Research article

The impact of uncertainty on international trade: an evidence from container traffic in Turkish ports

Abdullah AÇIK
Res. Asst. Dr., Maritime Business Administration
Maritime Faculty, Dokuz Eylül University, Turkey
abdullah.acik@deu.edu.tr, ORCID 0000-0003-4542-9831

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Abstract: Since container trade is mostly used for the transportation of finished products, it can be used as a measurement tool in tracking the trade of high value-added products in the international arena. This study aims to examine the effect of uncertainties on international trade through the amount of exported and imported containers handled in Turkish ports. The dataset consists of 64 quarterly observations and covers the periods between the first quarter of 2004 and the last quarter of 2019. The results of the asymmetric causality test applied reveal that negative shocks in the uncertainty index are the cause of positive shocks in both exported and imported container quantities. This shows that the decrease in uncertainties within the country has a positive effect on container traffic in ports and thus on international trade. However, a reducing effect of the increase in uncertainty cannot be determined.

Keywords: Uncertainty index; container throughput; international trade; asymmetric causality.

JEL Code: C58, D81.

1. Introduction

The consumption behavior of people forms the basis of the economy since the demand for goods and services is the most important factor affecting the intensity of economic activities (Anderson, 1995, p. 27). One of the most important factors influencing international trade is uncertainty (Van Bergeijk, 2009, p. 47), as, under uncertainty, people tend to save by cutting their consumption levels (Lewis, 2008, p. 119). Therefore, it can be said that uncertainty has an important effect on international trade.

In 2019, approximately 60% of Turkish exports and 53% of imports in monetary value were realized by sea transport (TUİK [Türkiye İstatistik Kurumu / Turkish Statistical Institute], 2020). Therefore, it is considered reasonable to examine the effect of uncertainty on trade through freight traffic at ports. This study aims to determine the effect of uncertainties on international trade through the container traffic in Turkish ports. Although there are types of cargo such as dry bulk cargo, liquid bulk cargo, and gas in maritime transportation, only container cargo statistics are used in this study, because most manufactured products are transported by container transportation (Şeker, 2020, p. 140). Therefore, they are considered to represent international trade better than other types of cargoes. Theoretically, this study is based on two assumptions; (i) people reduce their spending when uncertainty increases and increase when uncertainty decreases; (ii) that countries in the international area take into account the uncertainty in the producing country in their trade, therefore they reduce their trade when uncertainty in trading partner increases and increase when uncertainty decreases. The uncertainty index value determined by Ahir, Bloom, and Furceri (2018) for Turkey to measure the uncertainty in the country is used. As a method, the asymmetric causality test developed by Hatemi-J

(2012a) is used to determine asymmetric relationships. This method can detect asymmetric relationships between positive and negative shocks, so it provides a great advantage as the units in the market may react differently to positive and negative shocks.

The results obtained showed that uncertainty is determinant in both export and import levels of Turkey. There are various studies in the literature modeling the port throughputs by several factors. In these studies, the effects of factors such as exchange rate (Lättilä & Hilmola, 2012; Chi & Cheng, 2016; Tsai & Huang, 2017; Kim, 2017; Açık, Sağlam & Tepe, 2019a), freight rates (Kim, 2016; Açık, 2019), industrial production (Chou, Chu, & Liang, 2008; Lättilä & Hilmola, 2012; Tsai & Huang, 2017; Gosasang, Yip & Chandraprakaikul, 2018; Açık, Sağlam & Kayıran, 2019b), GDP (Chou et al., 2008; Lättilä & Hilmola, 2012; Akar & Esmer, 2015; Tsai & Huang, 2017) and population (Chou et al., 2008; Akar & Esmer, 2015) were examined and significant results were obtained. However, to the best of the authors, no study examining the effect of an important factor such as uncertainty has been conducted. Also, it is thought that a trade measure such as the number of containers without inflationary effects could better represent international trade. An important and original contribution was hoped to be made in this respect. The findings related to the impact of uncertainty on international trade may increase the motivation of policymakers to provide a more stable economic environment.

In the second section of the study, the uncertainty index is introduced. Then related literature is reviewed in the third section to draw the framework of the study. The method used to investigate the relationship between trade and uncertainty is introduced in the fourth section. The fifth section begins by examining the data set reached by the authors, and then the major method of the study is implemented after the pre-tests are applied. In the last section, the findings of the study are interpreted, and recommendations are made to policymakers and port users in order to develop sustainable strategies.

2. The World Uncertainty Index

The World Uncertainty Index (WUI) has been developed by Ahir et al. (2018). They have formed quarterly indices for 143 countries from 1996Q1 to 2019Q2 and used the Economist Intelligence Unit (EIU) country reports. These reports include major political and economic developments in each country and forecasts of political, policy, and economic conditions.

The logic of the WUI is counting the number of times uncertainty is mentioned in the EU country reports. The authors have searched for the word “uncertainty” (and its variants such as “uncertain” and “uncertainties”) for each country. In order to provide comparable WUI scores for each country, they have scaled the raw counts by using the total number of words in each report. The authors have also investigated their index and showed that the index is associated with greater economic policy uncertainty (EPU), stock market volatility, risk, and lower GDP growth. Moreover, uncertainty related to economic and political developments both in near-term and long-term concerns can be captured by the index.

3. Literature review

Studies in the literature can be grouped under two main headings; (i) studies examining the effect of uncertainty on trade and investments; (ii) studies modeling port throughputs. Since maritime markets have a derived demand structure (Branch, 1988, p. 1), every factor that affects international trade also affects the demand for ports. Therefore, our theoretical basis will be established with studies examining the effect of uncertainty on trade. In addition, trade and port relationships will be supported by studies investigating the port throughputs.

In the study examining the effect of uncertainty on international trade, Abaidoo (2019) examined the effect of uncertainties in the US, China, and the European Union, which form large economic structures on a global scale, on international trade components. The results of the research show that the effect of increasing uncertainty on international trade is negative. In addition, it has been determined that the contractionary effect of the increase in uncertainty in the US on international trade is more than China's effect. In the other China-related study conducted by Wei (2019), the effect of uncertainty and oil price shocks on Chinese trade was examined. As a result of the research, it was determined that the shocks in the global economic uncertainty index caused a decrease in the trade of the country in some periods. In another study examining the effect of uncertainty on trade, Ruixiang, Xiangyun, and Yu (2018) examined the effect of EPU value on trade volume. The results show that the growth of the EPU value negatively affects the trade volume.

Uncertainty in countries affects not only commodity trade but also capital flows and investments. In a research conducted by Canh, Binh, Thanh, and Schinckus (2020) with Economic Policy Uncertainty (EPU) and World Uncertainty Index (WUI), whether uncertainty has an effect on Foreign Direct Investment (FDI) was analyzed using panel data method through 21 economies. As a result of the research, they determined that the uncertainty in the country had a negative effect on the amount of FDI inflows. A similar research question has been researched by Avom, Njangang, and Nawo (2020) through EPU for 138 countries. The results of the study showed that increasing uncertainty reduces the amount of FDI and the effect of uncertainty is higher in developing countries. The higher effect of uncertainty in developing countries was also found in the study conducted by Aizenman and Marion (1993). The authors stated that the increase in macroeconomic uncertainty has a negative effect on private investment in developing countries. Uncertainties have a negative effect on trade, as seen in studies examining the effects of uncertainty on economic variables.

Since port traffic is a reflection of the economic activities in the country and the demand for the goods of that country, it is also affected by the variables that influence these factors. Empirical studies examining the port throughput in the literature have used variables such as exchange rate (Lättilä and Hilmola, 2012; Chi & Cheng, 2016; Tsai & Huang, 2017; Kim, 2017; Açık et al., 2019a), freight rates (Kim, 2016; Açık, 2019), industrial production (Chou et al., 2008; Lättilä & Hilmola, 2012; Tsai & Huang, 2017; Gosasang et al. 2018; Açık et al., 2019b), GDP (Chou et al., 2008; Lättilä & Hilmola, 2012; Akar & Esmer, 2015; Tsai & Huang, 2017) and population (Chou et al., 2008; Akar & Esmer, 2015). Since it is not possible to touch upon all the studies in detail, we will touch upon some basic papers from each factor and discuss in particular the research on Turkey.

The summarized studies examining the port throughput indicate that many factors are affecting this amount of cargo. Based on the multiplicity of these factors, Açık et al. (2019a) analyzed the relationship between exchange rate and port throughput with a time-varying causality test, considering that the effect of the exchange rate on port throughput may not be continuous and change over time. There are studies (Lättilä & Hilmola, 2012; Chi & Cheng, 2016; Tsai & Huang, 2017; Kim, 2017) showing this significant relationship between the variables, but the effect may not be permanent. As a result of the study, Açık et al. (2019a) found that the exchange rate had a significant effect on the port throughput of Turkey, however, this effect had lost its significance in some periods. These studies show that the exchange rate has a significant effect on port traffic, but this effect may change over time.

In the study linking container throughputs in Turkish ports with transport costs, Açık (2019) examined the volatility spillover between the container freight index and port throughputs. The demand for the goods of the country is not only related to the price of the goods but also the transportation cost because this cost is also included in the final product price. The result of the research shows that there is a volatility spillover from the container freight index to the container throughput of Turkish ports. In other words, the fluctuations in freight rates affect the fluctuations in port traffic. In addition, positive shocks in freight have a negative effect on container traffic. A similar result was found in the research conducted by Kim (2016) in South Korea. It found that the volatility in the BDI variable has a negative effect on the port loaded cargo throughput of the country. As can be understood from these studies, transportation costs also have a significant effect on port traffic.

The positive effect of industrial production on port throughputs has been tested and confirmed by many studies (Chou et al., 2008; Lättilä & Hilmola, 2012; Tsai & Huang, 2017; Gosasang et al. 2018). Modeling the port throughput with industrial production in Turkey, Açık et al. (2019b) determined that the variables of industrial production and port throughput are nonlinear and they used a causality analysis suitable for this structure. According to their conclusion, there is a one-way causality relationship from industrial production to port throughput and this relationship lasts for 3 periods. They attributed this situation to the late reflection of imported cargo, despite the immediate reflection of industrial production on exported sea cargo. In the country where imported intermediate goods are heavily used, the current industrial production level is a pioneer for future production levels, so imported intermediate goods supply plans may be made in the current production levels for the future levels. This situation may cause the relationship between the industrial production index and port output to continue for a period.

In addition to the significant effect of these macro variables on port throughputs, some factors on a micro-scale can also significantly affect the output amounts of the ports. These are factors such as the user-port relationship and the trust arising from this relationship (Sağlam & Karataş Çetin, 2018), the efficiency of the ports (Ateş, Esmer, Çakir & Balci, 2013; Ateş & Esmer, 2014; Güner, 2015a; Güner, 2015b; Sağlam, Açık & Ertürk, 2018), physical attributes of the ports (Talley, 2006). These factors make it possible to increase port throughput by competing with both national and international competitors.

Within the framework of the literature mentioned so far, the effect of uncertainty on international trade is negative. Since the main determinant of the cargo traffic in ports is international trade, the effects of uncertainty are expected to reflect directly on ports. As far as the authors know, the absence of a study that empirically examines the effect of uncertainty on ports constitutes the originality of the study. In addition, the quick spread of information in the global world accelerates the spread of shocks and the structures of the variables become nonlinear. Our method, which takes into account asymmetric relationships, provides an advantage in this respect. In light of these studies, research, and evaluations, our study provides an original contribution to the literature by using an up-to-date method that takes into account the asymmetric information spillover and a new index developed for the uncertainty measure.

4. Methodology

There are a variety of methods that examine the econometric relationship between variables. One of the most common is causality tests and were first developed by Granger (1969). According to this method, if the own and past values of a series explain the present and future values of the other series better than its own values, a Granger causality can be mentioned among them. However, in later studies, it has been shown that linear causality analysis failed to identify nonlinear relationships between the variables (Bal & Rath, 2015; Kumar, 2017; Adıgüzel, Bayat, Kayhan, & Nazlıoğlu, 2013).

The asymmetric causality test developed by Hatemi-J (2012a) is one of the methods developed by considering standard linear causality as insufficient. This method separates the shocks of the variables as negative and positive, and presents the causal relationship between these shocks in four different combinations; from positive to positive, from positive to negative, from negative to negative, and from negative to positive. It embodies the idea behind Toda and Yamamoto (1995) test and considers the possible nonlinear structures in the series (Shahbaz, Van Hoang, Mahalik & Roubaud, 2017). Given that asymmetric positive and negative shocks can produce different causal impacts (Hatemi-J, 2012b), it provides a very good advantage in diversifying the results. Hatemi-J (2012a) uses bootstrap simulations in order to calculate critical values since the possible autoregressive conditional heteroscedasticity in the series should be evaluated. Therefore, thanks to the leverage corrections, this method provides more accurate critical values (Hatemi-J & Uddin, 2012). In addition, the asymmetric test does not oblige data to be normally distributed and this provides a great advantage (Hatemi-J, 2012a) considering that financial series are exposed to too many unexpected shocks and events causing non-normal distributions.

In this method, the series does not have to be stationary since it follows Toda and Yamamoto (1995) process, but the maximum degree of integration needs to be determined. This determination is made by unit root tests and if there is a unit root, extra lag is added to established unrestricted VAR equations (Hatemi-J & Uddin, 2012).

5. Data and findings

The dataset used in the study consists of 64 quarterly observations and covers the periods between the first quarter of 2004 and the last quarter of 2019. Container quantities are obtained as monthly data and converted to quarterly frequency by summing 3-month quantities to enable matching with quarterly index values. The units of container variables are Twenty-foot Equivalent Units (TEUs), while the value of the uncertainty index is the index score.

In order to determine which shocks are more effective in the period discussed in the return series, the sign of skewness values can be interpreted. Accordingly, negative shocks are more effective in all three variables. However, in order to interpret this information properly, the Kurtosis value is recommended to be slightly higher (more than 6). Logarithms of the variables have been taken and analysis continued. This is because the discrete data becomes continuous and the processability of the data becomes easier. In addition, better distribution properties can be obtained (Shahbaz et al., 2017).

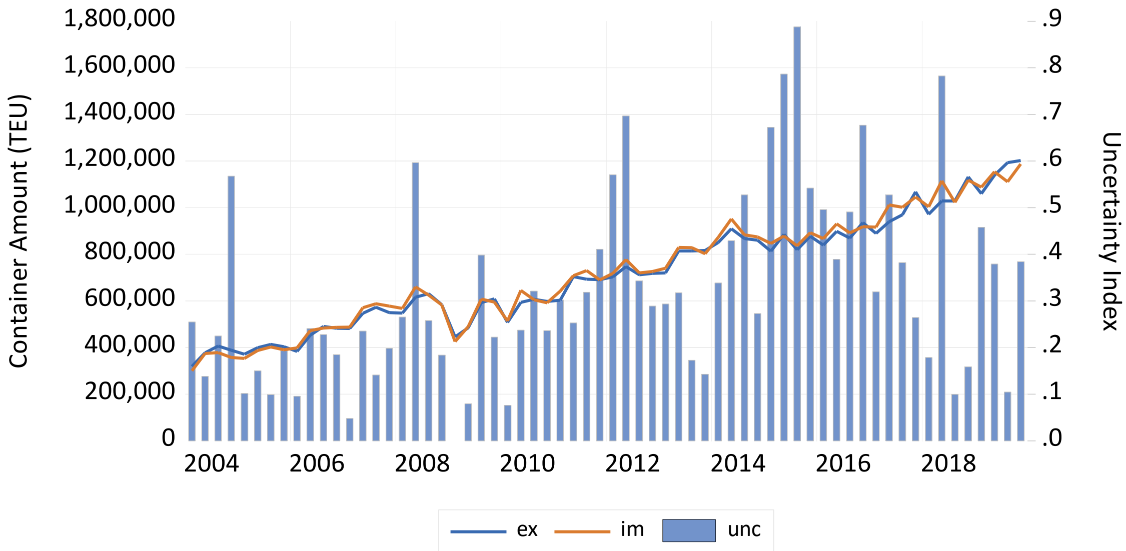
Table 1. Descriptive statistics of variables

	Export	Import	Uncertainty	Δ ln Exp.	Δ ln Imp.	Δ ln Unc.
Mean	713109.1	722554.1	0.322326	0.021074	0.021832	0.006529
Med.	703264.6	719310.4	0.269188	0.016465	0.011449	0.080079
Max.	1202642.	1187157.	0.887818	0.201458	2.370832	1.694238
Min.	318811.7	300033.6	0.000000	-0.271161	-2.342908	-2.535520
Std.D.	232436.2	237978.1	0.198371	0.081439	0.432582	0.842840
Skew.	0.238194	0.096192	0.868553	-0.550321	-0.055303	-0.391238
Kurt.	2.109383	1.980404	3.213096	4.733838	28.89541	3.691204
J-Bera	2.720384	2.870902	8.167866	11.07121	1760.285	2.861335
Prob.	0.256611	0.238008	0.016841	0.003944	0.000000	0.239149
Obs.	64	64	64	63	63	63

Source: DTGM [Denizcilik Genel Müdürlüğü / Maritime General Directorate] (2019); EPU [Economic Policy Uncertainty] (2019).

In Figure 1, there is no significant relationship between the variables presented graphically. While the quantity of export and import containers has a continuously increasing trend, the uncertainty index is fluctuating. This indicates the difficulty of finding a linear relationship and suggests how accurate the chosen method is since the method can capture the causal relationship between the shocks.

Figure 1. Graphical display of the variables



Source: DTGM (2019); EPU (2019).

In the asymmetric causality test used, the series are not necessarily stationary. However, as the method follows a Toda and Yamamoto (1995) process, the maximum degree of integration (dmax) needs to be checked. Firstly, ADF (Dickey & Fuller, 1979) unit root test has been applied to all variables, and the results are presented in Table 2. The results reveal that the uncertainty is non-stationary at both intercept and trend and intercept options, while the other variables are stationary only when the trend and intercept option is selected at the level. Therefore, it is seen that when the first difference is taken, the uncertainty variable became stationary, which indicates that the dmax value should be 1.

Table 2. Unit roots tests of the variables

Variable	Level: Intercept	Level: Trend and Intercept	First Difference: Intercept	First Difference: Trend and Intercept
Uncertainty	-2.49	-2.86	-7.66^{***}	-7.58^{***}
Export	-0.76	-3.35^{**}	-4.39^{***}	-4.40^{***}
Import	-1.28	-3.19^{*}	-3.81^{***}	-4.01^{**}

Note: Whole Sample CVs -3.54 for ***1%, -2.91 for **5%, -2.59 for *10% at Intercept. -4.12 for ***1%, -3.48 for **5%, -3.17 for *10% at Trend and Intercept. Akaike Information Criteria is used in ADF analysis for the lag length.

While testing the unit-roots of variables, we also supported our findings of dmax value by applying tests with a structural break. Accordingly, we applied the one break ADF test (Zivot & Andrews, 1992) and one break LM test (Lee & Strazicich, 2013) tests and presented the results in Table 3. According to the findings, considering the breaks in the series, only the uncertainty variable is stationary at the level. However, both export and import variables are not stationary. This does not cause a change in the dmax value, even if it expresses the opposite of the previous unit root test. According to these tests, the dmax value is determined as 1 and the analyzes are applied.

Table 3. Unit roots tests with structural breaks

Test Items	Mod A Uncertainty	Mod C Uncertainty	Mod A Export	Mod C Export	Mod A Import	Mod C Import
ZA ADF Stat	-4.39	-4.86^{*}	-4.31	-4.67	-4.14	-4.71
Break Date	2017Q2	2014Q4	2015Q4	2008Q3	2005Q4	2005Q2
Fraction	0.84	0.68	0.12	0.23	0.12	0.09
Lag	2	2	4	4	4	4
LS LM Stat	-8.03^{***}	-8.12^{***}	-2.61	-4.18	-2.41	-3.91
Break Date	2016Q4	2014Q2	2006Q1	2007Q3	2009Q2	2006Q2
Fraction	0.81	0.65	0.14	0.23	0.34	0.15
Lag	4	0	4	4	4	4

Note: Akaike Information Criteria is used for the lag length. Mod A refers to Structural Break in Level, Mod C refers to Structural Break in Level and Trend. Null of unit root is rejected at *90%, **95%, ***99%.

Following the determination of the maximum degree of integration (dmax) as 1 by ADF test, the application process of the asymmetric causality test has been commenced. The analyses have been implemented by GAUSS econometrics software and test codes written by Hatemi-J (2012a). In addition to the maximum degree of integration value, the maximum lag value, type of information criterion, and the maximum number of bootstraps should be also determined before the implementation. The maximum number of lags is selected as 4 due to the quarterly observations in the dataset. AICc, which is a corrected type of Akaike Information Criteria (AIC) for small samples, is found to be a suitable one for the selection of the best model. The maximum bootstrap repetition used to make the critical values more robust is selected as 1000. In accordance with these values, an asymmetric causality test has been applied and the results have been presented in Table 4. The causalities have been tested from the uncertainty index to the quantity of exported and imported containers. According to the results obtained, negative shocks in the uncertainty index are the cause of positive shocks in both exported and imported container quantities.

Table 4. Asymmetric Causality Test Results for the Whole Sample

		U^+E^+	U^+E^-	U^-E^-	U^-E^+	U^+I^+	U^+I^-	U^-I^-	U^-I^+
Optimal Lag; VAR(p)		1	1	1	1	1	1	2	1
Additional Lags		1	1	1	1	1	1	1	1
Test Stat (MWALD)		1.28	0.05	0.86	18.82***	0.35	0.18	1.17	23.4***
Critical Val.	1%	9.46	7.29	9.23	8.90	11.4	8.33	15.8	9.83
	5%	4.74	4.62	4.70	4.32	5.58	4.62	8.41	4.85
	10%	3.28	3.01	2.94	2.96	3.47	3.09	5.83	2.99

Note: Significance levels ***1%, **5%, *10%. "U" refers to Uncertainty Index, "E" refers to Export Container Volume, and "I" refers to Import Container Volume.

Our results show that the effect of uncertainty on foreign trade is asymmetrical. While the decreases in uncertainty have an increasing effect on both exports and imports, the increase in uncertainty does not have a decreasing effect. This may be due to the method of examining the relationship between shocks, which refer to instant events. An increase in uncertainty will have a lowering effect, but this may happen with a delay. The method we use may not technically detect this. The reason for this delayed relationship may be long term contracts and switching costs in foreign trade relations. Costs and uncertainties to be encountered in acquiring a new supplier may cause a late decision to terminate commercial relations.

The effect of uncertainty on international trade is clear and there are many studies (Ruixiang et al., 2018; Abaidoo, 2019; Wei, 2019) that empirically verified this effect. Our findings are in line with these studies on the direction of the relationship. However, while discussing the subject from a symmetrical point of view in these studies, our study is handled asymmetrically, and this is thought to increase the originality of our research. The factor that suggests this is that we only detect a significant relationship from negative shocks in uncertainty to positive shocks in export and import. In studies supporting our research on the port throughput side, the effects of the exchange rate (Lättilä & Hilmola, 2012; Chi & Cheng, 2016; Tsai & Huang, 2017; Kim, 2017; Açık et al., 2019a) and industrial production levels (Chou et al., 2008; Lättilä & Hilmola, 2012; Tsai & Huang, 2017; Gosasang et al. 2018; Açık et al., 2019b) on ports were empirically tested and verified. In this respect, the uncertainty in the country may inevitably affect the volatility in exchange rates and industrial production levels, which consequently results in an effect on port throughputs. In this respect, the lack of a study dealing with the subject in the literature to the best of authors' knowledge increases the contribution of the study to the maritime economics literature.

5. Conclusion

We investigated the impact of uncertainty on international trade through container traffic in ports specific to Turkey. There are studies in the literature examining the effect of uncertainty on international trade. In this study, we aimed to make an original contribution by carrying this subject to maritime. We used the uncertainty index, which is used in several academic studies as a current indicator for uncertainty, and examined whether it is an indicator of uncertainty in Turkey.

The method we use is advantageous as it can present the results of the interaction in 4 different combinations. Since the agents in the market may react differently according to the type of news received, this feature ensures very realistic results. As a matter of fact, while the decrease in uncertainty caused an increase in foreign trade, no meaningful results were obtained showing that the increase in uncertainty decreased trade in our results. It would not be possible to detect this asymmetrical relationship with another method.

The results obtained show the importance of reducing uncertainty for policymakers. In line with our assumptions stated at the beginning of our study, uncertainty in the country affects both household expenditures and foreign demand for goods. Therefore, keeping this uncertainty phenomenon low both at the macro level and perceptual level is important for sustainable economic and commercial relations. When we consider the subject from the port side, ports that require huge capital investments are mostly built with external financial resources. Turkish ports are built and operated with different management models. Accordingly, there is a risk that investors will fail to achieve the expected financial returns, as uncertainty directly affects port traffic as well. This situation may confront the country as a thought-provoking factor for future port investors. Our study was conducted specific to Turkey and the generalizability of the results is so questionable. Future studies can be extended to other countries, because the effect of uncertainty may also differ according to the economic structures of the countries. Developing countries may be more affected by uncertainty, as their economies may be relatively fragile. In this respect, enlarging the sample to include developed and developing countries may be beneficial for enriching the conclusion.

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