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***Research Article***

# Long-Term Natural Gas Contracts and Economic Performance: A Historical Decomposition Analysis for Turkey[1]

*Uzun Vadeli Doğalgaz Sözleşmeleri ve Ekonomik Performans: Türkiye için Bir Tarihsel Ayrıştırma Analizi*

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***Abstract***

*In this study, it was intended to capture a better relationship between the determined macroeconomic variables and natural gas prices via the long-term natural gas contracts of Turkey, due to the upcoming expiry dates for some of the long-term natural gas contracts that Turkey signed before. Especially, the long-term contracts between Turkey and Russia are taken as a basis and examined because Turkey mostly imports natural gas as well as crude oil and products from Russia, and the nearest long-term natural gas contract expiry date is the one with them. The main underlying cause of such a study is based on Turkey's need of ensuring energy supply security for its ever-growing population and economy as well as accessing clean and cheaper energy sources like natural gas, as a net energy importer country via alternative long-term natural gas contracts more suitable for both sides. Exclusively with the help of the Historical Decomposition Method by benefitting the Near-VAR Model, the missing part about the quantitative examination of long-term natural gas contracts and economic performance of Turkey was attempted to be executed by applying econometric techniques explained in the methodology part of the paper. These econometric techniques implemented in three different scenarios and, besides, five different natural gas price formulas are offered for Turkey's long-term natural gas contracts to be discussed in detail. The scenarios are based on concerning different energy commodities and different regional benchmarks by considering the effects on many macroeconomic variables or vice versa. Consequently, as an empirical finding, it has been obtained that a better performance can be demonstrated in terms of industrial production with one of the formulas produced as an alternative. In a nutshell, this paper is constructed*

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*upon five parts beyond the introduction and organized as follows: Natural gas markets, pricing, and contracts; Turkey's natural gas market and long-term natural gas contracts; literature review; methodology and empirical findings; conclusion and recommendations.*

***Keywords:*** *Energy Economics, Historical Decomposition Method, Natural Gas, Natural Gas Contracts, Near-VAR Model*

***Öz***

*Bu çalışmada, Türkiye'nin daha önce imzaladığı uzun vadeli doğalgaz sözleşmelerinden bazılarının yakın zamanda vadelerinin dolacak olması nedeniyle, belirlenen makroekonomik değişkenler ile doğalgaz fiyatları arasında daha iyi bir ilişki yakalanması amaçlanmıştır. Türkiye'nin ham petrol ve petrol ürünleri ile doğal gaz ithalatını çoğunlukla Rusya'dan gerçekleştirmesi ve ayrıca en yakın uzun vadeli doğal gaz sözleşmesi bitiş tarihinin Rusya ile olması nedeniyle özellikle Türkiye ile Rusya arasındaki uzun vadeli sözleşmeler esas alınarak inceleme yapılmıştır. Böyle bir çalışmanın temel nedeni, Türkiye'nin sürekli artan nüfusu ve büyüyen ekonomisi için enerji arz güvenliğini sağlama ihtiyacının yanı sıra her iki taraf için daha uygun alternatif uzun vadeli doğalgaz sözleşmeleri ile net enerji ithalatçısı bir ülke olarak doğal gaz gibi temiz ve daha ucuz enerji kaynaklarına erişme ihtiyacına dayanmaktadır. Çalışmada, özellikle Near-VAR Modelinden faydalanılarak kullanılan Tarihsel Ayrıştırma Yöntemi ve makalenin metodoloji bölümünde açıklanan diğer ekonometrik teknikler uygulanarak Türkiye'nin uzun vadeli doğalgaz sözleşmelerinin kantitatif incelemesinde eksik olan kısımlar doldurulmaya çalışılmıştır. Bu ekonometrik teknikler üç farklı senaryo üzerinde uygulanmıştır ve ayrıca Türkiye'nin uzun vadeli doğalgaz sözleşmelerinin detaylı olarak tartışılması için beş farklı doğalgaz fiyat formülü sunulmuştur. Senaryolar, birçok makroekonomik değişken üzerindeki etkiler göz önünde bulundurularak farklı enerji emtialarına ve farklı bölgesel karşılaştırma ölçütlerine veya bunun tersine dayanmaktadır. Sonuçta ampirik bulgu olarak, alternatif olarak üretilen formüllerden birisi ile sanayi üretimi açısından daha iyi bir performans ortaya konabileceği elde edilmiştir. Özetle, bu makale girişin ötesinde beş bölüm üzerine inşa edilmiş ve şu sırayla düzenlenmiştir: Doğal gaz piyasaları, fiyatlandırması ve sözleşmeleri; Türkiye doğal gaz piyasası ve uzun vadeli doğal gaz sözleşmeleri; literatür taraması; metodoloji ve ampirik bulgular; sonuç ve öneriler.*

**Anahtar Kelimeler: Doğal Gaz, Doğal Gaz Sözleşmeleri, Enerji Ekonomisi, Near-VAR Modeli, Tarihsel Ayrıştırma Yöntemi**

## 1. Introduction

Energy is the fundamental of global economic growth and development. And mainly for the countries struggling of lack of energy sources, it is a vital component to be emphasized in terms of production, current account, unemployment, and inflation. Especially following the Industrial Revolution, it is observed that energy demand comes to the fore in many subjects (Mokyr, 1977). As stated by Mokyr, after the Industrial Revolution, the rapid economic growth resulted with vast build up in energy demand that created a congestion. Reallocation of sources became decisive addition to emphasis of the energy production. Moreover, in the following decades, energy and, yet, its economics has developed into being more critical input for the entire countries. Consequently, petroleum and its derivatives which are the core sources of input for remarkably the industry sector, have become a globally vital input for life and the future of countries (Işık and Koşaroğlu, 2020).

Following 1980s, influence of natural gas has increased all around the world including Turkey. Along with the industrial consumption, many different areas of usage such as residential emerged that has increased natural gas demand further. Nonetheless, concerning the transportation of natural gas from supply locations to demand points, significance of pipelines has increased in reach of the technology at that time and thus, concept of natural gas has become a cross-border policy tool. This development has converted the international natural gas trade into a phenomenon which is not only a commercial activity but also a subject of international policy.

Natural gas is a form of fossil fuel that is composed of four hydrocarbon atoms and one carbon atom according to American Gas Association (n.d.). Natural gas, also called methane, is colorless and odorless in nature. It is actually an organic feedstock buried underground for million years and was converted into natural gas with the help of heat and pressure at thousands of meters of

depth in Earth's cluster. Transferring natural gas from the production location to the end-users necessitates many complex processes. According to EIA (2019), the infrastructure of natural gas transmission is categorized in three stages as processing, transportation and storage. As natural gas itself is in gas form in its natural phase in atmospheric pressure, the common way of transporting natural gas is using pipelines. Other way of transporting natural gas in long distances is liquefying it and carrying in liquid form which is known as Liquefied Natural Gas (LNG). LNG and pipelined gas are homogeneous products. However, different elements they bring into an import portfolio, in both commercial and political terms, can offer important strategic, as well as economic, diversification.

There are several distinct natural gas contract models each of which is associated with different price schemes. Different countries use different models based on their interests, and also their strategic posture. In particular, the oil indexation method, long-term take-or-pay contracts, and hub pricing models are few examples that frequently utilized in today's natural gas market. At present, within continental Europe and Asia, an oil-indexed pricing method yet to determine the natural gas prices, and within European market, long-term take-or-pay contracts are currently used for pipelined gas contracts. The phrase "*long-term contract*" is defined by the Energy Charter Secretariat (2007, p. 232) as:

> "*A contractual relationship between two parties beyond a single transaction with a minimum duration usually of at least one year up to 20 years and longer. While single parts of a long-term contract, like pricing provisions, may be changed over time under the rules of the contract, the contractual relationship between the parties will remain for the term of the contract.*".

Such agreements are mainly designed in order to protect the large investments of supplier as, on the contract basis, the demanding party has the obligation to buy contracted amount of gas or to pay for the unpurchased gas. Therefore, even if the supplier does not fall under massive financial liabilities in case of various fluctuations in demand, the consumer side is ought to undergo a substantial material burden. To serve this purpose, the European natural gas market aims to pursue the hub pricing method by adopting the integrated market introduced by the European Union (EU) to determine the imported pipelined gas price into Europe. Additionally, different alternatives progressively arise on natural gas pricing and contracting globally.

The natural gas trade process cannot be accounted as a simple commercial activity, and thus, this fact revealed obligation of more detailed and extensive research in order to examine what alternatives would be more beneficial for Turkey. According to the pre-research conducted on previous literature, the main rationale behind this paper is based on that analytically there are limited amount of empirical studies about the long-term oil-indexed natural gas contracts, the natural gas pricing formula and its effects on economy and energy security of Turkey. Studies on contracting, benchmarking, pricing and other related topics have mostly been carried out within the context of international relations and more in line with qualitative policies. This paper aims to demonstrate Turkey's conditions analytically and empirically on natural gas contracts negotiations. Additionally, this paper anticipates in helping policymakers to gain an incentive about the problem and the solutions from the view of economic perspective in order to contribute to the provisions and regulations about tangible justifications of such problem. The Historical Decomposition Method via benefitting Near-VAR Model has been applied to Turkish market data, those were extracted from several sources, which is the most original contribution of this paper to the economics literature via analytically obtained findings. Furthermore, this study is conducted in order to investigate and contribute to the answers of whether a country with high energy bills such as Turkey can benefit from these contractual factors to be renegotiated with the suppliers and whether Turkey can improve the contract system in order to force the source country under any obligation or to find any alternative solution. In a nutshell, this paper is constructed upon six parts beyond the introduction and organized as follows; natural gas markets, natural gas

pricing and contracts, Turkey's natural gas market, Turkey's long-term natural gas contracts, methodology and empirical findings, and conclusion and recommendations.

## 2. Natural Gas Markets, Pricing and Contracts

In principle, natural gas contracts are not different than any other commodities trade contract. Although there are specials terms and conditions for natural gas contracts, this is a typical application in most of the short-term or long-term commodities trading especially for determining the price (Zlámal, 2009).

### *Natural Gas Markets*

Natural gas is traded in commercially structured markets where buyers and sellers meet to have a defined term of agreement on a pre-defined price. Natural gas markets can be designed as either for long-term or short-term agreement utilities (Levine et al., 2014). As specified by the IGU (n.d.), according to the contract lengths, natural gas trade contract types can be classified as; short-term contracts of whose volumes traded on a spot basis or under contracts of less than two years; medium-term contracts of whose volumes traded under contracts of between two to five years; long-term contracts of whose volumes traded under contracts for more than five years. The natural gas market is believed to have been in a transition phase in the last decade from a long-term utility market to a short-term market where natural gas is expected to be priced in a relatively competitive environment.

In this new context, different natural gas supply options will compete in a free market which is supposed to occur with a fairly assessed price rather than oil-indexed pricing. With the increased LNG supply, these new producers help sellers by transporting their gas to distant locations and new technologies yielded large amount of gas extracted such as happened in US shale gas industry. Increased supply of gas caused more affordable energy solution to the emerging and emerged markets that caused a shift from crude oil and coal to natural gas which globalized the gas industry. This global presence of natural gas markets increased flexibility of lateral agreements between buyers and sellers. In addition, geographically limited consumers like South Korea and Japan could have access in natural gas markets. This increased global competition raised a requirement for buyers to have different contract options.

According to Natgas (n.d.), the global natural gas markets can be categorized into four groups; gas-on-gas markets (US, UK, Canada), markets where prices indexed to substitute energy prices (Continental Europe), oil-linked price markets (Japan, Korea, Taiwan) and regulated markets (Middle East, Russia, China) [see Şahin (2020) for more details].

### *Natural Gas Pricing*

Contracts arise from the regional market conditions which are related to the regional pricing methodology used. For this reason, before examining the natural gas contracts, one needs to understand the natural gas pricing methodologies. It varies among the main global markets where natural gas is priced and sold. Furthermore, it is important to apprehend that the natural gas pricing models are fundamental for energy regulators, consumers, and suppliers because natural gas is becoming a gradually significant energy source.

According to the (IGU, n.d.), there are different pricing methods to achieve more open pricing regimes which are Oil Price Escalation, Gas on Gas Competition, Bilateral Monopoly, Netback from Final Product, Regulation: Social and Political, Regulation: Below Cost, Regulation, Cost of Service and No Price [see Şahin (2020) for more details]. One or more of these price mechanisms could be applied depending on supply and demand-side factors which are import/export, level of economic growth, seasonal weather conditions, and others. Regional prices may differ at different locations to meet market needs. Based on that, any natural gas or LNG contract could be priced by a combination of one or any other of the pricing mechanisms mentioned above.

### *Natural Gas and LNG Contracts*

The buyers and sellers would like to secure themselves in the course by simple basics of any trade. The natural gas market is no exception and has adapted itself too many different contract types to create an efficient and sustainable trading system. As natural gas supply is reliant on the upstream activities that require extensive investment and operational expenditures, natural gas contracts have evolved to secure suppliers. However, increasing LNG supply in the markets, shifted the contract mechanisms to a more competitive level that buyers started to dictate their requirements. In theory, no matter what contract type is preferred for any physical trade agreement, the basis would be to build a risk-minimized mutual environment for both parties. In practice, each side pushes for their favor, which created different types of contracts to be questioned in terms of their practicality. In most cases, natural gas contracts are long-term contracts due to the nature that buyers and sellers need a long-term commitment from the other side of the trading.

The natural gas contract types for natural gas and LNG can be stated as long-term LNG contracts, short-term spot LNG contracts, spot LNG contracts, take-or-pay natural gas contracts, and hub-based Pricing [see Şahin (2020) for more information]. As stated by Energy Charter Secretariat (2007), each contract has its unique terms and conditions. In some cases, different alternatives are computed in variable prices such as spot LNG example in Germany (Nexant, 2017). There are also cases that spot contracts are priced against hub prices such as in NBP or TTF; however, in current market conditions, physical gas, especially the gas supplied by Russia, still arrives in European gas hubs with oil-indexed contracts. Natural gas contracts continue to evolve with market needs, upstream developments, demand structure changes, and long-term risk assessments in the natural gas market.

In regions like Europe, where there is a supply-side monopoly and the assumption that natural gas can be substituted by crude oil or oil products in case of a gas supply shortage have caused the market to price natural gas with oil-indexed pricing mechanisms. However, different markets have different dynamics so different price formulations have evolved to reflect how the changes in oil prices could be reflected in gas prices and find a balance between the seller's expectations and buyer's commitments (Müller et al., 2015). The main difference comes from the demand pattern differences between oil and gas markets.

On the other hand, natural gas also has different demand patterns at different time frequencies. According to Müller et al. (2015) this yields different oil-indexed price formulations based on three parameters: The number of averaging months, the time lags, the number of validity months. Moreover, formulation of natural gas has two main components; fixed term, which is a basic price for the gas, and variable term, which links the gas price to its substitutes (Zlámal, 2009). The substitutes are alternative energy sources that are assumed to be able to replace natural gas in case of a supply disruption. The main alternative sources are gasoil, light or heavy fuel oil, coal, and electricity. The common usage of variable terms is generally having a combination of more than one alternative in a weighted average principle. Different formulations depend on a different combination of these alternatives. Basis price is generally a pre-evaluated price of the gas at the time of commencement of the contract. Each alternative is calculated to have different weighs in the variable term based on their competitive power against natural gas or market conditions.

## 3. Turkey's Natural Gas Market and Long-term Natural Gas Contracts

Turkey has a continuous increase in its energy demand as a developing country. Due to Turkey's location and proximity to the world's top crude oil and natural gas suppliers, its primary energy sources have been hydrocarbon sources. Addition to that, Turkey has also adapted usage of coal in its primary electricity generation cycle, as a country having important domestic coal reserves. Turkey's close relations with Soviet Union helped the country to access in important natural gas imports that has been a vital catalyzer in Turkey's economic growth for the last few decades. Moreover, the foreign dependency ratio has increased significantly because of the incremental progress in consumption of natural gas from the beginning of 1990s and has followed a path of

70-76% from the beginning of the 2000s (Türkiye Petrolleri, 2018; Türkiye Petrolleri, 2019). Turkey benefits natural gas from many different perspectives besides the political, geopolitical, and economic power. Besides, these issues make it necessary for demanding and using natural gas more in Turkey.

Thanks to its precious geostrategic location, Turkey has a great potential to be transformed into a hub or a multi-source transit country nourished by many suppliers of the Caspian region, the Middle East and Russia. The main objective of Turkey's energy projections is not only playing a transit country role but also being a hub location for the whole region mainly for natural gas. Turkey embodies many advantages in this respect with its compelling economy, existing natural gas pipelines infrastructure, current pipeline projects and geostrategic location. According to Balat (2010), four challenges for Turkey's energy security, which ensures the region's energy security as well, can be determined as "*high dependency on imported fossil fuels, reliability of energy suppliers, high energy intensity, and investment needs of the Turkish energy sector*".

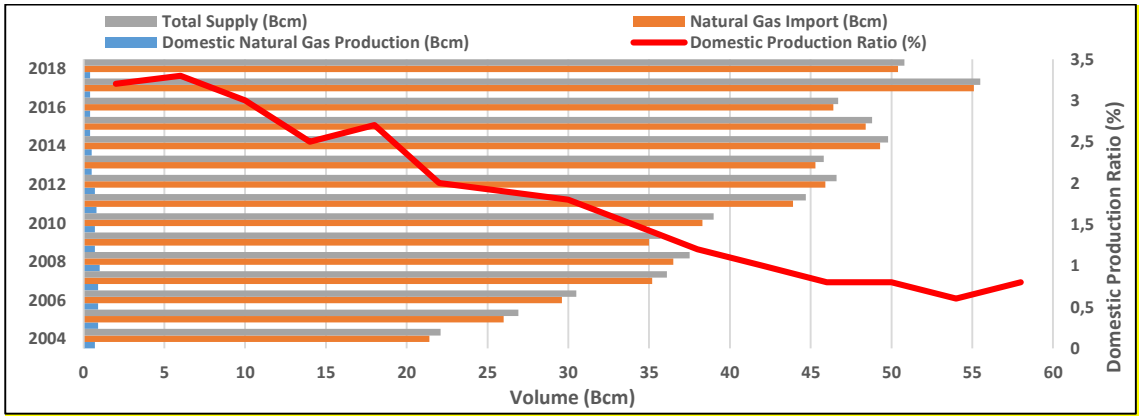



**Figure 1.** Total supply, import, domestic production and domestic production ratio of natural gas in Turkey between 2004-2018. **Sources:** EMRA (2018), EMRA (2019), Authors' Calculations

As seen from Figure 1, share of domestic natural gas production over total supply in Turkey in 2018 increased compared to 2017 and stood at 0.8%. Turkey's domestic natural gas production reached a total of 354 Mcm in 2017 and 428 Mcm in 2018. Turkey's natural gas imports were 50.4 Bcm while total supply in market was approximately 50.8 Bcm in 2018. So, the dependence on natural gas imports in Turkey was 99.3% in 2017 and has been slightly decreased to 99.2% in 2018 solely because of the weather conditions above the seasonal standards and decreasing demand for natural gas. When Turkey's natural gas import share by countries investigated, Russia ranked first with 46.95% share in 2018 while in 2017 this ratio was 51.93%. In 2018, Iran ranked second with a share of 15.6% while Azerbaijan ranked third with a share of 15%. This is followed by Algeria (9%), Nigeria (3.3%) and the share of countries that spot LNG imported from was 15% (EMRA, 2017; EMRA, 2018; EMRA, 2019).

**Table 1.** Amounts of total production, total consumption, total import and total export of natural gas in Turkey between 2002-2018 (Mcm)

| Year | Total Production | Total Consumption | Total Import | Total Export |
|---|---|---|---|---|
| 2008 | 969 | 36,865 | 37,350 | 436 |
| 2009 | 684 | 35,219 | 35,856 | 709 |
| 2010 | 682 | 37,411 | 38,036 | 649 |
| 2011 | 759 | 43,697 | 43,874 | 714 |
| 2012 | 632 | 45,242 | 45,922 | 611 |

| | | | | |
|---|---|---|---|---|
| 2013 | 537 | 45,918 | 45,269 | 682 |
| 2014 | 479 | 48,717 | 49,262 | 633 |
| 2015 | 381 | 47,999 | 48,427 | 624 |
| 2016 | 367 | 46,480 | 46,352 | 675 |
| 2017 | 354 | 53,857 | 55,250 | 631 |
| 2018 | 428 | 49,329 | 50,361 | 673 |

**Sources:** EMRA (2012), EMRA (2014), EMRA (2017), EMRA (2018), EMRA (2019), MENR (2017)

In Table 1, data of Turkey's production, consumption, imports and exports of natural gas are given between 2008 and 2018. According to the data for production, in 2017, 354 Mcm of natural gas was propounded for selling by ten producer companies that have active wholesale license and in 2018, 428 Mcm of natural gas was propounded for selling by 12 producer companies that have active wholesale license. The domestic production of natural gas in 2017 decreased by 3.58% compared to 2016 and in 2018 increased by 20.9% compared to 2017. The amount of consumption in 2017 increased by 15.87% compared to 2016 and in 2018 decreased by 8.41% compared to 2017. When the trade volumes are examined, the changes in natural gas trade volumes were 19.20% increase in imports and 6.52% decrease in exports in 2017 compared to 2016; 8.85% decrease in imports and 6.76% increase in exports in 2018 compared to 2017. According to EMRA (2018; 2019), while 91.30% of total natural gas imports in 2017 consist of long-term import contracts (44,484.66 Mcm pipeline, 5,961.08 Mcm long-term LNG), 8.70% was spot LNG (4,804.20 Mcm) and while 89.79% of total natural gas imports in 2018 consist of long-term import contracts (39,032.13 Mcm pipeline, 6,188.47 Mcm long-term LNG), 10.21% was spot LNG (5,139.98 Mcm). Companies, holding long-term import licenses, imported natural gas mostly from Russia and Iran respectively both in 2017 and 2018. In 2017, 77.45% of imported LNG from Algeria and 22.55% from Nigeria consists of long-term contracts and in 2018, 73.05% of imported LNG from Algeria and 26.95% from Nigeria consists of long-term contracts.

Essentially, Turkey's natural gas imports took place via pipelines with long-term oil-indexed contracts of which remarkably supplied from Russia. In addition to that, Turkey mainly imports natural gas via pipelines in line with the ever-increasing demand for limited resources and tries to implement a source diversification strategy by increasing in both pipelined gas and LNG imports.

**Table 2.** Turkey's long-term natural gas purchase contracts according to countries

| Agreement with | Signature Date | Operation Date (Date effective) | Duration (Year) | Volume During the Plateau Period) (Bcm/Year) | End Date (Expiry date) | Status | Contract Type |
|---|---|---|---|---|---|---|---|
| Russian Federation (West Line) | 14.02.1986 | 1987 | 25 | 6 | 2011 | Ended | Oil indexed |
| Algeria (LNG) | 14.04.1988 | 1994 | 20 + 10 | 4.4 | 2024 | Operating | Long-term LNG |
| Nigeria (LNG) | 09.11.1995 | 1999 | 22 | 1.3 | 2021 | Operating | Long-term LNG |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Iran | 08.08.1996 | 2001 | 25 | 9.6 | 2026 | Operating | Oil indexed |
| Russian Federation (Blue Stream) | 15.12.1997 | 2003 | 25 | 16 | 2025 | Operating | Oil indexed |
| Russian Federation (West Line) * | 18.02.1998 | 1998 | 23 | 14 | 2021 | Operating | Oil indexed |
| Turkmenistan | 21.05.1999 | - | 30 | 16 | - | Pending | - |
| Azerbaijan (SD Phase-I) | 12.03.2001 | 2007 | 15 | 6.6 | 2021 | Operating | Oil indexed |
| Azerbaijan (SD Phase-II) | 25.10.2011 | 2018 | 15 | 6 | 2033 | Operating | Oil indexed |
| Azerbaijan (BIL) | 2011 | 2011 | 35 | 0.15 | 2046 | Operating | Oil indexed |
| Qatar (LNG) | 01.10.2017 | 2017 | 3 | 2.1 | 2020 | Operating | Long-term LNG |

**Sources:** BOTAŞ, PETFORM, MENR, GAZİD, Authors

* A total of 10 Bcm contract transfer to four companies took place in 2007 which are Enerco Energy (2.5 Bcm), BosphorusGas (0.75 Bcm), Avrasya Gas (0.50 Bcm), Shell Energy (0.25 Bcm) and again to four companies took place in 2013 which are Akfel Gas (2.25 Bcm), BosphorusGas (1.75 Bcm), Kibar Energy (1.0 Bcm), West Line (1.0 Bcm). 4 Bcm amount of these contracts expire in 2021.

Turkey's first long-term natural gas purchase agreement was with Russia in 1984 as stated historically before along with the other contracts made via other supplier countries. Turkey's natural gas contract agreements and their properties can be seen in Table 2 and these contracts in total represent nearly 50 Bcm of gas supply that will expire by 2020's. As it can also be seen, Turkey's natural gas contracts are mostly as long-term and oil indexed contract agreements. Moreover, one can see that Turkey should be well prepared for the approaching renegotiations on natural gas contracts and so for the prices which is an issue that will indeed affect the Turkey's economy for many years [see Şahin (2020) for more information].

## 4. Literature Review

In this study, a literature review on natural gas pricing, contracts, and market structures was conducted to get information about the subject and find the missing parts by reviewing academic studies on the pricing of natural gas, factors affecting the natural gas price, the debate on oil-indexed and hub-based natural gas contracts, and the studies about Turkey's long-term natural gas contracts are examined in a historical manner [See Şahin (2020) for more details)]. The review in this section is based on two main distinctions: duration of the contract and subject-wise classification of the literature. Natural gas pricing mutually in long-run and short-run is the core factor behind the economics of natural gas and the contracts between suppliers and demanders. There are considerable amount of literature and different approaches about natural gas pricing in the world, but the empirical results haven't reached a consensus. Additionally, in Turkey there are not many studies conducted about the topic, especially in a quantitively manner. As the core result of the literature review, it was noticed that there was a missing gap among studies about pricing and long-term contracting in Turkey's natural gas market especially from the quantitative perspective. The studies like Yardımcı and Ediger (2010), Balat (2010), Yardımcı (2011), Cağaptay and Evans (2013), Skalamera (2016), Berk and Schulte (2017), and Şahin (2020) are

concerned with the natural gas issues and natural gas market of Turkey. Moreover, some of the recent studies about the subject is as follows:

***Natural Gas Pricing and Factors Affecting Natural Gas Price***

Neumann and Hirschhausen (2015), as followers of oil indexation mechanism on behalf of pricing of natural gas discuss that the Asian premium is on account of distinctive market principals. Creti and Nguyen (2015), emphasize that the energy prices are still solely affected by demand and supply essentials of the market even after the global financial crisis in 2018 where the natural gas prices influenced by financial markets more. Giziene and Zalgiryte (2015) analyze the pricing of natural gas in the Lithuania and the EU and moreover indicate that both internal factors such as fuel and other energy sources and external factors such as production price, storage price, transportation price, purchase price and factors of substructure costs may affect the prices of natural gas. Pal and Mitra (2015) examine the possible asymmetries arising between oil prices and its derivative prices by implementing a Multiple Threshold NARDL Model. They conclude that there are variances with the oil derivative prices because of the crude oil price changes both from the perspective of magnitude or direction of the relationship. Moreover, they discuss that intense crude oil decreases do not entirely diffuse to oil derivative prices. Geng et al. (2016b) investigates the effect of the shale gas revolution among the relationship between natural gas and oil prices besides the natural gas pricing dynamics. Demand and supply mechanism is the major factor in the US market while the oil prices are the major factors in European and Japanese markets. Geng et al. (2016c) discovered that US Henry Hub gas prices have been largely affected by the shale gas revolution. However, same effect has not been observed in NBP gas prices following the study on the impact of shale gas on the gas price movement systems focusing on the relation between oil and gas prices both in the US and Europe. Hulshof et al. (2016) study the effect of coal price, oil price, demand and supply essentials on TTF spot prices. They figure out that TTF spot prices are determined among gas-on-gas competition because the prices are affected solely by factors like weather conditions, economic transactions, natural gas consumption level especially affect beyond the oil price and coal price. Jadidzadeh and Serletis (2017) suggest that natural gas price reaction varies significantly to the oil price shocks. Furthermore, they conclude that aggregate demand and aggregate supply shocks cause the 45% of the variations of the natural gas price with empirical methods implemented. They also find out that oil price and natural price decoupled from each other. Wiggins and Etienne (2017) show that natural gas prices are variously affected by demand shocks and supply shocks. These aggregate demand and aggregate supply shocks justify post-regulation price volatility with a ratio of 20%. Moreover, in the study it is resolved that aggregate demand and aggregate supply shocks have a higher effect than preventive stock shocks. They also conclude that elasticity of demand increases as consumers substitute more easily to other energy sources. Zhang (2017) indicates that the international financial market affects the prices of oil from the time when the global financial crisis occurred in 2018. This also influences the prices of natural gas.

***Integration and Linkage Between Other Energy Sources and Natural Gas Prices***

Lin and Li (2015) assert the spillover effect concerning Japanese, European and American natural gas and oil markets by means of moments of mean value and volatility. They endorse the cointegration in Japanese and European markets while asserting the decoupling in the American market. Additionally, they explain this fact with the oil-indexed natural gas contracts in Japanese market and European markets while American market has specific market essentials for the formulation of price. This spillover effect is through oil price to natural gas price. Geng et al. (2016a) mention that Brent oil prices and WTI oil prices has a noteworthy effect on Henry Hub natural gas prices and NBP natural gas prices correspondingly. After the US shale gas revolution this relation is altered as WTI affecting less whereas European natural gas market still affected by the volatility of oil price. They bring up that the comparative prices of natural gas and crude oil prices track a “state-dependent regime-switching model” and they decoupled in the medium-term and long-term with empirical evidences. Moreover, there are two directional ancillary

spillovers of volatility between oil prices and natural gas prices. They add that European natural gas pricing mechanism may draw away from getting affected by the oil prices if European countries differentiate the supply sources and formulas of pricing. Asche et al. (2017) provide the information that there is a cointegration on Brent oil prices and the UK natural gas prices within a regime switching framework. In addition, they emphasize that during fall and beginning of winter months, there is a tendency to decouple in natural gas prices, when the gas specific pricing becomes major because of the demand increase for heating. Batten et al. (2017) emphasis the dynamic relation between natural gas market prices and oil market prices. Additionally, they indicate that even before there is a causality from natural gas markets to oil markets, after 2007 the two markets are decoupled from each other. These markets can't be used for hedging as substitutes because of the gas on gas price mechanism in the US market and the shale gas revolution. Caporin and Fontini (2017) indicate that there is a structural break in the relation between oil prices and natural gas prices by the shale gas revolution. They affirm that after the global financial crisis in 2008 the relation among oil and natural gas prices in the long-term start to exhaust and thus in general it surpasses the effect of the shale gas. Zhang et al. (2017) figure out that the low oil prices corresponding to shifting essentials are also a reason causing structural breakdown in the oil and natural gas price relationship beyond the global financial crisis in 2018. Ramberg et al. (2017) try to figure out if there is a decoupling between oil and natural gas prices with empirical tests. The motive behind the analysis is the detected price upheaval in oil markets and natural gas markets with the obvious deviation in the price of them. Liu and Li (2018) examine the popular opinion that prices of natural gas are driven by prices of crude oil, shale gas has considerably suppressed the prices of crude oil. Zhang and Ji (2018) examine the dynamic relations of prices of natural gas in three different markets with the price of Brent oil by implementing a method named long-memory approach. They figure out the decoupling in prices of European and Japanese markets are nonpermanent.

***Oil-Indexed vs. Hub-Based Natural Gas Contracts***

Stern (2014) questions as an opposition to the oil-indexation in natural gas pricing that whether oil indexation is appropriate because it does not neglect the essential features in the natural gas. Additionally, he suggests forming the East Asian hubs to create benchmark prices which would bring forth the natural gas market essentials of East Asia as a substitute to oil indexation. Tong et al. (2014) claim that the Asian premium is caused by the oil indexation mechanism and they suggest local benchmark price developments through hubs for substituting oil indexation mechanism and lessen the Asian premium power. Moreover, they state that the natural gas pricing system based on oil indexation is started to be criticized which was very applicable until 1990s. According to Shi and Variam (2016), price of natural gas is adjusted by supply and demand in the natural gas market by the natural gas hub price. Moreover, they verify that Asian premium is not affected by the destination constraints that are aimed to maintain the LNG supplies. Stern (2016) suggests collaboration within the Asian consumers to support the hub-pricing mechanism progression for substituting oil-indexation mechanism and he offers generating benchmark prices to express regional market of East Asia essentials by forming East Asian natural gas trading hubs. Shi and Variam (2017) explain that some East Asian countries such as China, Japan and Singapore have been working on establishing their own standard gas prices for hub pricing. These three countries are exchanging natural gas among each other and Singapore has its own LNG price indexes with the emergence of the new markets. Although there is criticism about hub-based pricing system, they also support for such gas hubs in East Asia. In order to replace oil indexation, they propose gas trading hubs in East Asia that would reflect the fundamentals of the regions own market dynamics. Oil prices in European and Japanese markets have increased significantly despite historically low prices in American market. This creates concerns for the governments and producers in the applicability of transitioning from oil indexation to pricing hubs. Shen et al. (2018) come up with the idea that even in the mechanism of hub-based pricing, market risks that are very high so that it can diffuse to the natural gas prices. Zhang et al. (2018) point out that because of the natural gas hub price is disposed by demand and supply in the market, it should

better reveal the essential natural gas prices. They assert that European and Japanese natural gas prices still rely greatly on the oil price, but they began to decouple potentially especially after Global financial crisis in 2008.

## 5. Methodology and Empirical Findings

In this part, information on the variable and data determination is given, and the methodology of the study and the empirical results obtained from the econometric techniques used as Unit Root and Stationarity Tests, Factor Analysis, Near-Vector Autoregression Model, Historical Decomposition and Impulse Response Functions are explained and examined. Moreover, the findings of the empirical study are presented about the proposed alternative long-term oil-indexed natural gas contracts for Turkey and the results obtained from the study are assessed.

### Determining the Variables and Data

**Table 3.** Variables of quarterly time series used in the analysis with data sources of data

| Variable | Abbreviation | Variable | Abbreviation |
|---|---|---|---|
| Source: Refinitiv EIKON | | Source: Federal Reserve Economic Data (FRED) | |
| Fuel Oil 3.5% Sulphur Price | FOHIGHP | Consumer Price Index of Turkey | CPI |
| Brent Oil Price | BRENTP | Source: US Energy Information Administration (EIA) | |
| Fuel Oil 1% Sulphur Price | FOLOWP | Brent Oil Price | BRENTM |
| Gasoil Price | GASOILP | Source: TURKSTAT | |
| National Balancing Point Price | NBPP | Industrial Production Index of Turkey | IP |
| Henry Hub Price | NGOP | Source: CBRT Electronic Data Delivery System (EVDS) | |
| TTF Price | TTFP | Basket of USD/TRY and EUR/TRY | BASKET |
| LNG Price | LNGP | CBRT Interest Rate | INTEREST |
| Turkey LNG Landed Price | TURLNGP | Source: IMF Cross Country Macroeconomic Statistics | |
| | | Russian Natural Gas Border Price in Germany | GERNGP |

In this paper, time series data for nominal energy prices and macroeconomic variables are used for the empirical analysis and they are presented in Table 3 including the sources of the data. The energy commodity variables used in this paper are Fuel Oil 3.5% Sulphur Price, Brent Oil Price, Fuel Oil 1% Sulphur Price, Gasoil Price, National Balancing Point Price, Henry Hub Price, TTF Price, LNG Price, Turkey LNG Landed Price, Russian Natural Gas Border Price in Germany. These variables are initially selected for Turkey by examining many variables that could affect the natural gas contract price between importer and exporter countries. Firstly, the actual natural gas contract formulas used in Turkey and the World are taken into consideration while determining those variables. Besides, the path Turkey should follow when negotiating the natural gas contracts with other countries and alternative pricing formulas are intended to be suggested for the coming period. A comparison was made between the current contract formula and the proposed alternative contract formulas and a proposal was projected accordingly. For this reason, the energy commodity variables used in the analysis are selected from the current contract, the determinant variables that will affect pricing in Europe and in the world. Also, upon examination of the relationship between production and natural gas prices in Turkey, alternative natural gas

pricing formulization has been put forward. In addition, the relevant macroeconomic data which can be stated as Industrial Production Index of Turkey, Consumer Price Index of Turkey, Basket of USD/TRY and EUR/TRY Exchange Rates (the average of the exchange rates), CBRT Interest Rate (weighted average O/N funding cost) were included in the model in terms of other factors affecting production and finally the analysis was performed. The time span of whole data are between first quarter of 1960 and fourth quarter of 2018. The energy prices were taken quarterly because the price formula is being reviewed in every three months periods by the authorities. Consequently, all the data used in the analysis were taken as quarterly and the whole price data used in the analysis were taken in USD currency for the unity of the analysis.

***Unit Root and Stationarity Tests***

In this paper, Unit Root Tests are implemented for testing the stationarity of the time series data used for determining the alternative Natural Gas Contract Prices with Factor Analysis and making analysis with those variables. In this paper; ADF Test, PP Test and KPSS Test are applied to verify the property of the data. One can refer to Dickey and Fuller (1979), Phillips and Perron (1988), Kwiatkowski et. al. (1992) for more details.

**Table 4.** Unit root and stationarity tests for nominal energy prices

| | ADF TEST | | | PP TEST | | | KPSS TEST | | |
|---|---|---|---|---|---|---|---|---|---|
| Variable | level (intercept) | level (intercept and trend) | first difference (intercept) | level (intercept) | level (intercept and trend) | first difference (intercept) | level (intercept) | level (intercept and trend) | first difference (intercept) |
| Brent Oil | -2.1642 | -2.1892 | -7.8807*** | -2.0887 | -2.1533 | -8.2363*** | 0.6678** | 0.2194*** | 0.1334*** |
| Fuel Oil 1% Sulphur | -1.7925 | -2.7534 | -9.5045*** | -1.7920 | -2.9021 | -10.4490*** | 1.0029*** | 0.1222* | 0.0482** |
| Fuel Oil 3.5% Sulphur | -1.7130 | -2.7409 | -10.0647*** | -1.6167 | -2.6982 | -11.0880*** | 1.0054*** | 0.1241* | 0.0374 |
| Gasoil | -2.1624 | -2.2544 | -7.4334*** | -2.1504 | -2.2995 | -7.9329*** | 0.6813** | 0.2198*** | 0.1130*** |
| Henry Hub | -3.2752** | -3.2810* | -9.9832*** | -3.1170** | -3.0944 | -12.5546*** | 0.2758 | 0.2714*** | 0.1724 |
| LNG | -2.4593 | -2.6351 | -6.3343*** | -2.8925* | -2.8530 | -6.3343*** | 0.1833 | 0.0619 | 0.0686 |
| National Balancing Point | -1.8556 | -1.2795 | -3.9197*** | -1.8614 | -2.3792 | -5.7832*** | 0.3083 | 0.1817** | 0.4287* |
| Russian Natural Gas Border Price in Germany | -2.1848 | -3.2150* | -7.2177*** | -1.5260 | -2.1502 | -5.5049*** | 0.9476*** | 0.1402* | 0.1073*** |
| TTF | -1.8104 | -1.8704 | -5.1357*** | -1.8129 | -1.8704 | -5.1357*** | 0.1823 | 0.1685** | 0.1908 |
| Turkey LNG Landed | -1.9878 | -4.2335** | -2.3038*** | -2.5281 | -2.4810 | -7.7700*** | 0.1501 | 0.1500** | 0.0963 |

Notes: 1) ***Indicates the level of significance at 1%. **Indicates the level of significance at 5%. *Indicates the level of significance at 10%. 2) Series are not subject to logarithmic conversion 3) Eviews 10 Software Package is used for generating the Unit Root Tests. 4) Unit Root and Stationarity Tests of all series are available upon request.

Table 4 reports the results for ADF Unit Root Test, PP Unit Root Test, KPSS Stationarity Test and shows level of significance at 1%, 5% and 10% but results interpreted for only 1% significance level in the text. The tests are all implemented for the quarterly contract price data of

several time series as FOHIGHP, BRENTP, FOLOWP, GASOILP, NBPP, NGOP, TTFP, LNGP, GERNGP, TURLNGP (see Table 3). In order to draw attention to energy commodities, the Unit Root Tests and Stationarity Test results of macroeconomic variables are not shown in the table. The lag length for ADF determined by Schwarz Info Criterion and the bandwidths for PP and KPSS lag length determined by Newey-West Bandwidth techniques. The prices are used in nominal levels and the Unit Root Tests implemented for nominal data. As seen from Table 4, we reject the null hypothesis that the process has unit root in level with intercept for none of the variables with ADF Test and PP Test; FOHIGHP, FOLOWP, GERNGP with KPSS Test at 1% level. Also, we reject the null hypothesis in level with intercept and trend for none of the variables with ADF Test and PP Test; BRENTP, GASOILP, NGOP for KPSS Test at 1% level. Moreover, we reject the null hypothesis in the first difference with the intercept for all the variables with ADF Test and PP Test; BRENTP, GASOILP, GERNGP with KPSS Test at 1% level. We can conclude that the null hypothesis is rejected at 1% level for ADF and PP Tests in first difference with intercept that interprets the first difference of all variables are stationary.

***Factor Analysis***

Factor Analysis Method is benefitted in the paper for determining the most important sets of variables from the several prices affecting the Natural Gas Contract Price, and the determined factor as Natural Gas Contract Price (NGP) with those chosen commodity prices are used in the Near-Var Model. The overall idea behind the Factor Analysis Method is to summarize the gathered data for to interpret and investigate the patterns and the relationships. According to Bartholomew, Knott and Moustaki (2011), Factor Analysis utilizes with the concept that empirically observed variables may be reduced to lesser latent variables or so called reducing the dimensionality which are unobservable and assign a mutual variance. Cattell (2012) states that the said unobservable factors are fundamentally hypothetical concepts that are used to signify variables, but they are not measured directly. Different combinations of the various commodity prices will be used for analysis in different scenarios as in the following.

**Table 5.** Factor analysis of fuel oil 3.5% sulphur and Brent oil prices

| | FACTOR | | LOADINGS | |
|---|---|---|---|---|
| FACTOR | VARIANCE | PROPORTION | FOHIGHP | BRENTP |
| F1 | 1.7987 | 1.0000 | **0.9483** | **0.9483** |

***** Eviews 10 Software Package is used for executing the Factor Analysis.

The First Natural Gas Price (NGP1) is obtained with FOHIGHP and BRENTP because the current Natural Gas Contract Price formula is relying on these variables according to the information given by the authorities. As it can be seen from Table 5, one factor is obtained with the help of the Factor Analysis. Also, NGP1 obtained is used for the Impulse Responses and the Historical Decomposition Analysis.

**Table 6.** Factor analysis of National Balancing Point, Henry Hub, TTF and Russian Natural Gas Border Price in Germany prices

| | FACTOR | | LOADINGS | | | |
|---|---|---|---|---|---|---|
| FACTOR | VARIANCE | PROPORTION | NBPP | NGOP | TTFP | GERNGP |
| F1 | 2.3716 | 1.0000 | **0.9883** | **0.4983** | **0.9728** | **0.4474** |

The Second Natural Gas Price (NGP2) is obtained with NBPP, NGOP, TTFP and GERNGP because the natural gas prices in Europe and America are important benchmarks. Also, the natural gas prices in Europe is used for forming the spot prices. So, the related prices used for the Factor Analysis and one factor is obtained as it can be seen from Table 6. Moreover, NGP2 obtained is used for the Impulse Responses and the Historical Decomposition Analysis.

**Table 7.** Factor Analysis of Fuel Oil 3.5% Sulphur, Brent oil, Fuel Oil %1 Sulphur, Gasoil, National Balancing Point, Henry Hub, TTF, LNG and Russian Natural Gas Border Price in Germany prices

| | FACTORS | | LOADINGS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FACTOR | VARIANCE | PROPORTION | FOHIGHP | BRENTP | FOLOWP | GASOILP | NBPP | NGOP | TTFP | LNGP | GERNGP |
| F1 | 4.1316 | 0.6058 | **0.9428** | **0.9307** | **0.9216** | **0.9293** | **0.4933** | 0.3510 | **0.5398** | -0.0272 | 0.0691 |
| F2 | 2.0968 | 0.3075 | -0.2687 | -0.2774 | -0.3104 | -0.2500 | **0.8554** | 0.3820 | **0.8109** | -0.0535 | **0.5007** |
| F3 | 0.5912 | 0.0867 | -0.0601 | 0.0523 | 0.0004 | 0.1180 | -0.0357 | -0.0317 | -0.1678 | **0.5630** | **0.4728** |

The Third Natural Gas Price (NGP3), the Fourth Natural Gas Price (NGP4) and the Fifth Natural Gas Price (NGP5) are obtained with FOHIGHP, BRENTP, FOLOWP, GASOILP, NBPP, NGOP, TTFP, LNGP and GERNGP because the different energy prices from the world intended to be used to form a Natural Gas Price with the worldwide energy commodities. The related prices are used for the Factor Analysis and three factors obtained as it can be seen from Table 7. The first factor named as NGP3 is consisted of FOHIGHP, BRENTP, FOLOWP, GASOILP, NGOP and TTFP. The second factor named as NGP4 is consisted of NBPP, TTFP and GERNGP. The third factor named as NGP5 is consisted of LNGP and GERNGP. Furthermore, NGP3, NGP4 and NGP5 obtained are used for the Impulse Responses and the Historical Decomposition Analysis of each price.

***Vector Autoregression Model and Near-Vector Autoregression Model***

Vector Autoregression (VAR) Model was originated in the study of Sims (1980) by characterizing an alternate to the commonly used econometric techniques during that period of time and moreover stated that VAR is a very useful instrument for analyzing patterns in economic or financial time series to forecast the future values, policy analysis, structural inference and it is superior compared to the model of single equation because the VAR Model lets dynamic relations amongst variables and the VAR Model has more analytical supremacy.

The VAR Model can be stated analytically as follows:

$$Y_t = A_0 + A_1 Y_t + \cdots + A_i Y_{t-i} + BZ_t + u_t \qquad \text{(where t = 1, …, N)} \qquad (1)$$

where $Y_t$ denotes an endogenous variables vector; $Z_t$ denotes an exogenous variables matrix; $A_i$ and B denote coefficient matrices that i denotes lag length; $u_t$ denotes zero-mean and constant variance for error terms. [See Hamilton (1994, p. 291 and 323) and Berument, Şahin and Togay (2010) for detailed explanation and applications of the VAR Model by considering its theoretical roots.] In a VAR Model, ordering the variables and considering their endogeneity properties are essential and Cholesky Ordering is widely benefitted for this purpose. Furthermore, in this paper, VAR Model with block exogeneity is used since in conventional VAR Model that dependent variables are affected by the related variables including lag values. This issue is resolved with the help of block exogeneity.

In this paper, to forecast the Natural Gas Contract Price of Turkey, a Near-Vector Autoregression (Near-VAR) Model is benefitted. Moreover, it is used for analyzing the effects of natural gas price on macroeconomic shocks. The Near-VAR Model runs an extension of standard VAR approach is employed because it does not enforce the same lag lengths in all the equations in the system. In other words, for letting the lag lengths differ across the equations, the Near-Var Model is used for estimation. The Near-VAR Model, which is analogous to the Structural Vector Autoregressive (SVAR) Model initially offered by Cushman and Zha (1997), is operated in this paper and it proposes the opportunity to integrate economic constraints which affect the parameter of lagged regressors and with this avoiding double-counting the effect of interaction effects between the variables when compared to Standard VAR Model introduced by Sims (1980). This issue turns out to be very critical if the model depends on data at different levels. In the Near-

VAR Model there are two blocks parted as an exogenous block whose variables may influence the other variables of the model and a second block of endogenous variables which do not enter the equations of the first block while in the Standard VAR Model all the estimated variables are endogenous and treated as functions of lagged values of all the endogenous variables.

According to Lütkepohl (2007), Ordinary Least Square (OLS) Method gives consistent estimates while operating a Near-VAR Model system. However, specific potential gain comes from Seemingly Unrelated Regressions (SUR) estimator proposed by Zellner (1962) and that is the purpose why SUR is used rather than OLS in this paper for two main reasons. The first is to achieve estimation effectiveness by integrating information on various equations or in other words the SUR system allows us to increase the efficiency during the phase of parameter estimation. And, the second one is to examine the constraints in various equations that parameters are included.

Cushman and Zha (1997)'s identified VAR model can be specified generally with an implicit representation of equation (1) as;

$$A(L)Y(t) = \mathrm{u}(t) \tag{2}$$

where in equation (2); $A(L)$ denotes a $n\ x\ n$ matrix polynomial by a given lag operator L; $Y(t)$ and $\mathrm{u}(t)$ are the $n\ x\ 1$ vectors of observations and structural disturbances respectively. Equation (3) given below shows the identification of the model with two variables.

$$Y(t) = \begin{bmatrix} Y_1(t) \\ Y_2(t) \end{bmatrix}, A(L) = \begin{bmatrix} A_{11}(L) & A_{21}(L) \\ A_{21}(L) & 0 \end{bmatrix}, \ \mathrm{u}(t) = \begin{bmatrix} \mathrm{u}_1(t) \\ \mathrm{u}_2(t) \end{bmatrix} \tag{3}$$

In the equation, it is assumed for j > 0 that u($t$) is uncorrelated with $Y(t-j)$ and the coefficient matrix $A(0)$ is non-singular. $A_{22}(L)$ represents the Block Exogeneity in the matrix that is zero. The dimensions of the matrices which for $A_{11}(L)\ is\ n_1\ x\ n_1$, $A_{21}(L)$ is $n_2\ x\ n_1$, $A_{22}(L)$ is $n_2\ x\ n_2$, $Y_1(t)$ is $n_1\ x\ 1$, $Y_2(t)$ is $n_2\ x\ 1$, $\mathrm{u}_1(t)$ is $n_1\ x\ 1$, $\mathrm{u}_2(t)$ is $n_2\ x\ 1$ and $n_1 + n_2 = n$ and indicate that $Y_1(t)$ is exogenous mutually for concurrent and lagged values to the second block. On behalf of estimating the Near-VAR Model's efficient parameters, the SUR Model is used, which is the generality of a model of linear regression consisting of numerous equations of regression those respectively with its specific dependent and unalike exogenous explanatory variables.

The variables for the Near-Var Model used in this paper are taken in order as Natural Gas Price (NGP), Basket of USD/TRY and EURO/TRY Exchange Rates (BASKET), CBRT Interest Rate (INTEREST), Industrial Production Index of Turkey (IP), Consumer Price Index of Turkey (CPI) and the constant variable as Brent oil price (BRENTM). For the model, number of lags is two, the number of iterations is 10,000 and the parameters of the model obtained with SUR Model.

***Historical Decomposition and Impulse Response Functions***

The Near-VAR Model is utilized to develop Historical Decompositions (HD) and Impulse Response Functions (IRF) to observe and interpret the related data in this paper. Even the HD Method is employed less frequently than IRF and Variance Decompositions which are all constructed on the model's moving average representation, the HD is an extensively explanatory output (Wheeler and Chowdhury, 1993). The main notion of the issue is that in the VAR Model all variables may be broken up fully into the impact of the different shocks and an exogenous component which is referred to as the baseline projection. In other words, the original time series at time t would be recovered when the contribution of all the shocks at any time t summed up together with the baseline projection. The HD is a contrary to fact where one examines how differently would variables have evolved if particular histories of shocks have instead occurred. See Burbidge and Harrison (1985) and Kilian (2009) for examples of prominent empirical applications using the HD as the primary tool to figure out the significance of specific shocks during certain historical periods. Moreover, Burbidge and Harrison (1985) and McMillin (1988)

indicate that the concern amongst the base projection and the actual data as that to what degree the shocks for a particular variable close the gap between the base projection and the actual data is a measure of the significance of this variable.

IRFs demonstrate the predictable response of each variable in the system to a shock at one of the variables in the system and used to establish the direction of the association between two variables. To guarantee enough degrees of freedom in small samples only the appropriate lags of the dependent variables in each equation have been kept, which is known as a Near-VAR Model. In this paper, Monte Carlo simulation is used for computing confidence bands or standard errors for impulse responses.

On behalf of constructing the orthogonal residuals for orthogonalizing the residuals in the Near-Var model for computing HDs and IRFs. It is required that Near-VAR Model's variables ought to be ordered in a certain fashion in the Cholesky Decomposition. Accordingly, when a higher ranked variable in the ordering varies then all lower ranked variables in the ordering are acquired to vary owing to residual correlation of cross-equation where the level of the variation depends on the level of the correlation of residual.

The Near-VAR Model's moving average demonstration may be given as following:

$$Y_t = \sum_{i=0}^{\infty} Z_i \, u_{t-i} \tag{4}$$

where $Y_t$ denotes a of endogenous variables vector; $u_{t-i}$ denotes a serially uncorrelated residuals vector alongside a diagonal covariance matrix; $Z_i$ denotes an impulse response weights matrix appropriate for $Y$ and $u$.

And the matrix $Z_i$ in equation (4) has the interpretation as:

$$Z_i = \frac{\partial Y_t}{\partial u'_{t-j}} \quad \text{or} \quad Z_i = \frac{\partial Y_{t+j}}{\partial u'_t}$$

For HD, the value of $Y$ in after $t$ period by considering a base period projection that operates from observation one to $t$ may be written as follows:

$$Y_{t+j} = \sum_{i=j}^{\infty} Z_i \, u_{t-j-i} + \sum_{i=0}^{j-1} Z_i \, u_{t+j-i} \tag{5}$$

The first part of the equation (5) that is $\sum_{i=j}^{\infty} Z_i \, u_{t-j-i}$ denotes the base projection or in other words forecast of $Y_{t+j}$ based upon shocks to the system's variables up to time t. The second part of the equation (5) that is denoted by $\sum_{i=0}^{j-1} Z_i \, u_{t+j-i}$ justifies the shocks after time $t$ and it is benefited to define that how much the gap amongst $Y_{t+j}$ and the first part is closed by the shocks to a specific variable. The significance of a variable is investigated by the degree to which residuals in this variable after $t$, close the gap amongst the actual series and base projection. HD technique is usually illustrated with graphs to visualize for observations of time series.

For IRF Analysis via using equation (4) for the moving average representation of the Near-VAR, IRF with the reaction of $Y_{it+j}$ to a one-time impulse in $Y_{t+j}$ ceteris paribus with all other variables dated t or earlier can be written as:

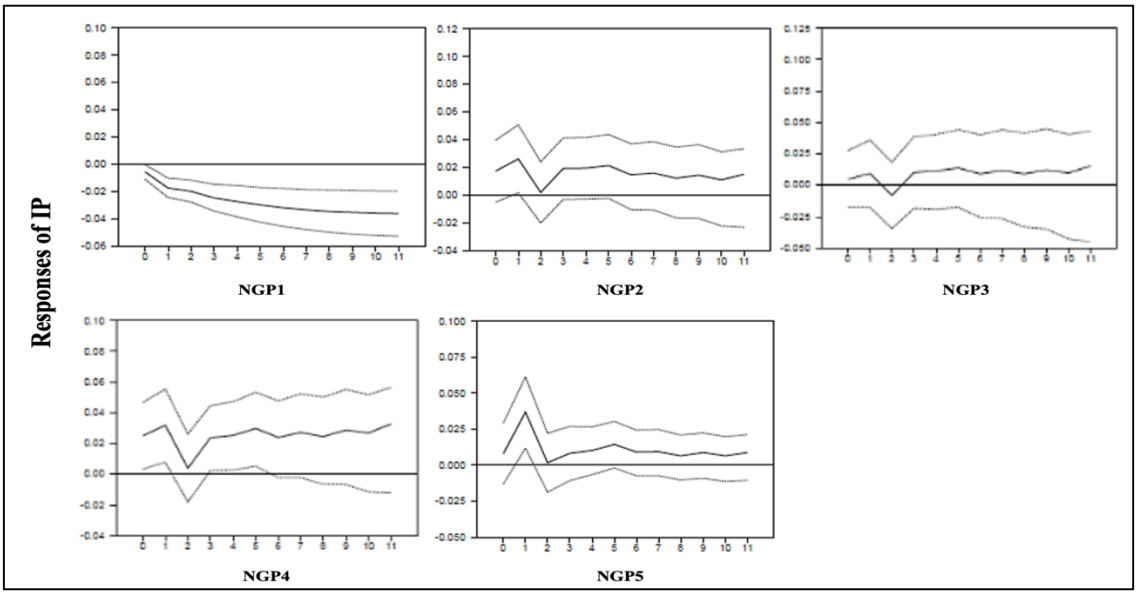
$$Y_{t+j} = \sum_{i=0}^{\infty} Z_i \, u_{t+j-i} \quad \text{so} \quad Z_{i,k} = \frac{\partial Y_{it+j}}{\partial u'_{kt}} \tag{6}$$

The reaction of variable $i$ to a unit shock or in other words forecast error in variable $k$ is sometimes represented graphically for developing a visual insight of the dynamic interrelation within the model as benefited in this paper. The estimation of parameters is executed with SUR Model.

The IRF and HD analysis of the study and the interpretations of the results are as follows:

Impulse Response Functions trace out the responses of the dependent variable in the VAR system to the shocks given. And the dependent variable is a function of its lagged values of other variables

in the model. In Figure 2, impulse and responses of NGP1, NGP2, NGP3, NGP4, NGP5 with respect to IP are illustrated. The solid line in the middle of the graphs shows the IRFs and the other dashed ones are the confidence intervals which of one standard deviation shock can be investigated. As it can be seen from the IP perspective, the NGP1 shock decreases the IP increasingly up to tenth period and then continues to decrease in a constant manner and all periods are statistically significant; the NGP2 shock increases the IP increasingly and then decreasingly around first period where it is statistically significant; it is statistically insignificant in all periods to the NGP3 shock; the NGP4 shock increases the IP increasingly and then decreasingly around first period and, also, increasing increasingly and then decreasingly between periods three and middle of five where it is statistically significant; the NGP5 shock increases the IP increasingly and then decreasingly between the middle of initial period and the middle of the first period where it is statistically significant [see Şahin (2020) for more details and the IRFs of other macroeconomic variables]. Furthermore, it can be interpreted from the economic perspective; the response of IP is meaningful as it decreases steadily with the increase in natural gas price as it can be seen in NGP1 shock.

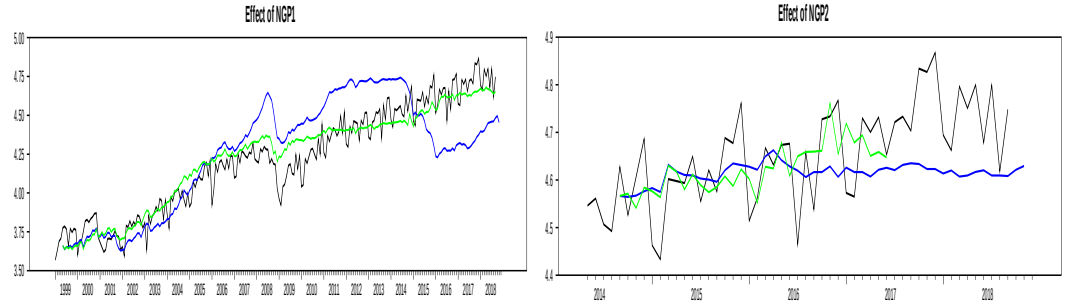



* WinRATS Software Package is used for generating the Impulse Responses. ** IRFs of all series are available upon request.

**Figure 2.** Response of Industrial Production to impulses of NGP1, NGP2, NGP3, NGP4, NGP5.

The color of the lines used in the HD graphs indicates that the black line is the actual data, the blue line is the base forecast, and the green line is the base forecast plus the effects of the shock. The gaps between the blue and green lines summed across all five series add up to the gap between the blue and black lines. The gaps between the lines can take either positive or negative sign.

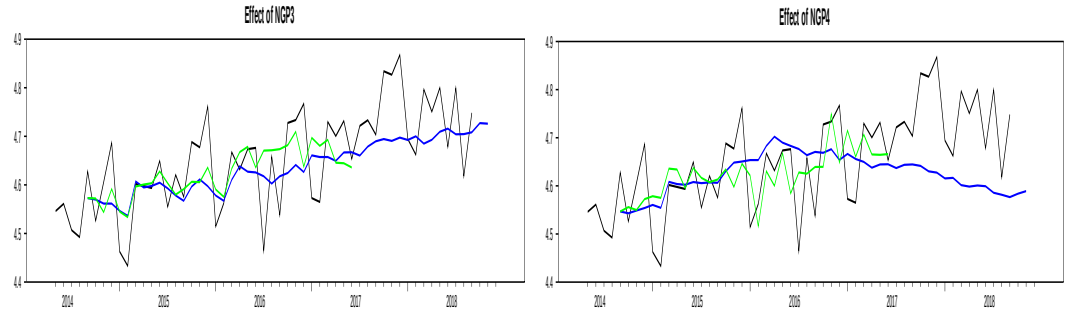
In Figure 3, the cumulative effects of past and current shocks of natural gas price especially on the IP are expressed by HD for examining the economic performance. It turns out to be necessary for constructing a HD of the effect of each of the shocks on the variable to comprehend the cumulative effect of such a series of shocks. It is depicted from the figures that the historical fluctuations between the actual IP data and the base forecast of IP solely caused by the effects of NGP, BASKET and IP itself. As it can be seen from Figure 3.a to 3.e. [see Şahin (2020) for more details and the HD of other macroeconomic variables]:




**a.** Historical decomposition of IP for NGP1

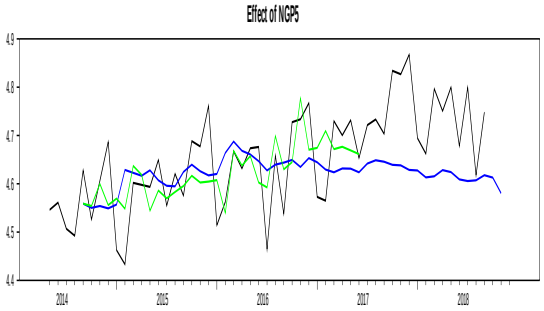



**b.** Historical Decomposition of IP for NGP2




**c.** Historical Decomposition of IP for NGP3

**d.** Historical Decomposition of IP for NGP4




**e.** Historical Decomposition IP for NGP5

*WinRATS Software Package is used for executing the Historical Decomposition analysis.
**HDs of all series are available upon request.

**Figure 3.** Historical Decomposition of Industrial Production for the Fifth Natural Gas Contract Price

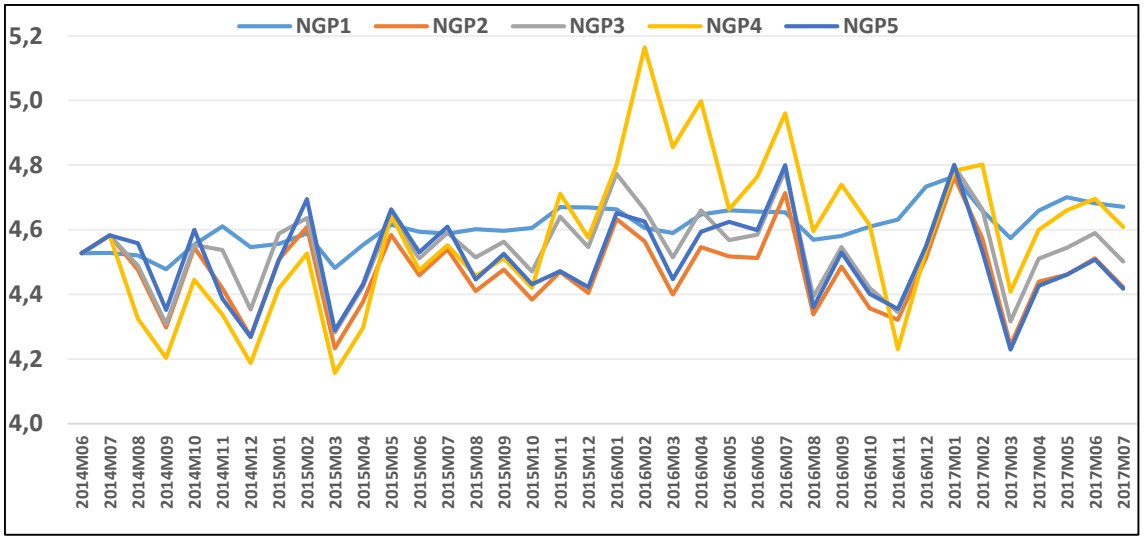
a. for NGP1, the gap in gas price is more noticeable after 2006 and especially in the period between 2006-2015 natural gas price contribution increases IP while after 2015 it decreases

b. for NGP2, the gap in gas price is more noticeable after the first quarter of 2015 and the natural gas price contribution to the IP is stable for all periods

c. for NGP3, the gap in gas price is more noticeable after the last quarter of 2015 and the natural gas price contribution to the IP is slightly increasing for all periods.

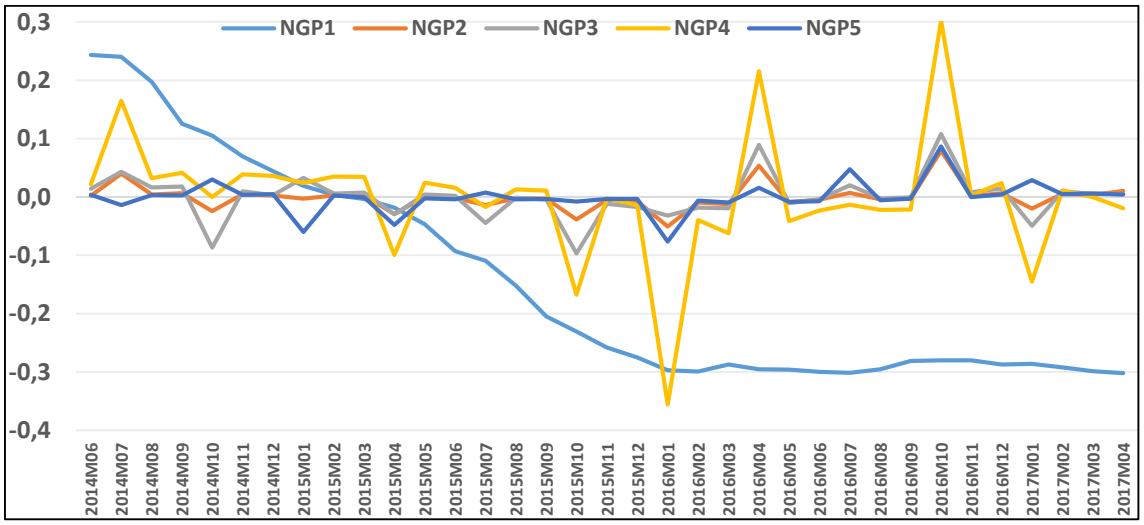
d. for NGP4, the gap in gas price is more noticeable after the last quarter of 2015 and the natural gas price contribution to the IP is stable for all the periods.

e. for NGP5, the gap in gas price is more noticeable after the second quarter of 2014 and the natural gas price contribution to the IP is stable for all the periods




*WinRATS Software Package is used for executing the Historical Decomposition analysis.

**Figure 4.** Effects of actual alternative natural gas contract prices on IP




*WinRATS Software Package is used for executing the Historical Decomposition analysis.

**Figure 5.** Effects of modelled alternative natural gas contract prices on IP

Finally, Figure 4 states the effects of present and the other four alternative Natural Gas Contracts with actual prices on IP while Figure 5 states the effects of present and the other alternative four Natural Gas Contracts with forecasted prices on IP within the model benefitting the data attained by HD analysis. The actual and alternative prices are benefitted to give a price shock for especially analyzing the effect on Industrial Production Index of Turkey and we compare the results. These two pairs of tables and figures give us an opportunity to compare the investigated situations.

It can be seen from Figure 4 that when compared to the other four Alternative Natural Gas Contract Prices, the actual price formula NGP1 is the most preferred one because it is the least volatile and it starts and ends above. NGP4 is the most volatile one and NGP5 is the least preferred one among alternatives. Also, it can be seen from Figure 5 that the fitted values of the actual Natural Gas Contract Price NGP1 is not so impressive. The model suggests NGP2 the most because it has low volatility and it is above the actual one. Also, NGP5 seems impressive compared the others except NGP2. The least preferred one is NGP4 because it is the most volatile

and lowest one compared to the others even it is better than the actual contract.

## 6. Conclusion and Recommendations

In this paper, it was intended to capture a better relationship between the chosen macroeconomic variables and natural gas prices via the long-term natural gas contracts of Turkey with the help of several econometric techniques, due to the upcoming expiry dates for some of the long-term natural gas contracts that Turkey signed before. Especially, the long-term contracts between Turkey and Russia are taken as a basis and examined for the model because Turkey mostly imports natural gas as well as crude oil and products from Russia, and the nearest long-term natural gas contract expiry date is the one with them. The main underlying cause of such a study is based on Turkey's need of ensuring energy supply security for its ever-growing population and economy as well as accessing clean and cheaper energy sources like natural gas, as a net energy importer country via alternative long-term natural gas contracts more suitable for both sides. Also, the subject is examined with remembering the perspective that "*Pipelines can, in a way, be a tool to build relationships between countries.*" (Karbuz, 2016, p. 66).

The long-term contract details and formulas are mostly a commercial secret between the agreed companies and countries. And based on this fact, we examined the concept and history of energy and natural gas, natural gas markets both in Turkey and in the world, natural gas pricing and contracting methods, and long-term oil-indexed natural gas contracts of Turkey. According to the literature review conducted to get information about the subject and find the missing parts by reviewing academic studies in a historical manner [See Şahin (2020) for more details)], there are considerable amount of literature and different approaches about natural gas pricing in the world, but the empirical results haven't reached a consensus. Additionally, it is realized that in Turkey there are not many studies conducted about the topic, especially in a quantitively manner. As the core result of the literature review, it was noticed that there was a missing gap among studies about pricing and long-term contracting in Turkey's natural gas market especially from the quantitative perspective.

Exclusively with the help of the Historical Decomposition method, the missing part about the quantitative examination of long-term natural gas contracts of Turkey was attempted to be executed by applying several econometric techniques. These econometric techniques implemented in three different scenarios and, besides, five different natural gas price formulas are offered for Turkey's long-term natural gas contracts to be discussed in detail. The scenarios are based on concerning different energy commodities and different regional benchmarks. The first scenario is by using the current pricing formula according to the information obtained from the authorities, the second scenario is an alternative one by using natural gas prices in Europe and America as important benchmarks, the third scenario is by using the different energy prices from the world to form a natural gas price via the contribution of worldwide energy commodities. As a result, we have figured out a slightly better alternative formula compared to the actual one which results in a greater boost on Turkey's industrial production. This alternative formula was based on the second scenario and called NGP2 which is less volatile and results in higher industrial production for Turkey. Although one of the alternatively generated formulas performed better, in terms of industrial production as a result of this study, the investigation of alternative recommendations should be further expanded with the variables such as renewable energy sources, coal, nuclear energy, spot hub natural gas prices, political and geopolitical factors that were included in the pricing formula by considering the effects on many more macroeconomic variables or vice versa.

Moreover, one of the worthwhile issues is whether Turkey could find a better alternative due to Turkey's unique political, geopolitical, geological, and economic rationales. Even the subjects like Turkey's dependency on Russian natural gas and price of this imported Russian natural gas have often been highly discussed, they should be examined more thoroughly with these facts. The authorities and academics should investigate the rationales and concrete criteria behind why

Turkey's natural gas import price is claimed to be high and, even if this is true, how this issue would be resolved with down to earth studies and practical recommendations. Additionally, Turkey, as a country, that can be considered inadequate in terms of energy resources, should be supported by realistic proposals to reduce dependency on energy imports. It is necessary to present and implement long-term projections that will be put forward with the relevant steps by accepting and reading the facts rather than delusions. For the time being, Russia seems to be the rational option in terms of natural gas imports due to the special circumstances of our country. When the conjunctures of other alternative countries are examined, the natural gas capacity that Azerbaijan can offer to Turkey is enough to meet a small portion of the country's needs. Turkmenistan has made over-commitments to many other countries which most of them cannot be fulfilled. Iran has been struggling in keeping its supply and export commitments with limited natural gas upstream development capacity due to long-lasting international sanctions that prevent them to increase output and export capacities. Although it is too far from meeting the vast demand for natural gas that cannot be met by other domestic resources, it is also seen that LNG import is the only alternative for the imported natural gas transported by the pipelines which are the subject of intense long-term contracts. However, LNG is not a commodity itself but a logistic option for the transmission of natural gas so it cannot be a direct competitor for natural gas alone. The most important factor in LNG trade is the transportation costs and the resulting price competition so it is not only about the total supply of LNG globally, but also Turkey's long-term demand and price competition against other large LNG buyers. Besides, Turkey cannot replace the amount of pipelined natural gas due to the lack of LNG term contracts, storage capacity, transmission methods, and geographical factors.

During the study, current petroleum products used in the existing contracts have been observed not to meet the current demand structure of Turkey. High sulfur fuel oil, low sulfur fuel oil, and gasoil are not direct substitutes for natural gas in Turkey anymore. This essentially creates a problem for the products used in the oil product indexed natural gas pricing mechanism for Turkey's imported pipeline natural gas. With the existing price methodology, one might also challenge that the demand pattern of the petroleum products used in the formula has been diverging from the demand pattern of Turkey's natural gas market. This contradicts the basic assumption of the oil price indexed pricing formula which is expected to provide a reasonable ground for Turkey to prefer pipeline natural gas rather than other energy sources to meet its demands while the cost of imported natural gas will not bring additional budget pressure. However, according to our observations, the unparalleled connection between Turkey's natural gas market and the products used in the price formula creates another problem for Turkey's energy import requirements.

Based on today's realities, despite the challenges behind Turkey's LNG import strategy, the only reliable substitute against Russian pipelined natural gas is imported LNG. Hence, one strategy that Turkey can follow is to force Russian counterparts to add spot LNG prices in the long-term pipelined natural gas pricing formula. This new price index might help Turkey to have a more realistic price for its imported pipelined natural gas that reflects the market trend of its direct substitute. In this way, Turkey might also dilute seeking alternative sources against Russian natural gas which can be a mutual benefit both for Turkey and Russia. It is important to mention that as Russia's second-biggest natural gas customer, Turkey has a vital role in Russia's overall energy export policy so this can be used as a useful tool by Turkey.

For the last words, as a result, it has been observed that the best solution for the long-term natural gas contracts of Turkey with other countries, which includes a total contract volume of natural gas those will expire about 15 Bcm in 2021 and 50 Bcm by 2020s and the ones which will expire, later on, is to remake new long-term natural gas agreements under mutually better conditions for the sake of energy security and to establish long-term cooperation for the future of each counterparty. Furthermore, Turkey should make an effort for being a natural gas hub instead of

just a corridor in the region and bravely take the necessary steps to become a player with significant influence in the world natural gas market.

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***Araştırma Makalesi***

# Long-Term Natural Gas Contracts and Economic Performance: A Historical Decomposition Analysis for Turkey

*Uzun Vadeli Doğalgaz Sözleşmeleri ve Ekonomik Performans: Türkiye için Bir Tarihsel Ayrıştırma Analizi*


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## Genişletilmiş Özet


Bu çalışmada, Türkiye'nin daha önce imzaladığı uzun vadeli doğalgaz sözleşmelerinden bazılarının yakın zamanda vadelerinin dolacak olması nedeniyle, belirlenen makroekonomik değişkenler ile doğalgaz fiyatları arasında daha iyi bir ilişki yakalanması amaçlanmıştır. Türkiye'nin ham petrol ve petrol ürünleri ile doğal gaz ithalatını çoğunlukla Rusya'dan gerçekleştirmesi ve ayrıca en yakın uzun vadeli doğal gaz sözleşmesi bitiş tarihinin Rusya ile olması nedeniyle özellikle Türkiye ile Rusya arasındaki uzun vadeli sözleşmeler esas alınarak inceleme yapılmıştır. Böyle bir çalışmanın temel nedeni, Türkiye'nin sürekli artan nüfusu ve büyüyen ekonomisi için enerji arz güvenliğini sağlama ihtiyacının yanı sıra her iki taraf için daha uygun alternatif uzun vadeli doğalgaz sözleşmeleri ile net enerji ithalatçısı bir ülke olarak doğal gaz gibi temiz ve daha ucuz enerji kaynaklarına erişme ihtiyacına dayanmaktadır. Özetle, bu çalışma girişin ötesinde girişin ötesinde beş bölüm üzerine inşa edilmiş ve şu sırayla düzenlenmiştir: Doğal gaz piyasaları, fiyatlandırması ve sözleşmeleri; Türkiye doğal gaz piyasası ve uzun vadeli doğal gaz sözleşmeleri; literatür taraması; metodoloji ve ampirik bulgular; sonuç ve öneriler.

Doğal gaz ticareti süreç olarak basit bir ticari faaliyet olarak değerlendirilmemelidir. Ve bu gerçek, Türkiye Doğal gaz Piyasası açısından hangi alternatiflerin daha faydalı olacağının belirlenebilmesi adına daha detaylı ve kapsamlı araştırmaların gerçekleştirilmesi zorunluluğunu ortaya çıkartmaktadır. Konuya değin literatürde yapılan ön araştırmaya göre, bu çalışmanın arkasındaki temel dayanak; uzun vadeli petrol ürünlerine endeksli doğalgaz sözleşmeleri, doğalgaz fiyatlandırma formülü ve bunların Türkiye'nin ekonomisi ile birlikte enerji güvenliği üzerindeki etkileri hakkında analitik olarak sınırlı sayıda ampirik çalışmanın bulunduğunun gözlenmiş olmasıdır. Sözleşme, kıyaslama, fiyatlandırma ve diğer ilgili konulardaki çalışmaların çoğunlukla uluslararası ilişkiler bağlamında ve daha da ötesinde nitel politikalar doğrultusunda yürütüldüğü görülmektedir. Bu çalışma, Türkiye'nin yaklaşmakta olan uzun dönemli doğal gaz sözleşmeleri müzakereleri açısından koşullarını analitik ve ampirik olarak ortaya koymayı amaçlamaktadır. Ayrıca, politika yapıcı mercilerin, ilgili sorunun ekonomik açıdan somut gerekçelerine dayalı olarak çözümlemeye dair ortaya koyacakları hükümlere ve düzenlemelere

katkıda bulunmak açısından bir bakış açısı elde etmelerine yardımcı olunması planlanmıştır. Near-VAR Model'inden faydalanılmasıyla birlikte kullanılan Tarihsel Ayrıştırma Yönteminin çeşitli kaynaklardan derlenen Türkiye piyasası verilerine uygulanması sonucu elde edilen analitik ve ampirik bulgular, bu makalenin ekonomi literatürüne en yenilikçi katkısı olarak görülmektedir. Ayrıca bu çalışmada, enerji faturası yüksek bir ülke olan Türkiye'nin doğal gaz tedarikçileriyle yeniden müzakere edeceği ilgili sözleşmelerde irdelenen etkenlerden yararlanıp yararlanamayacağının ve Türkiye'nin pazarlık açısından elini güçlendirmek için sözleşme sistemini kaynak ülkeye karşı herhangi bir yükümlülük altında bırakılmadan nasıl geliştirebileceğinin araştırılması ve bunun yanında alternatif bir çözüm bulunması amaçlanmıştır.

Gerçekleştirilen ampirik analizlerde, nominal enerji fiyatları ve makroekonomik değişkenler için elde edilen zaman serisi verilerinden yararlanılmıştır. Bu çalışmada kullanılan enerji emtiaları değişkenleri "%3,5 Kükürtlü Fuel Oil Fiyatı, Brent Petrol Fiyatı, %1 Kükürtlü Fuel Oil Fiyatı, Mazot Fiyatı, National Balancing Point Fiyatı, Henry Hub Fiyatı, TTF Fiyatı, LNG Fiyatı, Türkiye LNG Fiyatı, Almanya'daki Rus Doğal Gazı Sınır Fiyatı" olarak belirlenmiştir. Bu değişkenler belirlenirken, öncelikle doğal gaz ithalatçısı ve ihracatçısı ülkeler arasındaki doğal gaz sözleşme fiyatlarını etkileyebilecek birçok değişken incelenmiştir ve Türkiye ile Dünya'da kullanılan güncel doğalgaz sözleşme formülleri dikkate alınmıştır. Ayrıca, Türkiye'nin diğer ülkelerle doğalgaz sözleşmelerini müzakere ederken izlemesi gereken yol ve önümüzdeki dönem için alternatif fiyatlandırma formüllerinin önerilmesi amaçlanmaktadır. Mevcut sözleşme formülü ile önerilen alternatif sözleşme formülleri arasında bir karşılaştırma yapılarak buna göre bir öneri sunulmuştur. Bu nedenle, analizde kullanılan enerji emtia değişkenleri, Avrupa ve Dünya'da fiyatlandırmayı etkileyecek belirleyici değişkenler olan mevcut sözleşmeden seçilmiştir. Ayrıca Türkiye'de üretim ve doğal gaz fiyatları arasındaki ilişki incelenerek alternatif doğal gaz fiyatlandırma formülasyonu ortaya koyulmuştur. Bunun yanında "Türkiye Sanayi Üretim Endeksi, Türkiye Tüketici Fiyat Endeksi, ABD Doları / TL Döviz Kuru, EURO / TL Döviz Kuru, TCMB Faiz Oranı" olarak ifade edilebilecek ilgili makroekonomik değişkenler modele etki eden diğer faktörler olarak analize dahil edilmiştir. Çalışmada, değişken ve veri tespiti hakkında bilgi verilmiştir ve ayrıca çalışmanın metodolojisi ile birlikte kullanılan ekonometrik tekniklerden (Birim Kök ve Durağanlık Testleri, Faktör Analizi, Near-VAR Modeli, Tarihsel Ayrıştırma ve Etki Tepki Fonksiyonları) elde edilen ampirik sonuçlar detaylı olarak sunulmuştur. Ayrıca Türkiye için önerilen alternatif uzun vadeli petrole endeksli doğalgaz sözleşmelerine ilişkin ampirik çalışmanın bulguları ve çalışmadan elde edilen sonuçlar değerlendirilmiştir.

Çalışmada, özellikle Near-VAR Modelinden yararlanılarak uygulanan Tarihsel Ayrıştırma yöntemi ve metodoloji bölümünde açıklanan diğer ekonometrik teknikler yardımıyla Türkiye'nin uzun vadeli doğalgaz sözleşmelerinin kantitatif olarak incelenmesine ilişkin eksik kısmın tamamlanmasına katkıda bulunulması amaçlanmıştır. Belirlenen üç farklı senaryo üzerinde uygulanan bu ekonometrik teknikler ile modellenen beş farklı doğalgaz fiyat formülü, Türkiye'nin uzun vadeli doğalgaz sözleşmeleri açısından ayrıntılı olarak ele alınmıştır. İlgili senaryolar, farklı enerji ürünleri ve farklı bölgesel karşılaştırma ölçütlerine dayanmaktadır. İlk senaryo yetkililerden elde edilen bilgiler dahilinde mevcut fiyatlandırma formülü temel alınarak; ikinci senaryo önemli kıyaslama ölçütleri olan Avrupa ve Amerika'daki doğalgaz fiyatlarını kullanarak oluşturulan alternatif bir fiyatlandırma formülü olarak; üçüncü senaryo ise dünya çapındaki farklı enerji kaynaklarının katkısıyla oluşturulacak bir doğal gaz fiyatlandırma formülü şeklinde ortaya konmuştur. Sonuç olarak çalışmada, Türkiye'nin sanayi üretimi açısından daha olumlu olarak sonuçlanan ve mevcutta olana kıyasla daha iyi şartlarda bir alternatif formül ortaya konmuştur. İkinci senaryo temel alınarak elde edilen bu alternatif formül ile elde edilen daha az dalgalı ve Türkiye ekonomisi için daha yüksek sanayi üretimi sağlayan doğal gaz fiyatı, NGP2 olarak adlandırılmıştır.

Ayrıca çalışma ile birlikte mevcut sözleşmelerde kullanılan halihazırdaki petrol ürünlerinin, Türkiye'nin mevcut talep yapısını karşılamadığı görülmüştür. Türkiye'de artık yüksek kükürtlü fuel oil, düşük kükürtlü fuel oil ve mazot doğal gazın doğrudan ikâmesi değildir. Bu da esas olarak

Türkiye'nin ithal boru hattı doğalgazına yönelik petrol ürünlerine endeksli doğalgaz fiyatlandırma mekanizmasında kullanılan ürünler için sorun yaratmaktadır. Mevcut fiyat metodolojisi ile birlikte formülde kullanılan petrol ürünlerinin talep modelinin Türkiye doğalgaz piyasasındaki talep modelinden farklılaştığı da sorgulanabilir. Bu durum, Türkiye'nin taleplerini karşılamak için diğer enerji kaynaklarından ziyade bütçe açısından ek bir maliyet baskısı söz konusu olmaksızın ithal boru hattı doğal gazını tercih etmesine makul bir zemin sunması beklenen petrole endeksli fiyatlandırma formülünün temel varsayımıyla çelişmektedir. Ancak gözlemlerimize dayalı olarak, Türkiye doğalgaz piyasası ile fiyat formülünde kullanılan ürünler arasındaki paralellik göstermeyen bağlantı yapısı, Türkiye'nin enerji ithalatı ihtiyacı için ayrı bir sorun teşkil etmektedir.

Son söz olarak, Türkiye'nin 2020'li yıllarda vadesi dolacak olan yaklaşık olarak 50 Bcm hacminde veya daha sonrasında sona erecek olanlar da dahil olmak üzere diğer ülkelerle imzaladığı uzun vadeli doğalgaz sözleşmeleri için en iyi çözümün enerji güvenliği adına karşılıklı olarak daha iyi koşullarda yeni uzun vadeli doğal gaz anlaşmaların yapılması ve tarafların geleceği için uzun vadeli iş birlikleri kurulması olduğu görülmüştür. Ayrıca Türkiye, bölgede sadece bir koridor olmak yerine doğalgaz merkezi olma çabası içinde olmalıdır ve Dünya doğal gaz piyasasında önemli etkiye sahip bir ülke haline gelebilmek için gerekli adımları cesurca atmalıdır.