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Turkey’s role in natural gas – Becoming a transit country?[1]

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Abstract

This paper analyses the possible future role that Turkey can play in European natural gas markets. We employ a global gas market simulation model, COLUMBUS, to assess the outcomes of different scenarios concerning natural gas supply routes to Europe through Turkey up to 2030. The results imply simply that under current conditions, i.e., a more competitive environment in European gas markets leading to low gas prices, Turkey’s role would be of only minor importance. In accordance with various scenarios presented in this study, Turkey’s role is seen at its most important when European demand increases and Russia exerts power in the European markets.

Keywords: COLUMBUS, European gas supply, Turkey, scenario analyses

JEL classification: C68, L13, Q31

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1. Introduction

Turkey's long-lasting ambition to become a natural gas transit country, if not a hub, has been motivated by the country's unique geographical location as a natural bridge between major gas producers in the Caspian, Middle Eastern and Russian regions and one of the major consumers, Europe. Turkey's importance and the likelihood of her being a transit country have remained relatively high during the periods of possible threats to sustainable natural gas supplies to Europe. To date continental Europe is one of the largest natural gas consuming regions in the world. According to BP (2014), after increasing from 338.1 billion cubic meters (bcm, hereafter) in 1991, natural gas consumption in the European Union 28 (EU, hereafter) peaked with 502.2 bcm in 2010. Although there has been a slight decrease since then, the International Energy Agency's (IEA, hereafter) 2014 World Energy Outlook (WEO 2014, hereafter) New Policies Scenario estimates that natural gas demand in Europe will increase by an annual compound rate of 0.7% reaching 610 bcm by 2040 (IEA, 2014a). Most of this demand will be met by imports, as has so far been the case. Indeed, European import dependency is expected to grow even more rapidly due to declining local production in countries such as the Netherlands and the UK.[3] WEO 2014 also suggests that Russia will continue to be the major source of natural gas supplies to Europe.

The issue of import dependency, especially on Russia, and its implications for European energy security has been widely discussed by academia and policy makers.[4] With the 2009 Russian-Ukrainian dispute over gas prices, import diversity emerged as an increasingly important item on the European policy makers' agenda. The Crimean crisis, which began five

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[3] According to the report share of imports in annual natural gas demand of European Union will increase from the current level of nearly 65% to 81% by 2040 (IEA, 2014a).

[4] See for instance, Correljé and van der Linde (2006); Mañé-Estrada (2006); Costantini et al. (2007); Reymond, (2007); Spanjer (2007); Weisser (2007); Finon and Locatelli (2008); Goldthau (2008); Remme et al. (2008); Sagen and Tsygankova (2008); Bilgin (2009); Hedenus et al. (2010); Monforti and Szikszai (2010); Söderbergh et al. (2010); Umbach (2010); Bilgin (2011); Boussena and Locatelli (2013); Growitsch et al. (2014); Flouri et al. (2015), Hecking et al. (2016).

years later and was followed by disruptions in gas supplies over Ukraine and western sanctions against Russian companies and individuals, reactivated the issue of European natural gas supply security and import route diversity. In 2013, almost 50% of all gas imports from Russia passed through Ukraine (Martinez et al., 2015). This constituted nearly 15% of total gas imports to the EU for the same year.[5] Annexation of the Crimean peninsula by Russia along with an already existing Russian-Ukrainian gas price dispute increased the fears of disruptions to EU gas supplies.

A vast amount of literature has evaluated the consequences of the Russian-Ukrainian crises in 2009 and 2014 both qualitatively and quantitatively.[6] Among the qualitative contributions, Pirani et al. (2009), for instance, emphasised that concerns about the reliability of Russian supplies as well as the Ukrainian transit route have increased among European policy makers as a result of the 2009 crisis. Chyong (2014) argued that European countries should engage more in reforming the Ukrainian gas sector rather than trying to restrict Russia's aim of using natural gas as a political weapon or for leverage. In addition, more recently Stulberg (2015) stated that the Russian strategy to use gas for political leverage failed due to significant changes in global energy markets. There also exist a number of articles that have tried to quantify the effects of Russian disruptions using various scenario analyses/modelling techniques. For instance, Lochner (2011) simulated the 2009 Russian-Ukrainian crisis and found out that threats to European supply security were mitigated thanks to significant storage volumes. Moreover, Hecking et al., (2014) consider that Russian gas supply disruption, which continued for at least six months, would have profound effects on European gas security and that nine months of

[5] Please note that the crisis in 2014 led to a significant decrease in these shares.
[6] See, for instance, Pirani et al. (2009), Abada and Massol (2011), Bilgin (2011), Roth (2011), Belyi (2012), Balmaceda (2013), Behrens and Wieczorkiewicz (2014), Chyong (2014), Hecking et al. (2014), Holz et al. (2014), Pirani (2014), Pirani et al. (2014), Richter and Holz (2014), Zachman (2014), Martinez et al. (2015), Stulberg (2015).

disruption could possibly cause a 46 bcm deficit in total European supplies. More recently, Martinez et al. (2015) provided a comprehensive assessment of the Russo-Ukraine crises and argued that the 2014 crisis did not impact too much on North Western European markets, thanks mostly to the Nord Stream pipeline which was built after 2009 crisis. However, the authors also stress that Southern and Eastern European countries are still vulnerable to any supply disruptions over the Ukraine transit route.

Under these circumstances, Turkey has been referred to as the most plausible alternative route for carrying Russian gas resources to Southern and South-eastern Europe. The Crimean Annexation followed by EU sanctions and doubts over cancellation of the North Stream pipeline expansion led to a major policy change on the Russian side, i.e. cancellation of the South Stream project and initiation of the TurkStream project in December 2014.[7] This was a significant turning point for Turkey in terms of becoming an essential player in the global gas market. Turkey's role was expected to increase not only due to the Turk Stream project but also new supplies from Iran, the Kurdistan region of Iraq and the Eastern Mediterranean offshore fields, coming online in global gas markets for the first time.

There has been a vast amount of literature on Turkey's possible role for European energy supply security and on her future as an energy hub.[8] Erdogdu (2010), for instance, analyses the European dependency on Russian gas and points out the possible positive implications of the once planned Nabucco project for European supply security. According to the author, Turkey occupies a significant geographic position in this respect, yet the availability of gas resources,

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[7] On November 24, 2015 a Russian bomber aircraft was shot down by Turkish jets near the Syrian–Turkish border due to a claimed invasion of the Turkish territories. This was followed by increasing tension between the two countries and unilateral suspension of the project by Russian side. Yet, then in July 2016, governmental officials from both countries announced that relations would be back to normal in the short-term and that the project is put back on table. This volatile state of the relationship between Russia and Turkey sparks up the debate on Turkey's possible future as a natural gas hub and her role in European gas supply security.

[8] See for instance, Fink (2006), Barysch (2007), Bilgin (2007), Babalı (2009), Saivetz (2009), Bilgin (2010), Erdogdu (2010), Roberts (2010), Wigen (2012), Winrow (2013), Yeni (2013), Cohen (2014), Demiryol (2014), Erdogdu (2014), Karbuz (2014), Tagliapietra (2014a), Tagliapietra (2014b).

which would have fed the Nabucco pipeline, was the determining factor for Turkey's role. Bilgin (2011), moreover, suggests that Turkey's importance would increase until 2020 if and only if all European Union member countries adhere to a common energy security, as defined by the EU Commission, and diversify their import sources accordingly. Wigen (2012) similarly suggests that, although Turkey's geographical location offers her a unique opportunity for the future, realisation of this would depend very much on political developments in the region and the EU. According to Winrow (2013), becoming a major gas transit state is of secondary importance for Turkey's government, behind the need to safeguard its own energy security. Yet, the author stresses that Turkey would become an important component of the Southern Gas Corridor (SGC, hereafter) provided that sufficient gas supplies from northern Iraq, Turkmenistan and Azerbaijan are available. After comprehensive analysis, Tagliapietra (2014a) concludes that Turkey was very unlikely to become a natural gas hub until 2025, yet she could play an important role if SGC infrastructure projects are realised and if European demand is high enough. Moreover, Tagliapietra (2014b) stressed that the 2014 Russo-Ukrainian crisis could be an important turning point in EU-Turkey energy relations as the crisis might rekindle debate on the issue of gas import diversity among European policy-makers.

Although there are many qualitative contributions, the literature so far fails to deal with how the recent disputes would quantitatively reshape Turkey's role in European gas supply security. Indeed, we are aware of only one quantitative analysis about Turkey's role, that of Lise et al. (2008), which focuses on gas corridors affecting the European natural gas market. The authors suggest that Turkey is in a favourable position to become an important natural gas transit country and that according to their 'Business-as-usual' scenario there would be 31 bcm of gas transited via Turkey to Europe by 2030. Yet, the study is quite outdated, considering the recent developments in international politics and energy markets, e.g., Russian–Ukrainian and Russian–Turkish crises, the lifting of Iranian sanctions, capacity expansions in northern Iraqi gas fields. The aim of our study is, therefore, quantitatively to show Turkey's changing role in the light of recent developments. For this purpose, we use a global gas market simulation model, COLUMBUS, in accordance with Hecking and Panke (2012).[9] This article aims to assess quantitatively which conditions are economically necessary for Turkey to become a natural gas transit or hub and more importantly a reliable partner in European natural gas supply security.

Our methodology follows a two-fold structure.[10] Firstly, we used the COLUMBUS model to simulate a reference scenario, which is based on current global gas market conditions, over the period until 2030. To this end, we calibrated the model with the most recent data and in accordance with recent global gas market developments, such as the US shale gas revolution, decreasing fossil fuel prices and the European gas market's tendency to move to a more competitive structure. Using this reference scenario, we measured future gas volumes that are supposed to flow through Turkey to European markets from different sources up to 2030. According to our results, gas volumes, mostly from Azerbaijan and Iran, will reach 23.3 bcm, 4.8% of total European demand, by 2030. Compared with the current situation this result suggests that Turkey's role would be enhanced, yet barely sufficiently enough for the country to become a natural gas hub. Secondly, we analysed different scenarios, suggesting various drivers that may increase Turkey's importance in terms of transit volumes: for instance, higher than expected European demand, high Iranian production capacity, Russia exerting market power in European gas markets, all of which could change Turkey's role. The scenario in which there is higher than expected European demand and Russia behaves oligopolistically indicates the most important role for Turkey. According to this scenario, by 2030 Turkey's re-exports will reach 37.5 bcm, 6.8% of Europe's estimated demand. Conversely, given current market dynamics, low gas prices resulting from a more competitive environment in the European gas

[9] We provide a brief description of the model in Section 2.1, for details please refer to Hecking and Panke (2012)
[10] Please refer to Section 2 for details.

market, there is quite a low possibility that the circumstances assumed by this scenario would exist in the period until 2030.

The structure of this paper is as follows. Section 2 briefly introduces the methodology we have employed. Section 3 provides detailed results of the reference scenario. Different drivers that could enhance Turkey's future role as a natural gas transit country are featured in Section 4. Finally, Section 5 concludes with policy implications

2. Methodology

The quantitative analyses conducted in this study are based on the application of an economic model simulating the global gas market. This section provides the methodological setup including a brief description of the model used (Section 2.1), data employed and assumptions made (Section 2.2). Also included is the economic intuition behind current developments in the global and European natural gas market structure together with implications for the model (Section 2.3).

2.1. Brief Description of the Model

We employ COLUMBUS, a global gas market model, developed by Hecking and Panke (2012).[11] COLUMBUS is an inter-temporal partial equilibrium simulation model, which can derive possible gas market developments up to 2040. Although worldwide interdependencies are taken into account, special focus in this paper is given to the European gas market. The model takes various aspects of the global gas market into account: production, consumption, storage, pipelines and LNG infrastructures. The spatial structure of the model is formulated in accordance with network-flow. Production and demand regions are represented by initial and final nodes, whereas liquefaction, re-gasification and storage terminals are represented by

[11] COLUMBUS model is developed at the Institute of Energy Economics (EWI) at the University of Cologne. Please refer to Hecking and Panke (2012) and Growitsch et al. (2014) for a detailed explanation of the model.

intermediate nodes. The nodes are connected by arcs, which represent pipelines and LNG routes.

The model considers different market participants such as natural gas producers, exporters, re-gasification or storage operators, each trying to maximise profit simultaneously. Exporters are the key agents, who create trading connections between production and demand nodes whilst competing against each other. The model is designed as a mixed complementarity programming (MCP) problem similar to that of Egging et al. (2010), which allows simulation of the strategic behaviour among individual natural gas exporters with different degrees of market power.[12] Hence, the model's MCP structure allows us to define each exporter as competitive or oligopolistic.

The model takes several variables regarding production, demand and transportation[13] as exogenous inputs, such as capacities in production and transportation infrastructure, pricing elastic demand function, together with costs and it reveals key outputs, such as production and trade flows by each exporter, infrastructure investments as well as prices among different demand nodes. Each individual actor tries to maximise profit at each point in time by having the facility to decide instantaneously on the production quantity at each production node, the supply quantity to each demand node, as well as the amount of investment in production, pipeline, LNG and storage facilities. Each agent's profit maximisation is subject to several constraints, such as production capacity, pipeline transportation, storage, liquefaction and re-gasification as well as node flow and demand balances. Among the model's outputs, investment in the existing infrastructure (capacity additions to existing pipelines or LNG infrastructure) and investment into new infrastructure (new pipelines or storage facilities) are of significant

[12] Although the authors are aware of different gas market models such as that of Egging et al. (2008), Lise et al. (2008), Dieckhöner (2012), the reasoning for choosing COLUMBUS is to account for the strategic behaviour of individual players.

[13] Please see Section 2.2 for the explanation of the data.

importance given the research question being addressed by this paper. Taking the cost of investment exogenously, the model endogenously decides how much additional capacity will be required between nodes.

2.2. Data and Assumptions

Demand is assumed to be linear and exogenous and it is modelled on country level.[14] A country's demand, thereby, is divided into two sector groups: (1) households and miscellaneous together with (2) industry and power generation. Moreover, the model also assumes that demand price elasticity is varying over different countries as well as different sectors within a country. For instance, while the industry has partly intermittent processes that will reduce natural gas demand when prices are high, household demand depends on heating behaviour not changing critically in the short term. Hence, the industrial sector is assumed to have a higher elasticity than the household sector. The main sources for the demand data employed in the model are Natural Gas Information 2014 (IEA, 2014b), the Medium Term Gas Market Report 2014 (IEA, 2014c), the World Energy Outlook 2014 (IEA, 2014a) and the Ten Year Network Development Plan 2015 (ENTSOG, 2015). All in all, the model covers over 95% of global gas consumption in 2015, which is the year of data calibration.

While demand is modelled exogenously[15], the production decision for each exporter is endogenous. Each exporter has control over at least one production node and each of these nodes faces a capacity constraint at each point in time. The model includes 52 natural gas production nodes, which accounts for over 95% of global gas supply. Historical production volumes, which are taken from Natural Gas Information 2014 (IEA, 2014b), are used as the maximum capacity of each production node at the corresponding year in order to calibrate the

[14] The COLUMBUS model considers 86 demand nodes; i.e. countries or country groups.
[15] Please note that the general level of demand development is input into the model. However, since the COLUMBUS model is an equilibrium model, the equilibrium demand is an output to the model and can deviate slightly from the input path. It is driven by price elasticities of a country's sector demand function.

model. Moreover, the model chooses future production quantities that maximise each firm's profit corresponding to capacity at the production node. We used the Medium Term Gas Market Report 2014 (IEA, 2014c), the WEO 2014 (IEA, 2014a) and the Ten Year Network Development Plan 2015 (ENTSOG, 2015) as well as information about the suppliers resources as the main sources for determining maximum possible future production capacities at each production node.

Given its importance for the global gas market, the model covers a comprehensive data set on pipeline, LNG and gas storage infrastructure as well as long term contracts (LTCs) between different countries. While infrastructure, either existing or under development,[16] is exogenously given, the model is able to invest endogenously in new infrastructure, as mentioned above. Data on existing pipelines were collected from the Ten Year Network Development Plan 2015 (ENTSOG, 2015), on LNG infrastructure were gathered from the Retail LNG Handbook 2015 published by the International Group of Liquefied Natural Gas Importers (GIIGNL, 2015) and from publications of Gas Infrastructure Europe (GIE, 2015). Reports of Gas Storage Europe (GSE, 2015) and the Natural Gas Information 2015 (IEA, 2014b)(IEA, 2014b)(IEA, 2014b, IEA, 2014a, IEA, 2015) served as the main data sources for gas storage facilities. Finally, a detailed database on LTCs was developed using different sources, such as the literature survey by Neumann et al. (2015) and publications from the International Group of Liquefied Natural Gas Importers (GIIGNL). The model distinguishes different LTCs with take-or-pay (ToP) quantity or annual contracted quantity (ACQ).

2.3. Market Structure in European Gas Market: Oligopoly vs. Competitive

There seems to be consensus in energy economics literature that the global natural gas market (Growitsch et al., 2014), and in particular the European market (Mathiesen et al., 1987),

[16] Projects with financial investment decision (FID) status

has always been best represented by an asymmetric Cournot oligopoly with a competitive fringe. Market imperfection was attributed to the high import dependency of European countries on a small number of exporters (Abada et al., 2013). Russia in particular is recognised as the major supplier, which can exert certain market power to European, specifically eastern European, countries.

Yet, in the aftermath of the 2008/09 global economic crisis, there have been remarkable changes in the European gas market's structure. Increasing energy efficiency and the transition to renewable energy sources, thanks to high fossil fuel prices during the period between 2000 and 2008, followed by economic stagnation resulting from the crisis put downward pressure on gas demand growth in Europe. This threatened Russia's position in terms of European reliability on her gas supplies. Furthermore, the American shale gas revolution further reduced European dependence on Russian gas through two channels. Firstly, expansion in US gas capacity drove Henry Hub gas prices down increasing the competitiveness of gas in the US power sector, which in turn led to huge amounts of US coal being available for export. As a result, worldwide coal prices decreased making coal even more competitive in the European power sector, which further reduced gas demand. Secondly, as the US moved from being a major importer to an exporter, global LNG overcapacities started to be redirected towards European markets.

All of these developments have driven European gas prices down, especially in the spot market. Along with low oil prices since 2015, this threatened the future of long-lasting oil indexation pricing and long-term contracts, as consumers started to move towards spot LNG purchases.[17] As correctly noted by Henderson and Mitrova (2015), the most important implication of these developments is that the European market is moving to a more competitive structure as Russia now has a tendency to hold gas prices low, both for contracted and future

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[17] Please see Stern (2009) on a comprehensive analyses of oil-indexed pricing and LTCs in European gas market.

volumes, in order to maintain her share in the European market and to compete with the LNG spot market. Due to these recent developments, we assume that the European gas market will become more competitive. Hence, in our reference scenario Russia acts more competitively as a price taker, compared to the situation before 2014 which was characterised by the strategic behaviour of dominant suppliers resulting in a more oligopolistic European market.[18]

3. Reference Scenario Results

The reference scenario of the model is based on projections made by the *New Policies Scenario* of World Energy Outlook 2015 (WEO 2015, hereafter) of IEA (2015) and is built to capture current conditions in the global gas market. Given our paper's objective, this section provides certain gas market projections regarding Turkey. Figure 1, for instance, represents Turkey's natural gas consumption from 1985 until 2014 (solid line) and the model forecast until 2030 (dotted line). According to the model Turkey's consumption will rise from 48.5 bcm in 2014 to 65.5 bcm in 2023. In accordance with WEO 2015, the annual growth rate of demand will decline after 2023 yet the demand will still reach 67.2 bcm by 2030.

There have been a number of studies forecasting Turkey's gas demand, including those from state institutions as well as from academia.[19] For instance, BOTAS, the Turkish national pipeline grid operator, estimated in 2008 that the country's natural gas demand will increase to 76.4 bcm by 2030 (BOTAS, 2008). Melikoglu (2013), moreover, using two different models estimated that demand will rise to 76.8 bcm (linear model) or 83.8 bcm (logistic model) by 2030. More recently, Ozdemir et al. (2016) used genetic and simulated annealing algorithms to simulate two scenarios and forecasted that Turkey's natural gas consumption will increase to

[18] Strategic behaviour in a MCP is modelled by conjectural variation approach (for a good explanation see Perry 1982). To change strategic behaviour from oligopoly to competitive the conjectural variation needs to be adjusted from the Cournot conjecture to something more competitive.
[19] Please refer to Melikoglu (2013) for a comprehensive literature review on natural gas consumption forecasts in Turkey.

around 89 bcm in a high economic performance scenario and to around 56 bcm in a low economic performance scenario.[20] The fact that our model estimated lower natural gas demand than the previous estimates can be attributed to the recent contraction in the global and hence Turkish economy.

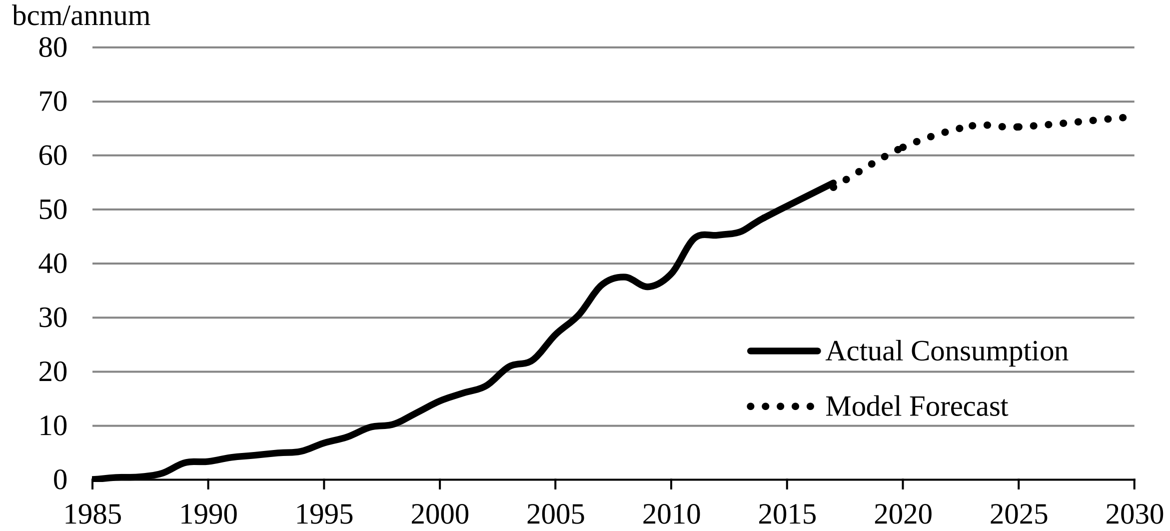

Figure 1. Turkey's Natural Gas Consumption 1985-2015 and COLUMBUS' forecast until 2035

Data: Historical consumption data between 1985-2010 BP (2014), model calibration data between 2010-2014 from WEO 2015 of EIA (2015) and 2015-2035 model forecast.

Given that Turkey has low indigenous production and is, therefore, highly dependent on imported natural gas, it is worthwhile analysing the model's forecast about which natural gas source countries would supply the Turkish market (Table 1). There are currently five main sources that import natural gas into Turkey, namely the Russian Federation, Azerbaijan, Iran, Nigeria and Algeria (BOTAS, 2014). In 2014, for instance, 98% of Turkey's 49.8 bcm of natural gas consumption was imported from these five source countries with the following shares: Russia 56%, Iran 19%, Azerbaijan 9%, Algeria 9% and Nigeria 7% (TPAO, 2014). The reference scenario, moreover, estimates that in 2017 out of these sources Russia would stay as

[20] The authors provided the forecasted figures in million tonnes of oil equilvalent (mtoe) unit. Their forecasted volumes for high economic performance is 80 mtoe and for low economic performance is 50 mtoe. According to the BP Statistical Review of World Energy 2015 the approximate conversion factors, 1 million toe of natural gas is around 1.11 bcm. Hence 80 mtoe and 50 mtoe can be calculated as 88.8 bcm and 55.5 bcm, respectively.

the major exporter to Turkey by supplying 31 bcm of natural gas. The following three import sources would be Iran (9.7 bcm), Azerbaijan (8.3 bcm) as well as LNG imports from Nigeria and Algeria together with spot market purchases (a total of 5.1 bcm). According to the reference scenario, the composition of import diversity would alter significantly throughout the next 15 years. For instance, although Russia stays as the major source for Turkey with 35.3 bcm in 2030, her share of total imports will decline to 38.9% while that of Azerbaijan will increase dramatically to 34.8% (31.5 bcm).[21] By 2030 the third largest supplier would be Iran with 10.2 bcm, comprising 11.3% of total imports. The reference scenario significantly also estimates slight increases in Iraqi and LNG imports over time.

According to Table 1, Turkey's total imports will rise from around 54.1 bcm in 2017 to 90.5 bcm by 2030. Yet these volumes are not only for Turkey's own demand, which is supposed to increase to 67.2 bcm by 2030, but they also include re-exports from Turkey to Greece and Bulgaria (Table 1). According to the reference scenario, by 2030 there will be around 23.3 bcm of gas re-exports from Turkey to Europe (9.2 bcm via Bulgaria and 14.1 bcm via Greece). This amount corresponds to around 4.8% of total European gas consumption, which is estimated by the model to be around 490 bcm by 2030.[22] From 2020 onwards according to the model Turkey will start to contribute more than 2.5% of European gas supplies. Although these shares correspond to a very small volume of gas compared with the current situation, this would enhance Turkey's role in Europe's gas supply security. In particular, Caspian natural gas

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[21] Please note that these volumes are not only already existing long-term contracts (LTC, hereafter) but they also include estimates for future volumes. Future estimated volumes can either be LTC or spot trading. Note also that already existing LTC's have certain due dates. For instance in 2015 Turkey would import around 48 bcm gas due to existing LTC contracts, yet this volume will be only around 14 bcm in 2030. The remainder is to be imported using either new LTCs or the spot market.

[22] Here, European consumption refers to the total amount of projected consumption in European continent, excluding Turkey. Countries included are, Austria, the Baltic countries, Belgium, Bulgaria, Switzerland, the Czech Republic, Germany, Denmark, Spain, Finland, France, Greece, Hungary, Ireland, Italy, Moldova, the Netherlands, Norway, Poland, Portugal, Rumania, Sweden, Slovenia, Slovakia, the United Kingdom, Yugoslavia.

sources that flow through Turkey would make a contribution to South-Eastern European markets, which are still characterised by a strong import dependency on Russian gas.

Table 1. Turkish Gas Flow Balance Including Already Existing and Contracted LTCs by Source Country (all figures in bcm)

	2017	2020	2023	2025	2030
From Russia (through the Black Sea)*	16.0	33.9	34.7	33.9	35.3
From Russia (through Bulgaria)**	15.0	0.1	2.0	0.0	0.0
From Azerbaijan (through Georgia)***	8.3	23.3	29.2	31.5	31.5
From Iran	9.7	6.3	5.0	7.4	10.2
From Iraq	0.0	1.2	0.2	0.0	4.1
From Israel	0.0	0.0	0.0	0.1	0.4
Total Pipeline Gas Imports	**49.0**	**64.8**	**71.2**	**72.8**	**81.5**
LNG from Algeria	2.4	2.4	2.4	0.0	0.0
LNG from Nigeria	1.1	1.1	0.0	0.0	0.0
LNG from Spot	1.6	5.5	6.9	9.4	9.0
Total LNG Imports	**5.1**	**9.0**	**9.3**	**9.4**	**9.0**
Total Gas Imports	**54.1**	**73.8**	**80.5**	**82.3**	**90.5**
Turkey's own Demand	**54.1**	**61.5**	**65.5**	**65.3**	**67.2**
To Bulgaria	0.0	1.6	3.3	4.6	9.2
To Greece	0.0	10.7	11.8	12.4	14.1
Total Gas Re-exports	**0.0**	**12.3**	**15.0**	**17.0**	**23.3**
Share of Gas Re-exports in Europe's consumption†	**0.0%**	**2.5%**	**3.1%**	**3.5%**	**4.8%**

Notes: Figures include contracted LTC's over Turkey, e.g. from Azerbaijan to Greece and further to Italy (TAP Project).
* We did not differentiate between Turk Stream and Blue Stream since future volumes may be carried either by using already existing Blue Stream and by enhancing its capacity or by investing into new project, i.e. Turk Stream.
** There are in principle other source countries that can feed Turkey through Bulgaria yet the model in the reference scenario estimates that the volumes that are transported from Bulgaria to Turkey will be Russian originated.
*** Azerbaijan LTCs involve 3 contracts to Turkey: Phase I and BIL, which are already operational and Phase II, which comes online in 2018 (Source: BOTAŞ Official Website).
† Total European gas consumption (projected) excluding Turkey (Countries: Austria, Baltic countries, Belgium, Bulgaria, Switzerland, the Czech Republic, Germany, Denmark, Spain, Finland, France, Greece, Hungary, Ireland, Italy, Moldova, the Netherlands, Norway, Poland, Portugal, Romania, Sweden, Slovenia, Slovakia, the United Kingdom, Yugoslavia)

The in and out-flows presented in Table 1 will be made possible only with a certain infrastructure, especially pipelines, and investment. One of the most important contributions made by the COLUMBUS model is that it estimates the annual demand for additional pipeline capacities between countries. According to the reference scenario, by 2030 there will be a total of 58 bcm additional capacity from the natural gas infrastructure network connecting Turkey to different countries (Table 2). The largest estimated pipeline capacity additions are: the Georgia–Turkey pipeline, carrying Azerbaijani and Turkmen gas, with a total capacity addition of 20.1 bcm, which can be attributed to a capacity addition to TAP/TANAP pipeline, the Russia–Turkey pipeline with a total capacity addition of 19.7 bcm and the Turkey–Bulgaria pipeline with a total capacity addition of 9.3 bcm.

Table 2: Demand for Additional Pipeline Investments Connecting Turkey

Bcm	2020	2023	2025	2030	Total
From Russia	18.3	0.5		0.9	19.7
From Iran				0.2	0.2
From Iraq	1.2			2.9	4.1
From Georgia*	11.7	6.0	2.3	0.1	20.1
From Israel			0.1	0.3	0.4
To Greece*	2.1		0.3	1.7	4.1
To Bulgaria	1.9	1.4	1.8	4.2	9.3

Notes: The numbers represent the demand for capacity additions under the corresponding year. Total amounts are the total added capacity between two countries from 2015 to 2030.
* The TANAP+TAP pipeline is not part of the investment decision because it is already under construction and given exogenously to the model.

Out of these, the Russia–Turkey pipeline investment is of significant importance. This 19.7 bcm of additional capacity can easily be attributed to the TurkStream project, with the pipeline planned to have a capacity of 31.5 bcm, 14 bcm of which is intended to feed Turkey's own demand with the rest being re-exported to Europe.[23] Hence, given that Turkey's own consumption would increase to 6 bcm by 2030, according to the reference scenario the TurkStream project would serve only Turkey's own needs and would not contribute to its ambition to become a gas transit country, if not a hub. Indeed, this can be directly concluded by looking at the inflows provided on Table 1. The model estimates that there would be no gas flows from Bulgaria; hence the 19.7 bcm of pipeline would be built in order to offset the transit volumes from Russia to Turkey through Ukraine and Bulgaria. Furthermore, instead of

[23] http://turkstream.info. Access date: 30.09.2016

transiting natural gas via Turkey, Russia would invest in an additional pipeline to run through the Black Sea directly to Bulgaria. The project, also known as South Stream[24], which has often been discussed in the past, would enable Russia to create a direct connection to the EU without passing through an additional transit country. However, in the reference scenario the model identifies a demand only for an additional capacity investment of 7 bcm/a. The official project capacity was planned to be 63 bcm/a.

Another important outcome of the model is that there would be 13.4 bcm of additional pipeline capacity investment from Turkey to Europe (Bulgaria and Greece) by 2030. This additional pipeline would carry mostly Azerbaijani and to some certain extent Iraqi gas to European markets.

In summary, the reference case scenario estimates that there would be significant increases in gas import volumes from Azerbaijan as well as the LNG spot market and Turkey's role in European gas supply security would slightly increase due to some of the imported volumes being directed as re-exports to Greece and Bulgaria. These results seem to be conceivable, given the vast natural gas resources existing in Azerbaijan and current developments in global gas markets leading to lower LNG prices, thereby increasing the competitive advantage of LNG transportation through pipelines. Yet the most important portion of imports will serve to meet the country's own demand. This result is also consistent with the agenda of Turkish policy-makers, whose priority is to secure adequate supplies for Turkey's internal market. Hence, in order for Turkey to become a reliable partner in European gas supply security, more gas volumes from the countries mentioned above or other sources, such as Iraq or Iran, must feed Turkey's re-export volumes. The reference scenario notably estimates that some Iraqi gas will

[24] Project was cancelled in 2015 due to political reasons. However, due to the model not considering political assumptions and being purely based on economic rational, a direct investment via the Black Sea to Bulgaria is suggested.

start flowing across Turkish borders as early as 2020 and by 2030 its import volumes will increase slightly to 4.1 bcm, equivalent to Iraq's total export capacity by then.

What is unexpected about the results, though, is that although the sanctions are being lifted, there would be no significant increase in imports from Iran, which is supposed to be one of the major suppliers in the Southern Gas Corridor (Tagliapietra, 2014a). It is valuable, therefore, to shed more light on the economic intuitions behind the Iranian results and their implications for Turkey in its ambitions to become an important gas transit country. One of the main reasons for Iran's low export volumes to Turkey is to do with its own domestic consumption. In line with WEO 2015, the model estimates that Iran's natural gas consumption will grow gradually from the current level of around 170 bcm to around 250 bcm by 2030. This huge increase may be attributed to recent political developments, namely the lifting of sanctions, which will result in increasing Iranian economic activity. One other key source of demand for Iranian natural gas is the upstream oil industry. Due to the geological structure of petroleum reservoirs in the country, natural gas is re-injected into oil fields as an enhanced oil recovery technique. Hence, the country is also consuming considerable amount of natural gas in order to maintain its oil production (Mohamedi, 2015; Stevens, 2015). Indeed, to satisfy its own needs, the model further estimates that Iran would be importing more than 10 bcm of gas from Turkmenistan from year 2020 onwards. This amount more or less equates with the gas exports to Turkey. The model also estimates that starting from 2020 Iran would be exporting some volumes of gas to India via Pakistan (reaching around 11.7 bcm by 2030) to enjoy better market prices than would be available from the European market. According to the model, India's equilibrium market prices would be on average around 30% higher than Turkish prices until 2030. As Iran can still exert some market power it would also choose to send volumes to India. Moreover, although Iranian officials often refer to LNG as one other option for exporting the country's gas resources[25], the model's reference case scenario does not estimate significant increases in Iran's LNG export capacity. This may be attributed to prohibitively high sunk costs related to LNG infrastructure, i.e., liquefaction and re-gasification terminals, and already existing overcapacity in the global LNG market.

Although according to the model the economic importance of Iran will remain relatively low, Turkmenistan would rise as a major supplier, along with Azerbaijan, in the Southern Gas Corridor. The model estimates huge increases in Turkmenistan's production, from around 82 bcm in 2014 to 162 bcm in 2030. This enormous increase in the country's production can be attributed to the vast gas resources yet to be developed. According to the model Turkmenistan will start investing in an upstream gas industry starting from 2020 when the gas prices all over the world start to increase. The model estimates that there are two main export destinations for the Turkmen gas, Eastern Asia (India and China) and Turkey. In 2030 Turkmenistan will be sending over 50 bcm of natural gas to India and China via Pakistan through the TAPI[26] pipeline and Kazakhstan. There exists one route over which Turkmenistan can deliver gas to Turkey, which is via Azerbaijan and Georgia. By 2030 Turkmenistan will start delivering 7.2 bcm via Azerbaijan, for which the model further estimates that there will be a new pipeline connection between Turkmenistan and Azerbaijan with a capacity of 7.2 bcm/annum. This pipeline can be attributed to the planned Trans-Caspian pipeline, whose capacity is estimated to be 30 bcm/annum.[27]

[25] See for instance Natural Gas Europe (2015a, 2015b, 2015c)

[26] TAPI is the abbreviation for Turkmenistan-Afghanistan-Pakistan-India Pipeline. The pipeline is planned with a capacity of 33 bcm/a. The model suggests a demand for investment of 50 bcm/a. Thus, the planned capacity is undersized.

[27] The model is used here is an economic optimisation model hence does not adjust for political conditions. In the case of Trans-Caspian pipeline, although it is an economically viable project, it would be politically difficult to materialise due to the border conflicts between Caspian countries. Please see O'Lear (2004) and Madani et al. (2014) for further discussion on the Caspian dispute.

4. Drivers for Turkey's potential to become transit country

The results of the reference scenario so far suggest that Turkey's importance in European supply security will only slightly increase over the period under investigation. In 2030, for instance, Turkey would re-export 23.3 bcm of gas to Bulgaria and Greece, contributing only 4.8% of total European consumption, while her imports would rise to 90.5 bcm (Figure 2). Furthermore, according to the results these re-exported gas volumes would be originated mostly from Azerbaijan and Iran, while Russian gas will be consumed within the Turkish domestic market. In this section, we try to answer the question under which conditions Turkey's role would increase and in doing so we consider different scenarios, which allow us to detect drivers for higher natural gas transits via Turkey.

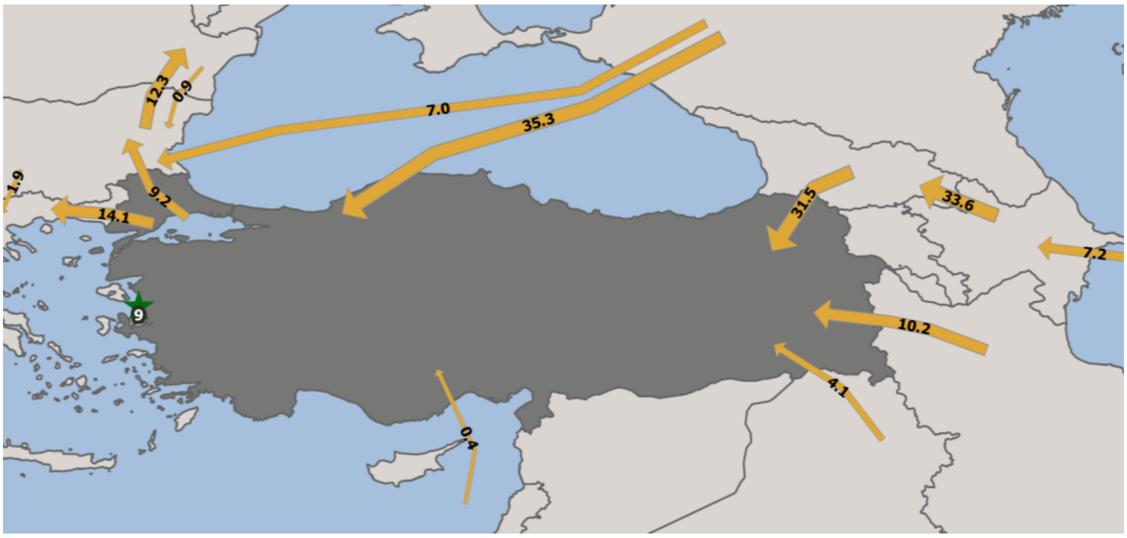

Figure 2. Estimated Gas Flows through Turkey in 2030 – Reference Scenario

As mentioned earlier, the European gas market has recently moved to a relatively more competitive environment leading prices to decline. Low gas prices may have profound positive effects on demand. Furthermore, there are several other drivers that can generate higher European demand, as for instance a fuel switch in power markets. Accordingly, we analysed to what extent an **increase in European demand** would affect Turkish gas transits by 2030.[28] Results reveal that there will be only 1.5 bcm/annum of additional transits via Turkey. The increase in European demand would, therefore, mostly be covered by LNG and increasing Russian supplies. Hence, the benefit to Turkey of an increased European demand is relatively minor.

There has been much debate about the possible cancellation of Nord Stream expansion due to various political issues between Russia and the EU, including the Crimean Annexation and the Syrian dispute. Taking these issues into consideration, we considered a case where **no expansion in the Nord Stream pipeline** was assumed. The results of this scenario suggest that Russia would use already existing gas infrastructure in Ukraine to feed the demand shortage for Central and Western Europe. The simulation results show no demand for investment in a potential pipeline to Turkey (Turk Stream). This illustrates that the potential pipeline projects Nord Stream 2 and Turk Stream are not in competition with each other. However, the results within this scenario show that there would be no significant change in the gas volumes that are transited through Turkey.

Currently the European gas market is moving towards a more competitive environment due to the over-capacity of LNG directed to Europe instead of the US, thanks to the shale revolution. However, if gas prices stay relatively low in the medium term, US shale investment would decline leading the country to become an importer again. In this case, Russian market power in European gas markets would increase once more. We constructed a case, therefore, in which **Russia acts in an oligopolistic** way to enforce higher prices. It can be shown that if Russia and its main competitors act so, European demand for gas from the Southern gas corridor increases. If we assume **additionally that European demand increases** until 2030 (as mentioned above),

[28] In the preliminary analysis we assumed that European projected demand will increase by 20%. Turkish demand increases also by 20%.

this effect becomes even stronger. The results illustrate that Turkey's re-exported gas volumes to Europe would increase significantly to 37.5 bcm/annum by 2030. Provided that Russia is withholding production capacity due to its oligopolistic behaviour, most of this 37.5 bcm would be supplied by other countries: Azerbaijan (19 bcm), Iran (7.5 bcm), Turkmenistan (5 bcm) and Iraq (1.3 bcm). Compared with the 23.3 bcm/annum in the reference scenario, this would indicate a greater likelihood for the Southern Gas Corridor to feed Turkey's ambitions of becoming an important natural gas transit country. Yet, the assumptions borne in these scenarios are not very likely to occur in the short-term given current conditions in global and European gas markets.

In the next step we analysed the impact on global gas markets of lifting Iranian sanctions and in particular how Turkish gas transits would be affected. It is assumed, therefore, that **Iranian production capacity is higher** than in the reference scenario[29], thus allowing Iran to export higher volumes of gas. However, results show that Iranian exports to Europe via Turkey would increase only slightly up to 4.3 bcm by 2030, compared with 3.9 bcm in the reference scenario. Instead of exporting via new, high cost infrastructure in Turkey to the European market, Iran decides to invest in infrastructure to Pakistan and India. Due to stronger demand growth and, therefore, higher price signals, these countries are of greater interest to Iran. In total Turkish re-exports to Europe would increase only slightly by 0.3 bcm in 2030.

Finally, variations in **Turkish demand**[30] and their effects on Turkish transit volumes are analysed. It is easy to foresee an overall worsening of the Turkish economy in the future due to, for instance, internal political disputes, terrorist attacks and their implications on the tourism sector, together with depreciation of the Turkish lira against the US dollar and Euro. [31]

[29] It is assumed that Iranian production capacity is 20 percent higher, for instance due to higher foreign direct investment following the cessation of sanctions.
[30] It is assumed that Turkish demand is 20 percent lower than in the reference scenario.
[31] Please see for instance: "Rough Seas Ahead for the Turkish Economy" In: Stratfor, 01.11.2016. Available at: https://www.stratfor.com/analysis/rough-seas-ahead-turkish-economy (Access date: 07.11.2016).

Compared with the reference scenario, lower Turkish domestic demand would lead to additional re-exports to Europe of 3.4 bcm by 2030. Thus, the development of Turkish demand has only a small effect on the country's transit amounts. The reason is that Russia acts as a swing supplier to the Turkish market and Turkey's demand reduction is merely balanced out mainly by a reduction in Russian supplies. Because Russia prefers direct connections to Europe, for instance through South Stream, the change in Turkish transit volumes would be low.

5. Conclusion and Policy Implications

This study has aimed to assess quantitatively Turkey's future role in the European natural gas market. For this purpose we used COLUMBUS, a global gas market simulation model, to conduct several scenarios regarding Turkey. Results from our reference scenario imply that Turkey's role would increase only slightly until 2030, by which time 23.3 bcm of natural gas, originating mostly in Azerbaijan, Turkmenistan and Iran, would flow across Turkish borders to European markets. Although these values are not high enough to conclude that **Turkey** could turn into an important natural gas transit country, according to the reference scenario Turkish transits would at least contribute a positive effect to the natural gas supply diversity of South Eastern European countries which are highly dependent upon Russian gas.

Moreover, from various scenarios analysed, Russia's behaving oligopolistically would have the greatest impact in elevating European gas demand, suggesting that by 2030 the amount of gas that could be re-exported from Turkey to European markets would reach 37.5 bcm, constituting 6.8% of total European demand. However, the assumptions made in this scenario are quite unlikely ever to be realised given the current conditions in global and European gas markets. The second scenario that creates a major deviation from the reference scenario features lower than expected Turkish gas demand growth due to a possible weakening of the Turkish economy. Accordingly, total re-exports would be 26.7 bcm, which is slightly higher than the reference scenario by 2030.

One of the most important outcomes of this paper according to our theoretical models is that Turkey's importance as a future European natural gas hub, or even a transit country, would be rather limited and highly dependent on several internal and external factors such as the behaviour of Russia together with future Turkish and European demand. Out of these factors, European demand and Russia's ability to exert market power are the most significant. Turkey's role may be stronger if European gas demand is higher than expected and Russia exerts greater market power. From a European perspective these conditions would not be preferable as they would lead to higher gas prices and a corresponding worsening in general welfare levels.

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