AN ANALYSIS OF SOLID FUEL BASED ON 2016 AND 2017 DATA WITH DIFFERENT TECHNIQUES

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Abstract: Purpose: In this applied study, solid fuel data belonging to the years of 2016 - 2017 and published by TURKSTAT have been explained with different analysis methods. First, a theoretical infrastructure has been formed with the scientific papers prepared and published under various topics in terms of content. Scope: Data belonging to the years of 2016 and 2017 published by TURKSTAT constitute the scope of the research. These data have been adopted and arranged for the analysis. Data Analysis: Panel data analysis has been used in this research and data obtained have been processed in E-Views 8.0 program. As a result of the Unit Root, Granger causality, Cointegration, Covariance and Regression analysis performed, the existence of a relation between the solid fuel factors, its direction and how they affect each other have been researched. Conclusion: The variables of solid fuel contain unit root. There is a causality relation between the variables of Export and Production, Production and Delivery, Import and Export, Export and Delivery. While a negative relation is observed between import and production, there is a positive relation between export and production. On the other hand, there is a negative relation between delivery and production while the variables of solid fuel are stable. When the production increases by one unit, import increases by 28 units, export increases by 0.06 unit and deliveries increase by 27 units.

Key Words: Solid Fuel, Production, Variable, Comparison, Causality

Doi: 10.17364/IIB.2018.29.2

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INTRODUCTION

The need for energy has directly increased due to the emergence of needs after the first appearance of humanity and to the jump into production process later. The energy that has gained importance for such basic needs as lighting, heating and cooking at first has transformed into a strategic product following the industrialization. Both population increase and the variation in goods and services have increased the interest and demand for energy and energy sources. For this reason, it has become an obligation in order to meet these needs and to use different resources with the purpose of continuing the production without interruption. Natural resources wealth of a country is vital for its competition with the world countries (Kalyoncu, 2016: 101-124). Energy is one of the most important needs of humanity (Adaçay, 2014: 87-103). Effective use of resources indicates the social and economic development level of that country (Yılmaz, 2012: 33-54). The need for the energy used in production increases day by day (Esen and Bayrak, 2015: 45-61). The relation between the demand for energy produced from solid fuel and the demand for renewable energy is a remarkable factor. Concerning the countries being interested in renewable energy today, it is observed that these are the developed countries having a say in the field of industry (Soydal, Mızrak and Çetinkaya, 2012: 117-137). For this reason, the economic benefit obtained after meeting this need for energy and the realization of production for this demand is considerable (Bülbül and Çokluk, 2017: 89-114). It is clearly observed that the world countries managing their energy sources well have superiority compared to different world countries (Tezcan, 2014: 119-135). Turkey has a significant place in terms of underground sources compared to world countries. Zonguldak coal basin with a million tone volume of hard coal is an important place for Turkey. Manisa, Kütahya, Tavşanlı, Tunçbilek, Amasya, Erzurum, Çeltek and Değirmisaz regions have also significant places in terms of different underground mines. Kahramanmaraş and Muğla are also important for the lignite reserves. ¹Looking at the importance of solid fuel in terms of world countries and the economy, it is concluded that many studies have been conducted in this field. These are as follows;

The demand for increasing energy due to the technological developments and the accompanying needs is showing an increase each day (Adaçay, 2014: 87-103).

Energy economy has a vital importance in terms of input resources of country/countries. The world countries leading the energy

¹ http://www.sosyal-bilgiler.com/ders-notlari-dizini/1267-turkiyede-cikarilan-madenler-veralti-zenginlikleri.html
economy have an important strategy (Altay and Nugay, 2013: 1-35).

Energy policy is on the agenda of many world countries. It increases the importance of the countries producing energy-based policy from the eyes of various world countries each passing day (Anlar, 2017: 59-88).

Energy is considered to be a security problem by the developed world countries. It is thought that the countries possessing the power of energy may pose a threat in the future (Atabey and Gürdoğan, 2015: 56-63).

When addressed in terms of the modern world and inter-governmental relation, energy policies shape and manage the relations of world countries with each other. This contributes to the achievement of a strategic superiority for the world countries holding the power of energy (Chase-Dunn and Grimes, 1995: 387-417).

When we look at today’s Asian societies and especially Arab countries, it is clear that many different problems arise due to energy policies and that some developed global forces produce different scenarios in order to have a say in these energy policies (TMMOB, 2012: 1-584).

Another point is that world countries have now turned their faces towards renewable energy from the solid fuel consumption. Since the air pollution caused by the solid fuel leads to many different problems. What about the end or the beginning of this sentence? Health issues are one of these problems. The budgets allocated by the national economies to the health problems that arise depending on the air pollution are in a great dimension. Thus, the efforts for the use of renewable energy sustain at full speed. 2

According to a research conducted by Turkish Thoracic Society, the results of a presentation made in the “Woman and Lungs” health symposium in Northern Anatolia Region have pointed out that 4.3 million people die because of “BIOMASS” fuel type and smoke every year all over the world. 3

Looking at the TURKSTAT’s data on solid fuel belonging to 2017 September, it is observed that “the amount of hard coal is 74 thousand 354 tons, lignite is 4 million 677 thousand 764 tons and smell of hard coal is 359 thousand 665 tons in terms of production amount and regarding the delivery amounts; hard coal is 3 million 317 thousand 641 tons, lignite is 4 million 520 thousand 841 tons and smell of hard coal is 437 thousand 931 tons” 4.

2 http://www.ekoyapidergisi.org/1578-cagimiz-yenilenebilir-enerjiye-degil-100-yenilenebilir-enerjiye-gecis-cagidir.html
3 http://www.hurriyet.com.tr/dunyada-4-3-milyon-kisi-biomas-nedeniyle-ol-40807357
4 http://www.tuik.gov.tr/PreHaberBultenleri.do?id=24621
Turkey has a significant position in terms of lignite coal production and delivery. The production is delivered to the thermal power plants and they have a major effect in transforming the energy into the production. Looking at the production and delivery rates of 2017 September, it is observed that “concerning the distribution of solid fuel by the place of delivery; 48.5% of hard coal is delivered to thermal power plants, 11.7% to coke plants, 6.3% to the industry apart from iron and steel while 83.5% of lignite is delivered to thermal power plants, 11.4% to the industry apart from iron and steel. 93.4% of hard coal coke is delivered to iron and steel industry”

RESEARCH HYPOTHESES

H1: Solid fuel variables contain unit root.
H2: There is no causality among the solid fuel variables.
H3: There is no similarity among the averages of solid fuel variables.
H4: Solid fuel variables are static.
H5: There is no relation between import and production.
H6: There is no relation between export and production.
H7: There is no relation between delivery and production.

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5 http://www.tuik.gov.tr/PreHaberBultenleri.do?id=24621
IMPLEMENTATIONS and ANALYSES

Table 1. Definitions of the Variables

| Variable | Definition                      |
|----------|---------------------------------|
| PROD     | Marketable production value    |
| IMP      | Import value                    |
| EXPO     | Export value                    |
| DEL      | Delivery value                  |

BASIC INDICATORS ANALYSIS

Table 2. Basic Indicators

|          | PROD      | IMP        | EXPO       | DEL        |
|----------|-----------|------------|------------|------------|
| Mean     | 107435.5  | 2979670.   | 6670.542   | 3039278.   |
| Median   | 110120.0  | 3027453.   | 7072.000   | 3074240.   |
| Maximum  | 144368.0  | 4158996.   | 15510.00   | 3983638.   |
| Minimum  | 74354.00  | 1919126.   | 389.000    | 2111134.   |
| Std. Dev. | 19022.06 | 559072.4   | 5217.534   | 527456.8   |
| Skewness | 0.133891  | 0.076919   | 0.223293   | 0.020481   |
| Kurtosis | 2.173135  | 2.549024   | 1.651720   | 2.053488   |
| Jarque-Bera | 0.755413 | 0.227046   | 2.017299   | 0.897562   |
| Probability | 0.685432 | 0.892684   | 0.364711   | 0.638406   |
| Sum      | 2578451.  | 71512080   | 160093.0   | 72942661   |
| SumSq. Dev. | 8.32E+09 | 7.19E+12   | 6.26E+08   | 6.40E+12   |
| Observations | 24       | 24         | 24         | 24         |

UNIT ROOT ANALYSIS

H1: Solid fuel variables contain unit root.

According to the unit root tests performed, it has been understood that the main hypothesis can be accepted due to the value of the probability higher than the confidence
The result of the unit root test commonly performed for the variables is negative; therefore, the use of these variables in future analyses will not cause any deviation. Solid fuel variables do not contain unit root.

### Table 3. Solid Fuel Variables Unit Root Analysis

| Method                          | Statistic | Prob.** | Sections | Obs |
|-------------------------------|-----------|---------|----------|-----|
| Levin, Lin & Chu t*           | -2.82531  | 0.0024  | 4        | 92  |
| Im, Pesaran and Shin W-stat   | -3.45052  | 0.0003  | 4        | 92  |
| ADF - Fisher Chi-square       | 26.6768   | 0.0008  | 4        | 92  |
| PP - Fisher Chi-square        | 27.6490   | 0.0005  | 4        | 92  |

** Probabilities for Fisher tests are computed using an asymptotic Chi-squared distribution. All other tests assume asymptotic normality.

**GRANGER CAUSALITY TEST**

- **H0**: There is no causality among the solid fuel variables.

When the causality relations between the variables are analyzed, it has been determined that some probability values are lower than 0.05 and H0 hypothesis should be rejected. For this reason, a causality relation will be sought among these variables.

- There is not a causality relation between Export and Production variables.
- There is a causality relation between Production and Delivery variables.
- There is not a causality relation between Export and Import variables.

Table 4. Solid Fuel Variables Causality Analysis

| NullHypothesis                  | Obs | F-Statistic | Prob. |
|---------------------------------|-----|-------------|-------|
| IMP does not GrangerCause PROD | 22  | 0.0086      | 0.0014|
| PROD does not GrangerCause IMP |     | 2.5508      | 0.1074|
| EXPO does not GrangerCause PROD| 22  | 0.0122      | 0.9878|
| PROD does not GrangerCause EXPO|     | 1.6391      | 0.2234|
| DEL does not GrangerCause PROD | 22  | 0.2220      | 0.8031|
| PROD does not GrangerCause DEL |     | 0.8535      | 0.0034|
| EXPO does not GrangerCause IMP | 22  | 0.3388      | 0.7173|
| IMP does not GrangerCause EXPO |     | 0.3470      | 0.0017|
| DEL does not GrangerCause IMP  | 22  | 8.2032      | 0.0032|
| IMP does not GrangerCause DEL  |     | 2.1739      | 0.1443|
| DEL does not GrangerCause EXPO | 22  | 2.1697      | 0.1448|
| EXPO does not GrangerCause DEL |     | 0.8821      | 0.0020|
COVARIANCE ANALYSIS

H3: There is no similarity among the averages of solid fuel variables.

Concerning the covariance relations among the variables, below relation has been established among them.

- There is a negative relation between import and production.
- There is a positive relation between export and production.
- There is a negative relation between delivery and production.

Table 5. Covariance Analysis

|     | PROD  | IMP    | EXPO   | DEL     |
|-----|-------|--------|--------|---------|
| PROD| 1.000000 |       |        |         |
| IMP | -0.076227 | 1.000000 |       |         |
| EXPO| 0.291496 | 0.048917 | 1.000000 |         |
| DEL | -0.171981 | 0.683306 | 0.020530 | 1.000000 |

COINTEGRATION ANALYSIS

H4: Solid fuel variables are static.

When the stationary analysis is performed for solid fuel variables, the results obtained are as follows. Analyzing the probability values in the analysis, it is observed that all probability values are higher than the 0.05 threshold value and the hypothesis should be accepted. Accordingly, solid fuel variables are static.
### Table 6. Cointegration Analysis

Sample: 2016M01 2017M12  
Included observations: 24  
Null hypothesis: Series are not cointegrated  
Cointegrating equation deterministics: C  
Automatic lag specification based on Schwarz criterion (maxlag=4)

| Dependent | tau-statistic | Prob.* | z-statistic | Prob.* |
|-----------|---------------|---------|-------------|---------|
| PROD      | -3.411612     | 0.2961  | -16.09037   | 0.2655  |
| IMP       | -1.602429     | 0.9490  | -12.39821   | 0.4907  |
| EXPO      | -4.448151     | 0.0653  | -22.08046   | 0.0503  |
| DEL       | -3.137877     | 0.4041  | -14.21035   | 0.3861  |

*MacKinnon (1996) p-values.  
Warning: p-values may not be accurate for fewer than 25 observations.

### Intermediate Results

|           | PROD    | IMP    | EXPO   | DEL    |
|-----------|---------|--------|--------|--------|
| Rho - 1   | -0.699581 | -1.094212 | -0.960020 | -0.617841 |
| Rho S.E.  | 0.205059  | 0.682846 | 0.215825 | 0.196898 |
| Residual variance | 2.84E+08 | 1.10E+11 | 24000713 | 1.28E+11 |
| Long-run residual variance | 2.84E+08 | 3.53E+10 | 24000713 | 1.28E+11 |
| Number of lags | 0 | 3 | 0 | 0 |
| Number of observations | 23 | 20 | 23 | 23 |
| Number of stochastictrends** | 4 | 4 | 4 | 4 |

**Number of stochastic trends in asymptotic distribution

**H₅**: There is no relation between import and production.  
Concerning the regression analysis between import and production variables, the results obtained are as follows. When the production increases by one unit, import increases by 28
units. However, R-Squared value is lower than zero. Therefore, it has been understood that the independent variable is unable to determine the dependent variable.

Table 7. Regression Analysis 1 – Import x Production

| Dependent Variable: IMP |
|-------------------------|
| Method: LeastSquares    |
| Sample: 2016M01 2017M12|
| Included observations: 24 |

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| PROD     | 26.86026    | 1.481616   | 18.12902    | 0.0000 |

R-squared -1.003997 \[\text{Mean dependent var} = 2979670.\]
Adjusted R-squared -1.003997 \[\text{S.D. dependent var} = 559072.4\]
S.E. of regression 791437.5 \[\text{Akaike information criterion} = 30.04186\]
Sumsquared resid 1.44E+13 \[\text{Schwarz criterion} = 30.09095\]
Loglikelihood -359.5024 \[\text{Hannan-Quinn criterion} = 30.05489\]
Durbin-Watson stat 0.967859

H₀: There is no relation between export and production.

Concerning the regression analysis between export and production variables, the results obtained are as follows. When the production increases by one unit, export increases by 0.06 unit.
### Table 8. Regression Analysis 2 – Export x Production

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| PROD     | 0.062610    | 0.009364   | 6.685987    | 0.0000|

R-squared: 0.080851

Mean dependent var: 6670.542

S.D. dependent var: 5217.534

S.E. of regression: 5002.167

Sumsquared resid: 5.75E+08

Loglikelihood: -237.9668

Durbin-Watson stat: 1.713541

**H7**: There is no relation between delivery and production.

Concerning the regression analysis between delivery and production variables, the results obtained are as follows. When the production increases by one unit, deliveries increase by 27 units. However, R-Squared value is lower than zero. Therefore, it has been understood that Independent variable is unable to determine the dependent variable.
### Table 9. Regression Analysis 3 – Delivery x Production

**Dependent Variable:** DEL  
**Method:** LeastSquares  
**Sample:** 2016M01 2017M12  
**Included observations:** 24

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| PROD     | 27.32515    | 1.513800   | 18.05070    | 0.0000|

- **R-squared:** -1.350308  
- **Adjusted R-squared:** -1.350308  
- **S.D. dependent var:** 527456.8  
- **S.E. of regression:** 30.08484  
- **Sumsquaredresid:** 1.50E+13  
- **Loglikelihood:** -360.0181  
- **Durbin-Watson stat:** 0.594821

### CONCLUSION
- Solid fuel variables do not contain unit root.
- There is not a causality relation between Export and Production variables.
- There is a causality relation between Production and Delivery variables.
- There is not a causality relation between Export and Import variables.
- There is a causality relation between Export and Delivery variables.
- There is a negative relation between import and production.
- There is a positive relation between export and production.
- There is a negative relation between delivery and production.
- Solid fuel variables are static.
- When the production increases by one unit, export increases by 0.06 unit.

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2016 VE 2017 YILLARINA AİT KATI YAKIT VERİLERİNİN FARKLI TEKNİKLERLE ANALİZİ

Öz: Giriş: Türkiye ve farklı dünyada ülkeleri açısından bakıldığında katı yakıt ihtiyacının giderek talebinin arttığını görmektediriz. Özellikle Türkiye açısından değerlendirildiğimizde özellikle linyit kullanımının demir çelik sanayi içerisindeki kullanım oranının yüksek olduğunu görürüz. Bu takip eden katı yakıt türüne bakıldığında ise taş kömürünün geldiğiğini gösterebilmektediz. Taş kömürünün en yoğun kullandığı alan ise termik santrallerdir. Termik santrallerde duyulan taş kömür ihtiyaçlarının ise giderek artış gösterdiğiğini söyleyebiliriz. 2017 yılı aralığı ayı itibariyle en fazla katı yakıt üretiminin “linyit” olarak gerçekleştiğini görmektediriz. Yine 2017 yılı aralığı ayı itibariyle satılabilir düzeydeki katı yakıt miktarlarına bakıldığında 89 bin 124 ton ile taş kömür, 6 milyon 333 bin 780 ton ile linyit olarak gerçekleştiği görülmektedir. Üretim ile teslim karışımlar oranlarına bakıldığında ise en düşük oranın taş kömürüne ait olduğunu görmektedir. Bu oranın %2.8 seviyesindedir. Üretilen ve teslim edilen taş kömür ile linyitin termik santrallere yapıldığı ifade edebiliriz. Bu iki katı yakıtın termik santrallerde yapılan yüzde dağılımasına bakıldığında %49.4 oran ile taş kömür ve %86 oran ile linyitin teslim edildiğini görmektediriz. %13.4 taş kömürü koc tesislerine, %5.1 taş kömür ise demir çelik sanayiine teslim edilmişdir. Linyit teslimatlarının diğer sanayi dağılımasına bakıldığında ise %7.3 demir çelik sanayi dışına ve %97.4’ün ise demir çelik sanayiine teslim edilmişdir. Yöntem: Bu araştırma Katı Yakıtların Üretim, İthalat, İhracat ve Teslimat değişkenlerine ilişkin 2016-2017 arası Türkiye İstatistik Kurumu verileri kullanılarak yapılmıştır. Verilerin Analizi: Bu araştırmada Panel veri analizinden faydalananmıştır. Bu araştırmadan elde edilen veriler E-Views 8.0 programı ile analiz edilmiştir. Yapılan Birim kök, Granger nedensellik, Cointegration, Covariance ve Regresyon analizleri sonucunda katı yakıt faktörlerinin arasındaki ilişkinin varlığı ve birbirlerini nasıl etkiledikleri araştırılmıştır. Bulgular: Yapılan birim kök testlerine göre; olasılık değerinin 0.05 güven aralığında yüksek çıkması sebebiyle temel hipotezin kabul edileceği anlaşılmıştır. Değişkenler için ortak olarak yapılan birim kök test sonucu olumsuz çıktı ve dolayısıyla ileri analizlerde bu değişkenlerin kullanılması herhangi bir sapmaya neden olmayacaktır. Katı yakıt değişkenleri birim kök içermemektedir. Yapılan birim kök testlerine göre; olasılık değerinin 0.05 güven aralığında yüksek çıkması sebebiyle temel hipotezin kabul edileceği anlaşılmıştır. Değişkenler için ortak olarak yapılan birim kök test sonucu olumsuz çıktı ve dolayısıyla ileri analizlerde bu değişkenlerin kullanılması herhangi bir sapmaya neden olmayacaktır. Katı yakıt değişkenleri birim kök içermemektedir. Değişkenler arasındaki nedensellik ilişkileri incelemiştir, bazı olasılık değerlerinin 0.05’ten küçük olduğu ve H0 hipotezinin ret etmek
gerektiği belirlenmiştir. Dolayısıyla bu değişkenler arasında nedensellik ilişkisi araçaktır. Değişkenler arasındaki kovaryans ilişkileri incelendiğinde, değişkenler arasında aşağıdaki gibi ilişki bulunmaktadır. Katı yakıt değişkenleri için durağanlık analizi yapıldığında, şu sonuçlar elde edilmiştir. Yapılan analizdeki olasılık değerleri incelendiğinde, tüm olasılık değerlerinin 0.05 sınır değerinden büyük olduğu ve hipotezin kabul edilmesi gerektiği görülmektedir. Buna göre katı yakıt değişkenleri durağandır. **Sonuç:** Katı yakıt değişkenleri birim kök içermemektedir. İhracat ve Üretim değişkenleri arasında nedensellik ilişkisi bulunmaktadır. Üretim ve Teslimat değişkenleri arasında nedensellik ilişkisi bulunmaktadır. İthalat ve İhracat değişkenleri arasında nedensellik ilişkisi bulunmaktadır. İhracat ve Teslimat değişkenleri arasında nedensellik ilişkisi bulunmaktadır. İthalat ve üretim arasında negatif ilişki bulunmaktadır. İhracat ve üretim pozitif ilişki bulunmaktadır. Teslimat ve üretim arasında negatif ilişki bulunmaktadır. Katı yakıt değişkenleri durağandır. Üretim bir birim arttığında, ithalat 28 birim artmaktadır. Üretim bir birim arttığında, ithalat 0.06 birim artmaktadır. Üretim bir birim arttığında, teslimatlar 27 birim artmaktadır.

**Anahtar Kelimeler:** Katı Yakıt, Üretim, Değişken, Karşılaştırma, Nedensellik