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Testing Causal Relationship between Energy Costs and Transport Service Prices: Evidence from Turkey

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ABSTRACT: Price stability is one of the main objectives of policy authorities for the health of the economy. The course of transportation services prices after the change in energy prices is a matter of concern for economists. In this study, the relationship between energy costs and transport service prices in Turkey's economy for a sample period of 2003M01-2019M03 is examined. The Johansen cointegration test is used to show long-run relationships between variables. According to findings; there is a one-way causality relationship from energy prices to the price of transport service as expected. It is seen that a 1% increase in energy prices leads to a 4.65% increase in transportation services prices.

Keywords: Transportation Services Prices, Johansen Cointegration Test, Energy Costs
JEL Code: E31, C51, Q43

Enerji Maliyetleri ile Ulaştırma Hizmet Fiyatları Arasındaki Nedensel İlişkinin Test Edilmesi: Türkiye'den Kanıtlar

ÖZ: Fiyat istikrarı, ekonominin sağlıklı yürüyebilmesi için politika otoritelerinin ana hedeflerinden biridir. Enerji fiyatlarındaki değişimden sonra ulaşım hizmetleri fiyatlarının seyri ekonomistler için endişe konusudur. Bu çalışmada, Türkiye ekonomisindeki enerji maliyetleri ile ulaştırma hizmet fiyatları arasındaki 2003M01-2019M03 örnek dönemi arasındaki ilişki incelenmiştir. Johansen eşbütünleşme testi, değişkenler arasındaki uzun vadeli ilişkileri göstermek için kullanılmaktadır. Bulgulara göre; beklendiği üzere enerji fiyatlarından ulaştırma hizmetinin fiyatına tek yönlü bir nedensellik ilişkisi vardır. Enerji fiyatlarındaki % 1'lik bir artışın ulaşım hizmetleri fiyatlarında %4,65'lik bir artışa yol açtığı görülmektedir.

Anahtar Kelimeler: Ulaştırma Hizmet Fiyatları, Johansen Eşbütünleşme Testi, Enerji Maliyetleri
JEL Kodu: E31, C51, Q43

1. Introduction

The transport service enables people or people's goods and services to be delivered from one place to another. Moreover, the transport service has an important role in the realization of economic and cultural activities. Furthermore, transport services interact with tourism, trade, industry and agriculture sectors and act as an important bridge between production and consumption (Saatcioglu, 2016: 1-5). For these reasons, the price of transport service has attracted the attention of economists.

The price of the transport service is followed by the interest of the transport service enterprises, transport service consumers and the central bank as well as the economists. While the price of transport service determines the revenue of transport service enterprises; transport service is a cost for service

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consumers. In terms of the central bank, it is important that transport service prices are stable. In a reverse scenario, the continuous increase in transport service prices could trigger inflation.

Transport service enterprises must bear certain costs in order to meet the transportation needs of people and people's goods and services. Transportation costs are fixed and variable costs. Fixed costs can be defined as costs that are independent of the amount of services to be provided in a certain activity volume. Fixed costs; vehicle purchase cost, vehicle traffic registration cost, insurance cost, long-term parking cost, vehicle maintenance cost are included. Variable costs can be defined as fluctuating costs depending on the amount of services provided in the enterprise. Variable costs include energy costs, short-term parking costs, vehicle maintenance and repair costs, and user accident-risk costs (Orhon, 1983: 145-148).

For service providers, one of the most important items of variable costs is energy. The motivation of this study is investigating the price policy carried out by transport enterprises in the case of the rise in energy prices. In this study, the relationship between energy prices and transport service prices is examined. First, it was investigated whether the transport service providers reflected the energy cost increase to the consumer. Afterward, how the service providers priced this cost increase was examined. It is expected that the prices of transportation services will increase after the increase in energy prices.

The right model should be established with the right variables to carry out the study. ENERG and ULASH variables were used to set up the model. ENERG represents crude petroleum and natural gas PPI, and ULASH represents transport service CPI. According to the tests, it was observed that there was a cointegration relationship between the variables and a Johansen Cointegration model was established.

2. Data and Methodology

ENERG and ULASH variables were used to set up the model. ENERG represents crude petroleum and natural gas PPI; and ULASH represents transport service CPI. The study covers periods of 2003M01-2019M03, and the frequency of time series is monthly. The time series is taken from the CBRT EVDS system and the CBRT statistics. The logarithm of the variables is taken to establish the relation of flexibility among variables.

In order to find the appropriate model, it was first tested whether the variables contain a unit root. Since the economic model generally has higher autoregressive processes, the ADF unit root test is applied. When this test is applied, the appropriate number of lags included in the model is determined with the help of the Akaike and Schwarz information criteria. The results are shown in Table 1.

Table 1: Unit Root Test Results for Series

	ADF			
	Level	**Level Prob.**	**1st Difference**	**1st Difference Prob.**
LNENERG	-1.0753	0.7254	**-12.170***	0.0000
LNULASH	-2.5738	0.1002	**-11.903***	0.0000
MacKinnon (1996) one sided p-values.				

* Significant at the 5 % level

According to the results of the unit root test, it is observed that when the first difference of the series is taken, they become stationary. Time series are integrated I (1) in the first degree. Although all series are not stationary at normal levels, there may be a long-run relationship between the variables due to being integrated at the first difference level. Thus the Johansen approach (1988, 1995) was applied as a method of cointegration analysis.

3. Findings

The Johansen cointegration test accepts all variables in the model as endogenous. For this reason, estimates should be made with the help of vector and matrix. The VAR model was estimated, and the values of the lag length criteria were found. Three of these criteria (LR, FPE and AIC) showed that 6 lags of variables should be taken. According to these three criteria, the appropriate model is VAR (6) and the appropriate error correction model is VECM (5). The results of the information criteria are shown in Table 2.

Table 2: Appropriate lag selection for VAR model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-98.72950	NA	0.010068	1.077321	1.111878	1.091324
1	786.8038	1742.654	8.10e-07	-8.350843	**-8.247171***	**-8.308835***
2	793.2709	12.58829	7.89e-07	-8.377229	-8.204442	-8.307216
3	796.3721	5.970164	7.96e-07	-8.367616	-8.125715	-8.269597
4	802.1192	10.94101	7.82e-07	-8.386301	-8.075286	-8.260278
5	805.6694	6.682834	7.85e-07	-8.381491	-8.001361	-8.227462
6	810.9069	**9.746817***	**7.75e-07***	**-8.394727***	-7.945482	-8.212692
7	812.4359	2.812549	7.96e-07	-8.368298	-7.849938	-8.158258
8	815.4257	5.436008	8.05e-07	-8.357494	-7.770019	-8.119449

* shows appropriate lag length

It is important that the short-term VAR model and the long-term cointegrating model contain intercept and trend. Five different models can be set considering the intercept and trend. While the generation of Model 1 is difficult in real life, interpretation of the Model 5 is very difficult. The use of Model 1 and Model 5 is unlikely and uncommon in economic studies (Sevüktekin and Çınar, 2014).

At the later stage, the appropriate rank for the model needs to be determined. It is determined that the appropriate model is Model 2. In model 2, there is no trend in the long-run cointegration model; there are no intercept and trend in the short-run VECM model. The rank of the Π matrix is calculated by the λmax and λtrace statistics in the Model 2 frame and the results are given in Table 3.

Critical values are MacKinnon-Haug-Michelis (1999) p-values. When the above values are compared with these values, it is seen that the null hypotheses of the maximum eigenvalue and trace test statistics are rejected according to the level of 5% significance level. Variables in the model are cointegrated. Since the matrix of Π is equal to the rank one, there is one cointegrating relationship between variables.

Table 3: Johansen (1988, 1995) cointegration test results

λ_{trace} statistics			
Hypotheses	**Eigenvalue (λ_i)**	λ_{trace}	**Critical Value % 5**
H_0: r = 0, H_1: r = 1	0.1530	**36.138***	20.261
H_0: r ≤ 1, H_1: r = 2	0.0247	4.7351	9.1645
λ_{max} statistics			
Hypotheses	**Eigenvalue (λ_i)**	λ_{max}	**Critical Value % 5**
H_0: r = 0, H_1: r ≥ 1	0.1530	**31.403***	15.892
H_0: r ≤ 1, H_1: r ≥ 2	0.0247	4.7351	9.1645

* Significant at the 5 % level.

The weak exogeneity test was applied. Weak exogeneity means that a variable is only affected by its lagged values. In order to make LNENERG and LNULASH variables weakly exogenous: it is necessary that LNENERG variable in the first equation, and LNULASH variable in the second equation be a function of their own lagged values respectively. Thus, if the matrix α is zero, then the variables are weakly exogenous because the effect of the parameters of the cointegration vector will be reduced from the corresponding equation. The results of the weak exogeneity test are given in Table 4. According to the results of the weak exogeneity test, LNENERG and LNULASH variables are endogenous.

Table 4: Weak exogeneity test results

Variables	Null Hypothesis	LR (rank=1)	Prob.
LNENERG	**H_0: a_{11} = 0**	5.6768*	0.0171
LNULASH	**H_0: a_{21} = 0**	23.165*	0.0000

* Significant at the 5 % level.

LNENERG and LNULASH models were established to find the casual relationship and parameter coefficients. The findings of the models are given in Table 5:

Table 5: Cointegrating coefficients (long-run elasticity)

MODEL LNENERG			
	LNENERG	LNULASH	C
Normalized Coefficients	1.0000	-0.2148	-7.0650
Standard Error		0.6538	3.6229
MODEL LNULASH			
	LNENERG	LNULASH	C
Normalized Coefficients	-4.6545*	1.0000	32.884*
Standard Error	1.9398		11.560

* Significant at the 5 % level.

LNULASH = C + 4.6545 LNENERG

According to the findings, there is a one-way causality relationship from LNENERG to LNULASH as expected. That means while changes in energy prices affect transportation services prices; changes in transportation services prices do not affect energy prices. A 1% increase in energy prices leads to a 4.65% increase in transportation services prices.

Table 6: Vector error-correction model prediction results: VECM (5)

	LNENERG	LNULASH
VECM Coefficients	-0.0124*	-0.0024*
Standard Error	0.0049	0.0004

* Significant at the 5 % level.

In the vector error correction model, it is proved that shocks that can occur in the long-run equilibrium can be corrected (Table 6). The coefficients in the error correction model were negative and statistically significant as expected. These coefficients indicate the rate at which the short-run deviations resulting from the non-stationary series are adjusted in the next period. The short-run imbalance that occurs in LNERG is adjusted approximately in eighty months; the short-run imbalance that occurs in LNULASH is adjusted in four hundred months to the long-run equilibrium level.

4. Conclusion

In this study, the relationship between energy prices and transport service prices is examined. First, whether the transportation service suppliers reflected the rise in energy costs to the customer was explored. It was subsequently examined how service suppliers priced this price rise. Energy prices and transport services prices variables were used to set up the model, and the Johansen approach was applied as a method of cointegration analysis.

According to the findings, a one-way causality relationship was determined from energy prices to transportation services prices. As energy prices increase, transport service providers reflect this increase directly to the service they offer. In addition, in the case of a 1% increase in energy prices, the price of transportation services increases by 4.5%. In other words, after a 1% increase in energy costs, service producers respond by raising the price of their services by 4.5%.

Service suppliers rise their price of transportation by %4.5 instead of %1. This situation is called “profit inflation”. Findings show that service providers tend to rise their transportation prices more than the increase of energy costs.

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