2.80
Kazakhstan, % of GDP	1.10	0.95	1.00	0.78	0.88
Turkmenistan, % of GDP	25.31	20.07	18.25	15.03	11.19

Source: Authors' own using World Bank (2018a).

Table 4: Energy Exports, $ million

	Crude Oil			Natural Gas		
Year	KAZ	AZE	TKM	KAZ	AZE	TKM
2000	4,249	985	34			941
2001	4,255	1,725	69	115	1	1,848
2002	5,028	1,476	125	278	1	2,072
2003	7,013	1,816	66	339	1	2,063
2004	11,417	2,264	56	698	2	2,587
2005	17,395	2,219	212	689	4	3,471
2006	23,612	3,848	119	898	10	4,004
2007	28,126	3,214	131	1,149	26	4,826
2008	43,508	44,171	244	1,978	93	6,035
2009	26,207	11,990	144	1,802	131	862
2010	36,982	18,490	88	1,677	304	1,012
2011	55,174	22,911	136	3,820	587	5,381
2012	56,442	20,233	136	3,620	661	8,691
2013	57,250	20,244	73	3,384	732	9,002
2014	53,627	18,405	184	3,297	324	9,535
2015	26,773	8,866	266	2,384	208	8,015
2016	19,378	6,504	537	1,738	982	5,861
2017	26,584	10,706	134	2,263	1,112	6,560

Note: KAZ = Kazakhstan, AZE = Azerbaijan, TKM = Turkmenistan.

Source: Authors' own using United Nations Comtrade (2018).

Oil and natural gas revenues represent a significant part of the total GDP of Azerbaijan, Kazakhstan, and Turkmenistan (Tables 2 and 3). Whereas Azerbaijan and Kazakhstan derive major energy revenues from oil exports, the main source of income in Turkmenistan is natural gas exports (Tables 2 and 3). The Caspian countries—especially Azerbaijan and Kazakhstan—transitioned from lower-middle-income to upper-middle-income status in 2006. Since 2002, GDP per capita has risen significantly and poverty incidence has fallen sharply. Energy exports from the Caspian region grew significantly over the period 2000–2015 (Table).

4. THE EUROPEAN UNION'S ENERGY SECURITY

As highlighted before, the 1973 oil crisis was an historical event that "officially" threatened Western countries' energy security. While oil shocks pushed them to draw an institutional security framework for energy issues, including the creation of the International Energy Agency (IEA) (Bielecki 2002), almost every European state focused on its own relations with exporter countries, and especially with the Russian Federation. However, the natural gas crisis between the Russian Federation and Ukraine represented a turning point for European countries to act toward common policies. The crisis accelerated the Energy Charter process, which had been initiated in 1994. On the other hand, ongoing and unexpected global, regional and local developments, such as the 2008 financial crisis, the 2008 Russian-Georgian war, the Syrian refugee crisis from 2012, the annexation of Crimea by the Russian Federation in March 2014, the United Kingdom's (UK) decision in June 2016 to leave the EU, and Union Catalonia's independence referendum in October 2017 all forced the EU to deal simultaneously with different problems and slowed the implementation of energy initiatives by its institutions. Thus, high dependency on energy imports from the Russian Federation, diversification challenges and member states' tendencies to continue energy relations with exporter countries on bilateral grounds have become the main potential threats to the EU's energy security. The EU primarily focuses on the following three objectives in the context of the common energy policy that it aims to establish:

- To secure energy supplies to ensure the reliable provision of energy whenever and wherever it is required;
- To ensure that energy providers operate in a competitive environment that ensures affordable prices for homes, businesses, and industries;
- To ensure sustainable energy consumption through reducing greenhouse gas emissions, pollution, and fossil fuel dependence.

The EU's interest in the oil and gas reserves of the Caspian region has been stated in the European Commission's (2000) *Green Paper on the Security of Energy Supplies* (Kalyuzhnova 2005). The EU is searching for diversification supply routes and a supplier base as part of its newly developing energy diplomacy. The need for secure energy supply diversification on the one side and the need for steady energy incomes on the other have constituted the key determinants of EU-Caspian relations following the dissolution of the USSR. Whereas energy export incomes have formed the basis of the economies of Azerbaijan, Kazakhstan and Turkmenistan, and ensuring the sustainability of hydrocarbon revenues in terms of economic, social and political stability has been the main task of these states' governments, an uninterrupted supply of Caspian energy resources has similarly been vital for the EU. The signing of memoranda of

understanding (Memorandum of Understanding 2006a, 2006b, 2008), including on cooperation in the field of energy between the EU and Azerbaijan, Kazakhstan, and Turkmenistan, has been a crucial step in strengthening the EU's energy relations with the Caspian region, while also helping these countries to reform and modernize their domestic energy sectors.

The opening of the Baku-Tbilisi-Ceyhan oil pipeline in 2006 helped stimulate energy cooperation between Azerbaijan and the EU, providing an alternative route for Kazakhstani crude oil as well. Both Azerbaijan and Kazakhstan are among the 10 main oil suppliers of the EU, supplying around 5% and 7% of the EU's oil demand, respectively (Table 5).

Table 5: EU Imports of Crude Oil

Exporter	2010	2011	2012	2013	2014	2015	2016	2017
Azerbaijan, % of EU imports of crude oil	4.0	5.0	4.0	4.8	4.4	5.2	5.0	4.8
Kazakhstan, % of EU imports of crude oil	6.0	6.0	5.0	5.8	6.4	6.5	7.2	7.9

Source: Authors' own using European Commission (2018).

The Southern Gas Corridor (SGC) is one of the most visible EU-led initiatives that proposes to transport gas from Central Asia, the Caucasus and potentially the Middle East. With this long-discussed pipeline project the EU aims to cooperate closely with gas suppliers in the region, including Azerbaijan, Iraq, and Turkmenistan. As a transit country, Azerbaijan also plays a pivotal role in bringing Caspian gas resources to the EU market through the SGC. A joint declaration signed in 2011 represents a strategic initiative for the promotion of a westward energy route that allows the transportation of natural gas from Kazakhstan and Turkmenistan to European markets across the Caspian Sea. However, unresolved disputes as to the Caspian Sea's legal status, involving the Russian Federation, Azerbaijan, Kazakhstan, Turkmenistan, and Iran, pose an obstacle for the realization of a Trans-Caspian pipeline. In negotiating with Azerbaijan and Turkmenistan on a Trans-Caspian Pipeline, the EU intends to optimize the sides' interests: the diversification of the EU's suppliers, the diversification of buyers of Turkmen gas, ensuring higher energy incomes, and increasing the rentability of the SGC. Within this context, the EU's resolution recommendation for existent disputes on the ownership of the Kyapaz/Serdar offshore gas field, including joint operations, is remarkable. In addition, the potential threat to energy exporters due to the geopolitical situation in energy-transporting countries has increased in all three of Azerbaijan, Kazakhstan, and Turkmenistan due to their landlocked position, limiting EU-Caspian interdependence. The EU aims to cooperate closely with energy-transporting countries, i.e., Azerbaijan, Georgia, and Turkey. On the other hand, the signing of the *Convention on the Legal Status of the Caspian Sea* by the leaders of five states bordering the Caspian Sea (Azerbaijan, Iran, Kazakhstan, the Russian Federation, and Turkmenistan) in August 2018 (Auyezov 2018) represents a positive step toward ending disputes. In a wider perspective, the signed convention provides hope for close cooperation between both energy-producer countries in the Caspian Basin and transit states. A coincidence of the importance of incomes from European energy markets and alternative suppliers with geopolitical dynamics in the region strengthens the possibility of collaboration in the near future.

5. METHODOLOGY

Given that energy security is usually defined as the uninterrupted availability of energy sources at an affordable price, indicators measuring energy security emerge from five dimensions of energy security related to energy availability, accessibility, affordability, and acceptability (the 4As) (Intharak et al. 2007). Several tools by which to measure the 4As have been suggested (Kruyt et al. 2009; Löschel et al. 2010), ranging from simple indicators (e.g., energy price, reserves, import dependence) to aggregated indicators (e.g., IEA index, supply/demand index). Most measure security of supply, although the risky external energy demand (REED) index evaluates the security of demand. REED has been adapted from the existing literature. The scope of this study is limited to two energy sources: crude oil and natural gas. A measure of energy security of demand in Azerbaijan, Turkmenistan and Kazakhstan is presented here, capturing the risks in energy-transporting countries. Energy security of demand is highly contingent on energy transportation to Europe through the Russian Federation, Ukraine, Georgia, and Turkey. Political situations in these countries can affect energy exports from the Caspian region to the EU. In order to capture these risks, an aggregate index measuring security of demand is generated, based on a set of individual indicators, including political risks in energy-transporting countries. This methodology can be used to generate indicators measuring the energy security of demand in countries that do not have direct routes to energy consumers, and instead rely on energy-transporting countries. Existing measures of energy security of demand (i.e., Akhmetov 2015; Dike 2013; Le Coq and Paltseva 2009) are modified through including political risks in energy-transporting countries (Figure 2). Political stability is highly volatile in all of the energy-transporting countries on the energy route from the Caspian region to importers such as the EU (Figure 2). We also provide measures of energy security of demand over the period 2000–2017. The methodology is based on Akhmetov (2015), Dike (2013) and Le Coq and Paltseva (2009). The contribution of this paper is its capturing of political risks in energy-transporting countries.

Indicators measuring the energy security of supply include a political risk index of the supplier of fuel. Existing measures of security of demand fail to account for risks in energy-transporting countries. However, energy-transporting countries have increased in importance for energy-importing and -exporting countries in recent years. Political instability in energy-transporting countries may disrupt energy transportation and thus increase risks. Here we include a political risk index of energy-transporting countries using the transportation routes of energy-exporting countries.

The REED index, adopted from Dike (2013) and Le Coq and Paltseva (2009), measures short-term risk to the security of energy demand. The REED index developed by Dike (2013) was modified by including political risks in energy-transporting countries that might threaten energy exports via existing routs. We calculate the REED index for three energy-exporting countries in the Caspian region (Azerbaijan, Turkmenistan, and Kazakhstan) as well as for two major exporting fuels (crude oil and natural gas).

The $\mathrm{REED}_{\mathrm{ift}}$ index is calculated for each fuel, $\mathrm{f} \in \{\text{crude oil}, \text{natural gas}\}$ and for each country, $\mathrm{i} \in \{\text{Azerbaijan}, \text{Turkmenistan}, \text{Kazakhstan}\}$ separately, by years, $\mathrm{t} \in \{2000, 2001, \ldots, 2017\}$, as a product of export-dependence, economic dependence, political risks in energy-transporting countries and transaction costs for energy exports:

$$REED_f = \frac{Xf}{X} \times \sum_{j=1}^{J} \frac{1}{J} \left(\frac{X_{fj}}{X_f}\right)^2 \times P_{ft} \times \frac{X_f}{GDP} \times \sum_{j=1}^{J} w_{fj} d_j, \quad (1)$$

where $\frac{Xf}{X}$ is the export dependence, calculated as a ratio of the value of fuel exports over the value of total exports; $\sum_j \left(\frac{X_{fj}}{X_f}\right)^2$ is a monopsony factor, which is the sum of the squared ratio of net positive exports of fuel *f* from energy-exporting country *i* to energy-importing country *j* over the total net positive exports of fuel f over all importers of energy-exporting country *i*; P_{ft} is the political risk index of country *t*, which transports fuel *f* from energy-exporting country *i* to energy-importing country *j*; $\frac{X_f}{GDP}$is economic dependence, which is a ratio of net exports of fuel *f* of country *i* to the GDP of country *i*; and $w_{fj}d_j$ is a transaction cost, measured as distance d_j between country of energy import origin (*i*) and energy export destination (*j*), which is a categorical variable (Equation 2) weighted by the share of exports in total exports $w_{fj} = \left(\frac{X_{fj}}{X_f}\right)$. Subscripts are assigned as follows: fuel $f \in \{crude\ oil, natural\ gas\}$, fuel-exporting country $i \in \{Azerbaijan, Turkmenistan, Kazakhstan\}$, fuel-transporting country $t \in \{1, 2 \dots T\}$ and fuel-importing country $j \in \{1, 2 \dots J\}$.

Transaction cost measures the risks of transportation and infrastructure disruptions. Dike (2013) and Le Coq and Paltseva (2009) measure transaction costs as the distance between energy-exporting and energy-importing countries as a proxy of transportation costs. The distance between countries is measured as that between energy hub ports (see Akhmetov 2015), instead of capital cities as in Dike (2013) and Le Coq and Paltseva (2009). Distance (d_j) is a limited variable with only three possible values depending on the distance between energy-exporting and energy-importing countries (Dike 2013; Le Coq and Paltseva 2009):

$$d = \begin{cases} 1, & if\ distance < 1500\ km \\ 2, & if\ 1500 \leq distance < 4000\ km. \\ 3, & if\ distance \geq 4000\ km \end{cases} \quad (2)$$

To find the political risk index we used one of the World Bank's (2018b) worldwide governance indicators: political stability and absence of violence/terrorism (political stability). The political stability index measures "perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism" (Kaufmann et al. 2007, 2011). It ranges from -2.5 (high political risks) to 2.5 (low political risks). To convert the political stability index to a political risk (high value – high risks) index with only positive numbers running from zero (low political risk) to five (high political risk), we use the following equation:

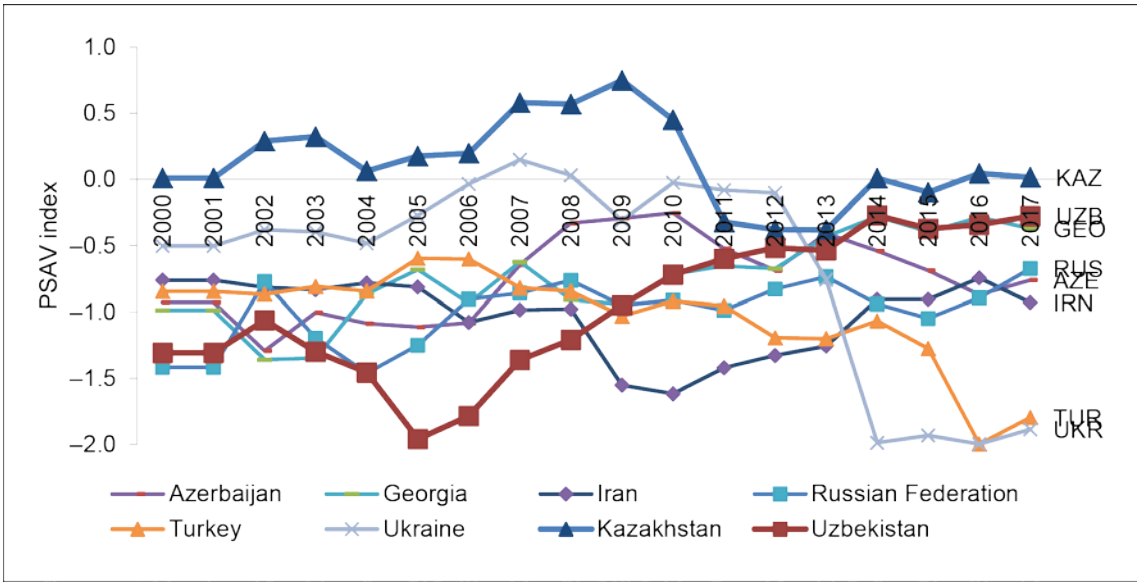
$$P = 2.5 - \frac{\sum_{k=1}^{K} PSAV_k}{K} \quad (3)$$

where *PSAV* is the worldwide governance indicators political stability and absence of violence/terrorism index, and *K* is the number of energy-transporting countries.

Energy-transporting countries are defined here as countries through which energy is transported from Azerbaijan, Turkmenistan, or Kazakhstan to an importer. Some energy exports are transported directly from exporters to importers (for example from Kazakhstan to the People's Republic of China). The main share of energy exports from Kazakhstan, Turkmenistan, and Azerbaijan is transported to the EU. The EU countries that also transport energy are not included as transit countries. The EU is treated as a single importer. The list of transit countries is identified separately for Azerbaijan, Turkmenistan, and Kazakhstan using the Interstate Oil and Gas Transport to Europe

(INOGATE) map. Using data on energy export routes from Azerbaijan, the list of energy-transporting countries includes four countries (see Table 6): Georgia, Iran, Turkey, and the Russian Federation. Using the data on energy export routes from Kazakhstan, the list of energy-transporting countries includes six countries: Azerbaijan, Georgia, Iran, the Russian Federation, Turkey, and Ukraine. The list of energy-transporting countries from Turkmenistan includes four countries: Kazakhstan, Uzbekistan, the Russian Federation, and Ukraine. One can also weight the political risk of a transit country by the share of energy transported through it when data on energy transportation by transit country and year become available.

Figure 2: Political Stability and Absence of Violence/Terrorism in Transit Countries[3]



Note: PSAV – Political stability and absence of violence, KAZ – Kazakhstan, UZB – Uzbekistan, GEO – Georgia, RUS – Russian Federation, AZE – Azerbaijan, IRN – Iran, TUR – Turkey, UKR – Ukraine.

Source: Authors' own using World Bank (2018b).

Table 6: List of Energy-transporting Countries

Energy Exporter	Energy-Transporting Countries
Azerbaijan	Georgia, Iran, Turkey, Russian Federation
Kazakhstan	Azerbaijan, Georgia, Iran, Russian Federation, Turkey, Ukraine
Turkmenistan	Kazakhstan, Uzbekistan, Russian Federation, Ukraine

Source: Authors' own.

Data were collected from various sources using free access. Data can be accessed from Azhgaliyeva (2019). Description of all variables as well as sources are presented in Table 7.

[3] The PSAV index is absent for 2001, hence we used the PSAV index from 2000 instead.

Table 7: Description of Variables and Sources

Variable	Description	Units	Source
X_f	Export value of fuel	US dollars	United Nations Comtrade Database – international trade statistics https://comtrade.un.org/data[4]
X	Total export value	US dollars	
X_{fj}	Export value of fuel *f* to country *j*	US dollars	
X_f	Total export value of fuel *f*	US dollars	
GDP	Gross domestic product	US dollars	World Bank (2018a)
d_j	Transaction costs factor for energy exports	{1, 2, 3}	See Equation (2)
distance	Distance between energy-exporting and energy-importing countries	Kilometers (km)	Calculated using online tool www.timeanddate.com
$PSAV_k$	Political stability and absence of violence/ terrorism (political stability) index	[–2.5, +2.5]	World Bank (2018b)
P	Political risk index	[0, 5]	See Equation (3)

Source: Authors' own.

6. RESULTS

Crude oil and natural gas REED indexes were calculated for Azerbaijan, Turkmenistan, and Kazakhstan over the period 2000–2017. The results of the REED index are presented in Figures 3–5 and A1, and Table A1. The results of the components of the REED index (i.e., export-dependence, economic dependence, political risks in energy-transporting countries, and transaction costs for energy exports) are presented therein, too. Economic dependence (share of fuel exports to GDP) and export dependence (share of fuel exports to total exports) for natural gas in Azerbaijan and Kazakhstan, as well as crude oil in Turkmenistan, are very low (nearly zero) owing to low volumes of exports. This explains the very low values of the natural gas REED index for Azerbaijan and Kazakhstan and the crude oil REED index for Turkmenistan. Low values of economic dependence and export-dependence render the impacts of other components of the REED index, including political risk, unnoticeable. For these reasons, the natural gas REED index for Azerbaijan and Kazakhstan as well as the crude oil REED index for Turkmenistan were excluded from the analysis of the results.

6.1 Political Risk in Energy-transporting Countries

The main contribution of this research is that the political risk of energy-transporting countries is included in the REED index. This is why it is important to understand the impact of the political risk index on REED indexes. The results show that the countries that transport energy from Azerbaijan, Kazakhstan, and Turkmenistan have high and volatile political risk. In recent years, the greatest political risks have been in Turkey and Ukraine. These represented the main drivers of the spikes in political

[4] Codes of commodities for crude oil and natural gas were used: 2709 (Petroleum oils and oils obtained from bituminous minerals; crude); and 2711 (Petroleum gases and other gaseous hydrocarbons; liquified natural gas).

risk in energy-transporting countries calculated for Azerbaijan, Kazakhstan, and Turkmenistan. Using Figures 3–5, we discuss the impact of the political risk in energy-transporting countries on the REED index. For comparison, the oil and gas REED index with and without political risk in energy-exporting countries is presented (Figures 3–5). Given that energy-transporting countries from Azerbaijan, Kazakhstan, and Turkmenistan have high levels of political risk, the inclusion of political risk in energy-transporting countries increases the REED index (i.e., the REED index with political risk is higher than the REED index without political risk), meaning that external energy demand is at greater risk when we consider the political risk of energy-transporting countries. In other words, political risk in transit countries reduces the security of external energy demand in Azerbaijan, Kazakhstan, and Turkmenistan. This has been especially noticeable in recent years due to a sharp increase in political risk in energy-transporting countries, particularly Ukraine and Turkey. The volatility of political stability in energy-transporting countries affects the REED index of Azerbaijan (Figure 3), Kazakhstan (Figure 4), and Turkmenistan (Figure 5). For example, the political risk index in energy-transporting countries from Azerbaijan, Kazakhstan and Turkmenistan significantly increased from 2014 due to reliance on crude oil transportation through Ukraine and Turkey. This occurred due to a sharp decrease in political stability in Ukraine from 2014 and in Turkey from 2015.

6.2 Economic Dependence and Export-dependence

Economic dependence and export-dependence are high for crude oil in Azerbaijan and Kazakhstan and natural gas in Turkmenistan due to high volumes of exports. The observable spike in the economic dependence and export-dependence of crude oil for Azerbaijan occurred due to a sharp increase in crude oil exports in 2008 (Table 4). This also explains the peak of the REED index for crude oil in Azerbaijan in 2008 (Figure 3). A sharp decline in export- and economic dependence for natural gas in Turkmenistan occurred in 2009–2010 due to a sharp decline in natural gas exports from Turkmenistan (Table 4). This explains the sharp decrease in the natural gas REED index of Turkmenistan in 2009–2010 (Figure 5).

6.3 Monopsony Factor

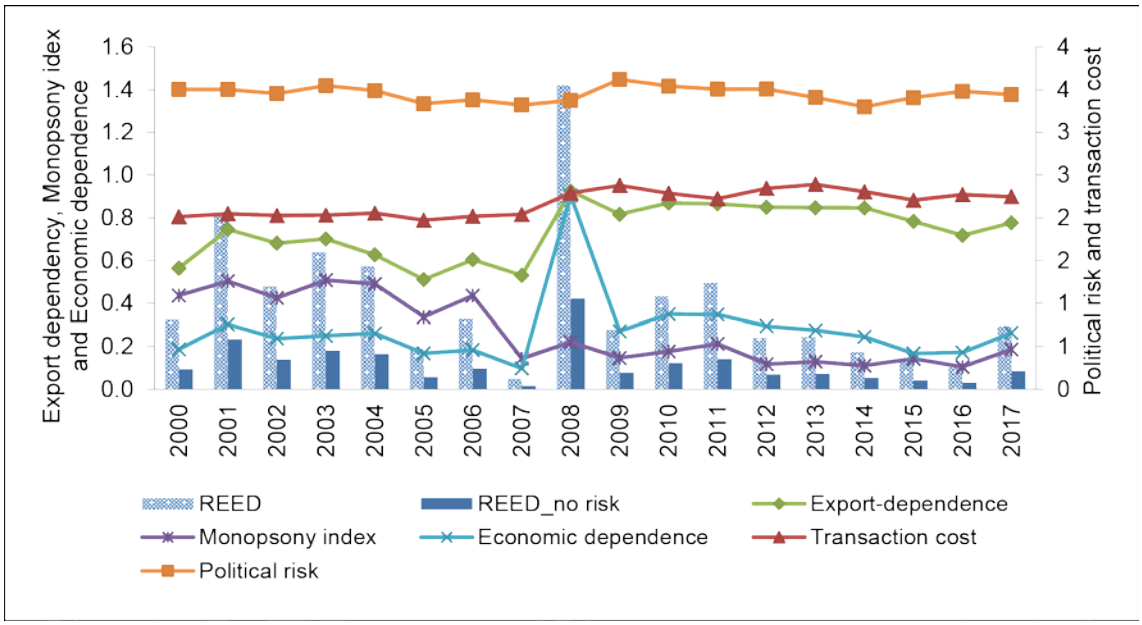
The monopsony factor measures the risk of dependency on importers. A lower monopsony factor means greater diversification of importing countries. Turkmenistan's natural gas has the highest monopsony index (Figures 3–5) due to high dependency on imports of natural gas by one country, i.e., the PRC (from 2010) and Ukraine (before 2010). Greater diversification of importers for crude oil from Azerbaijan and Kazakhstan than for natural gas in Turkmenistan explains the lower risks for external demand on crude oil in Azerbaijan and Kazakhstan than on natural gas in Turkmenistan.

6.4 Transaction Cost

Transaction cost measures the weighted distance from an exporter to an importer. Until 2009, transaction costs were highest for natural gas in Turkmenistan because Ukraine was the major importer. From 2010, these costs significantly decreased because the PRC became the major importer of natural gas from Turkmenistan.

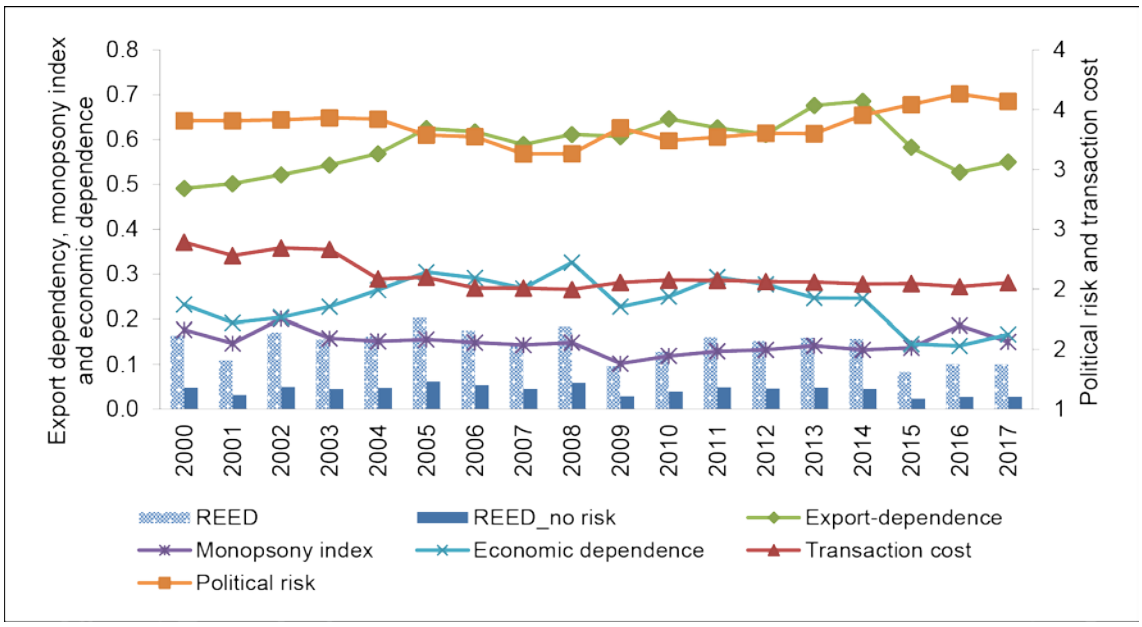
The results demonstrate the importance of considering political risk in energy-transporting countries when the energy security of demand is measured for energy-exporting countries without direct access to importers, e.g., Azerbaijan, Turkmenistan, and Kazakhstan.

Figure 3: Components of Oil REED of Azerbaijan



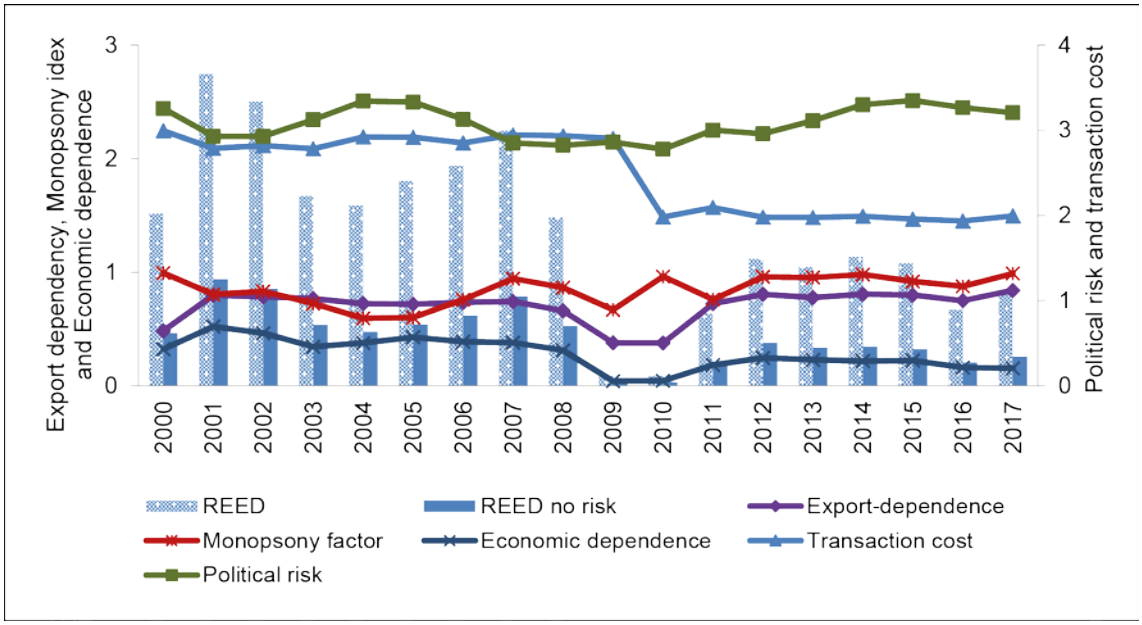
Source: Authors' own.

Figure 4: Components of Oil REED of Kazakhstan



Source: Authors' own.

Figure 5: Components of Gas REED of Turkmenistan



Source: Authors' own.

7. CONCLUSION AND POLICY RECOMMENDATIONS

Stable energy demand facilitates a regular income from energy exports for energy-producing countries. In this context, the security of oil and gas transportation is a common issue for both the Caspian region (i.e., Azerbaijan, Turkmenistan, and Kazakhstan) and the EU. The geographic routes of the pipelines that provide the energy supply from these countries to the EU are risky, because they are laid on the territories to conflict-affected regions.

Existing measures of energy security of demand have been modified here to include the geopolitical situation in energy-transporting countries. Using the newly derived index and country-level data over the period 2000–2017, this paper has assessed the energy security of demand for oil and gas of three countries in the Caspian region – Azerbaijan, Kazakhstan, and Turkmenistan – over a 16-year period. Countries from both the Caspian region and Europe are interested in finding routes to transfer energy more directly. The most straightforward route for gas from the Caspian region to Europe is via Turkey. In the current geopolitical situation, Turkey plays a key role as an energy-transporting country. In the last two decades, energy has emerged as an increasingly important component of the overall cooperation scheme being built between the Caspian region and Turkey. In particular, over time Turkish-Caspian energy relations have progressively focused on a specific segment of energy markets: natural gas. This emphasis has been primarily based on Turkey's strategic geographic location at the crossroads of major natural gas-rich regions, comprising the Caspian and the Middle East on the one hand, and a major natural gas-consuming region, Europe, on the other. This peculiar position has paved the way for the emergence of a vision in which Turkey will eventually play the role of a key transit country of future natural gas flows from Azerbaijan, Turkmenistan, Kazakhstan, and Iran to Europe. Together with the EU and the Caspian, Turkey needs to develop the necessary infrastructure and attract the extra gas.

Energy security indicators measure risks associated with dependence on the supply/demand of energy, and represent tools for communicating energy issues to policy makers and the public (Vera and Langlois 2007). Existing measures fail to capture the geopolitical situation and thus guide policy makers on the impact of challenges of energy security on energy transportation from the Caspian region to the EU. This project has measured energy security in the EU by capturing the geopolitical situation and has thus helped broaden understanding of the impact of the geopolitical situation in energy-transporting countries on energy transportation to the EU.

The risks of external energy demand for natural gas in Azerbaijan and Kazakhstan and for crude oil in Turkmenistan are nearly zero due to these countries' very low dependence on fuel exports. On the other hand, risks of external energy demand for crude oil in Azerbaijan and Kazakhstan and natural gas in Turkmenistan are high due to high dependence on fuel exports in these countries. In addition, the risks of external energy demand for natural gas in Turkmenistan are high due to the low diversification of importers. Energy exports to the EU from all three countries rely on a number of energy-transporting countries. The results demonstrate that when political risk in energy-transporting countries is not considered, the risk of energy security of demand in energy-exporting countries without direct access to importers (such as Azerbaijan, Kazakhstan, and Turkmenistan) is underestimated. The results show that the risk of energy security of demand is greater when political risk in energy-transporting countries is included in a measure of energy security of demand, i.e., REED. The sharp decline in PSAV in Ukraine and Turkey from 2013 and 2014, respectively, has increased the risks of energy security of demand in Azerbaijan, Kazakhstan, and Turkmenistan.

In calculating political risk in energy-transporting countries from Azerbaijan, Kazakhstan, and Turkmenistan, the list of energy-transporting countries and their weights were fixed across all years from 2000 to 2017. To overcome this limitation, one can weigh the political risk of energy-transporting countries by the share of energy transported through each transit country when data on energy transportation by transit country and year become available.

The results demonstrate the importance of considering political risks in energy-transporting countries when energy security of demand in energy-exporting countries is measured. The results also highlight the significance of cooperation not only between the EU and the Caspian region, but also with energy-transporting countries such as Ukraine, Georgia, and Turkey, as well as of finding alternative routes that bypass countries with low levels of political stability, such as through the Trans-Caspian Pipeline.

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APPENDIX

Figure A1: REED Index

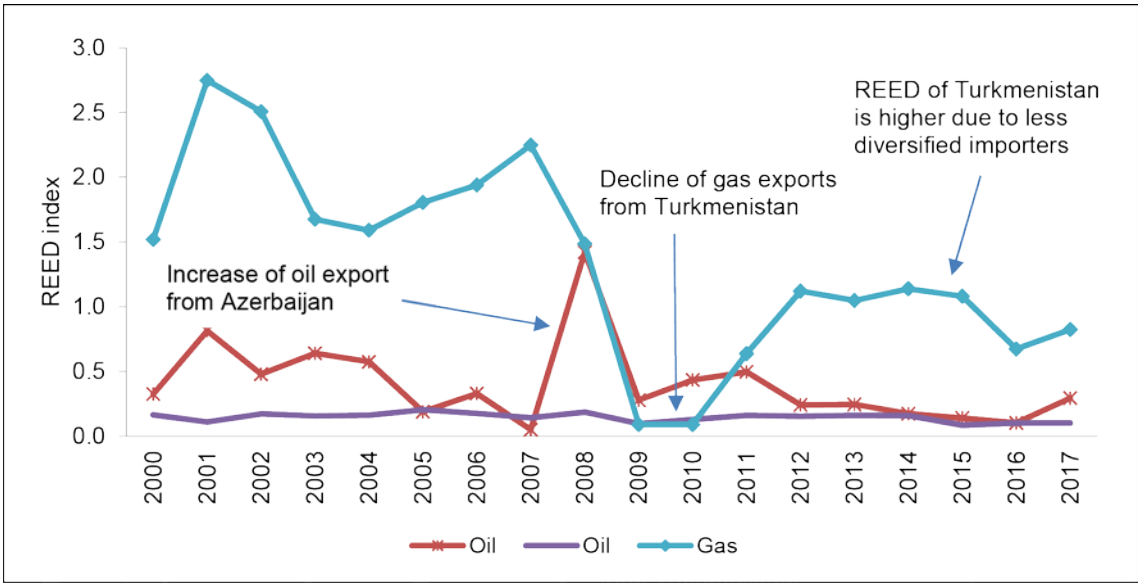

Table A1: Results

Fuel	Index	2000	2001	2002	2003	2004	2005
Azerbaijan							
Crude oil	Transaction cost	2.39	2.28	2.34	2.33	2.09	2.10
	Export-dependence	0.56	0.75	0.68	0.70	0.63	0.51
	Monopsony factor	0.44	0.50	0.42	0.51	0.49	0.34
	Economic dependence	0.19	0.30	0.24	0.25	0.26	0.17
	Political risk	3.50	3.50	3.45	3.55	3.49	3.34
	REED	0.32	0.81	0.48	0.64	0.57	0.19
	REED_no risk	0.09	0.23	0.14	0.18	0.16	0.06
Kazakhstan							
Crude oil	Transaction cost	2.39	2.28	2.34	2.33	2.09	2.10
	Export-dependence	0.49	0.50	0.52	0.54	0.57	0.62
	Monopsony factor	0.18	0.15	0.20	0.16	0.15	0.16
	Economic dependence	0.23	0.19	0.20	0.23	0.26	0.30
	Political risk	3.41	3.41	3.41	3.43	3.42	3.29
	REED	0.16	0.11	0.17	0.16	0.16	0.20
	REED_no risk	0.05	0.03	0.05	0.05	0.05	0.06
Turkmenistan							
Natural gas	Transaction cost	2.99	2.79	2.82	2.78	2.92	2.92
	Export-dependence	0.48	0.80	0.79	0.77	0.72	0.72
	Monopsony factor	0.99	0.81	0.83	0.72	0.59	0.60
	Economic dependence	0.32	0.52	0.46	0.35	0.38	0.43
	Political risk	3.26	2.93	2.93	3.12	3.34	3.33
	REED	1.52	2.75	2.51	1.68	1.59	1.80
	REED_no risk	0.47	0.94	0.86	0.54	0.48	0.54

continued on next page

Table A1 *continued*

Fuel	Index	2006	2007	2008	2009	2010	2011
Azerbaijan							
Crude oil	Transaction cost	2.01	2.01	2.00	2.05	2.07	2.07
	Export-dependence	0.60	0.53	0.92	0.82	0.87	0.87
	Monopsony factor	0.44	0.14	0.22	0.15	0.18	0.21
	Economic dependence	0.18	0.10	0.90	0.27	0.35	0.35
	Political risk	3.38	3.32	3.37	3.62	3.54	3.50
	REED	0.33	0.05	1.42	0.28	0.43	0.50
	REED_no risk	0.10	0.02	0.42	0.08	0.12	0.14
Kazakhstan							
Crude oil	Transaction cost	2.01	2.01	2.00	2.05	2.07	2.07
	Export-dependence	0.62	0.59	0.61	0.61	0.65	0.63
	Monopsony factor	0.15	0.14	0.15	0.10	0.12	0.13
	Economic dependence	0.29	0.27	0.33	0.23	0.25	0.29
	Political risk	3.27	3.13	3.13	3.35	3.24	3.27
	REED	0.18	0.14	0.19	0.10	0.13	0.16
	REED_no risk	0.05	0.05	0.06	0.03	0.04	0.05
Turkmenistan							
Natural gas	Transaction cost	2.85	2.94	2.94	2.91	1.98	2.09
	Export-dependence	0.73	0.74	0.66	0.38	0.38	0.72
	Monopsony factor	0.76	0.94	0.87	0.67	0.96	0.76
	Economic dependence	0.39	0.38	0.31	0.04	0.04	0.18
	Political risk	3.13	2.85	2.82	2.86	2.78	3.00
	REED	1.94	2.25	1.48	0.09	0.09	0.64
	REED_no risk	0.62	0.79	0.53	0.03	0.03	0.21
Fuel	**Index**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Azerbaijan							
Crude oil	Transaction cost	2.06	2.06	2.04	2.05	2.02	2.05
	Export-dependence	0.85	0.85	0.85	0.78	0.72	0.78
	Monopsony factor	0.12	0.13	0.11	0.14	0.10	0.19
	Economic dependence	0.29	0.28	0.24	0.17	0.17	0.26
	Political risk	3.51	3.41	3.30	3.41	3.48	3.44
	REED	0.24	0.24	0.17	0.14	0.10	0.29
	REED_no risk	0.07	0.07	0.05	0.04	0.03	0.09
Kazakhstan							
Crude oil	Transaction cost	2.06	2.06	2.04	2.05	2.02	2.05
	Export-dependence	0.61	0.68	0.69	0.58	0.53	0.55
	Monopsony factor	0.13	0.14	0.13	0.14	0.19	0.15
	Economic dependence	0.28	0.25	0.25	0.15	0.14	0.17
	Political risk	3.30	3.30	3.45	3.54	3.63	3.57
	REED	0.15	0.16	0.16	0.08	0.10	0.10
	REED_no risk	0.05	0.05	0.05	0.02	0.03	0.03
Turkmenistan							
Natural gas	Transaction cost	1.98	1.98	1.99	1.96	1.94	1.99
	Export-dependence	0.81	0.78	0.81	0.80	0.75	0.84
	Monopsony factor	0.96	0.95	0.98	0.92	0.88	0.99
	Economic dependence	0.25	0.23	0.22	0.22	0.16	0.15
	Political risk	2.96	3.11	3.30	3.35	3.27	3.21
	REED	1.12	1.05	1.14	1.08	0.67	0.82
	REED_no risk	0.38	0.34	0.34	0.32	0.21	0.26