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## Article

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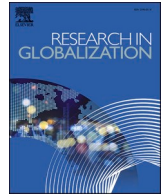
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# The effect of global financial markets and local shocks on Turkey airlines market; new evidence from structural break cointegration and causality tests

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## ABSTRACT

This study examines the relationship between Turkey's airline markets, which responded to local economic shocks, and the USA and Europe airlines market using daily closing stock price data from January 2016 to June 2022. All the variables are non-stationary at level but stationary at first difference. The long-run relationship among the variables is found by employing Maki's (2012) cointegration test considering multiple unknown structural breaks. In addition, the Granger causality analysis results of markets support the correlation of stock prices. The relationship between the global airlines market and Turkey's airlines market is analyzed with different regimes supporting structural breaks. This methodological framework may be considered a significant contribution to financial research.

## Introduction

Stock markets serve an important purpose of channelling resources to the productive sectors of an economy. The ability of financial markets to allocate capital efficiently is influenced by the degree of integration of financial markets and the informational efficiency of security prices. Global market integration enhances capital flows across national boundaries, reduces projects' cost of capital, expands investment opportunities, and improves the well-being of countries (Basak, 1996; Bekaert, Harvey, and Lumsdaine, 2002; Eun and Janakiraman, 1986). Like many emerging markets, the Turkish financial market has grown rapidly over the past few years due to several reforms including financial liberalization, abolition of the currency peg, structural change, trade liberalization, and institutional improvements. These internal reforms, combined with favorable global financial conditions, have improved the sentiment of foreign investors toward the Turkish financial market, which has led to an increase in the volume of foreign capital flows into the country. Financial markets not only grow rapidly in favorable economic conditions but also overreact to negative shocks. For example, the airline industry is exposed to additional risks such as market demand, financial (i.e., interest rates and exchange rate fluctuations), global events such as a terrorist attack, and government regulations, so the

airline industry is facing different risks and uncertainty (Morrell, 2021). Kang et al. (2014) find that economic uncertainty weakening firm-level investment is related to the business cycle. Baker et al. (2016) recently showed that policy-related economic uncertainty raises stock price volatility, reduces investment, and lowers employment of sectors sensitive to economic policies. Hence Turkey airlines' stock market are affected by both local and global shocks as every stock market. Therefore, when developing models to estimate the stock prices of airline companies, both international and domestic variables should be considered. When analyzing stock market volatility in Turkey, however, previous research on the Turkish stock market has considered variables such as oil prices, gold prices, exchange rates, and monetary policy. No investigation integrated the dynamics of the Turkish airline stock market with global markets and examined the breakpoints in integration. Therefore, this research contributes significantly.

First, in this study, we use the movements of global markets as an exogenous variable and determine the structural breakpoints internally for determining the global markets affecting the stock prices of Turkish airline companies. Because when the reflection of monetary policy and economic shocks on the stock market is not generally known. Second, we use the cointegration analysis which unknown structural breaks potentially increase the power of the cointegration tests and the precision of

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estimators for controlling spurious regression. Third, to verify the correlation between the USA and Europe financial markets and the Turkish market, we perform a causality analysis that takes into account structural breaks. Fourth, long-run relationship estimates, and policy recommendations are made by considering the regime changes caused by local and global shocks.

The sections are organized as follows in this study: In Section 2, a summarizing literature review is presented. Section 3 introduces the econometric methodology, while Section 4 presents the data, variables, and empirical results. The findings and discussion are summarized in Section 5.

## Literature review

A review of the literature based on time series approaches demonstrates that the ARDL cointegration test and Vector autoregression (VAR) model and its variations are the most common tests and models used to examine the relationship between Turkish stock prices and other variables. Regarding the analysis of Turkish airlines' stock price dynamics and the methodologies applied for this purpose, Table 1 represents the literature review.

Most of the literature investigates the relationship between Turkish stock prices and oil prices. Based on a VAR model, Eryiğit (2012) and Halaç et al. (2013) found that the stock market responded positively to oil price shocks. Tursoy and Faisal (2018) also confirmed the long-run positive relationship using an autoregressive distributed lag (ARDL) model. Regarding the nonlinear investigation of the relationship between oil prices and Turkish stock markets, we found only some studies that analyzed the relationship at aggregate levels. Harb and Abdelsalam (2019) used a time-varying situation-task-action-result model and found evidence in favor of a nonlinear relationship between oil prices and stock returns for Egypt and Turkey. Polat (2020) estimated time-varying parameter VAR models to examine Turkey's relationship between oil prices and stock markets. In contrast to linear estimates, he provided

supportive evidence for the time-varying negative and significant impact of positive oil price shocks.

Interestingly, Gok et al. (2020) investigate the effects of thirty-five major terrorist attacks that occurred between 01/01/2012 and 12/31/2016 in Turkey on the Borsa Istanbul equity market. By applying the E-GARCH (1,1) model, they were detected that the incidents did not significantly affect the volatility. The results of the intra-daily analysis demonstrated that the attacks that occurred during trading hours had the greatest negative effects in the first 30 min.

Recently, Kartal et al. (2022) examine the impacts of foreign portfolio flows (proxied by foreign investors' retention share) and monetary policy responses (proxied by the repurchase interest rate) on Turkey's stock market index (BIST100) taking the COVID-19 pandemic into consideration. A volatility index, credit default swap spreads, and foreign exchange rates are used as control variables, with a daily dataset between January 2, 2017, and October 20, 2020. Their results reveal that both foreign portfolio flows, and monetary responses have an important effect on the index, and foreign portfolio flows have a higher effect than monetary responses. Alp et al. (2022) examine the impact of stock market liquidity on a stock price crash, using firm data from Borsa Istanbul for the period 2009–2019. The results show that higher stock liquidity increases the likelihood of stock price crashes, but this positive link is not driven by block holder ownership. The study also investigates the effects of foreign investors, divided between institutional and individual investors, on the relationship between liquidity and crash risk. The findings indicate that higher stock liquidity increases the crash risk as the share of foreign institutional investors rises, but this impact is not present with individual foreign participation.

From this context, this article aims to extend the previous literature on the effects of the U.S. and European airlines' stock market prices on Turkish airlines' stock prices. Previous studies analyzing control variables affecting stock prices mainly utilized internal and macroeconomic variables. This type of analysis may be restrictive because it assumes that economic indicators have the same impact on each sector. Thus,

**Table 1**  
Literature Review.

Author (s)	Considered Variables	Period	Method	Results
Eryiğit (2012)	Borsa Istanbul stock exchange market index (BIST), interest rates, exchange rates, and oil price	01.07.2005 10.31.2008	VAR model	Oil price shocks explain a significant proportion of the BIST100 and interest rates and immediate negative effect on exchange rates.
Halaç et al. (2013)	BIST index, U.S. crude oil prices, nominal exchange rate	02.02.1991 24.02.2010	Hatemi-J (2008) Cointegration test, Dynamic OLS	Positive relationship between BIST100 and crude oil prices and nominal exchange rate
Aydoğan and Berk (2015)	BIST index and Brent crude oil prices	02.01.1990 01.11.2011	VAR model with sub-periods	Oil price changes significantly and rationally affect the Turkish stock market activity during only the third sub-period (July 14, 2008, to November 1, 2011)
Tursoy and Faisal (2018)	World Bank Commodity Price Data for Turkey, Brent crude oil prices, gold prices	January 1986 November 2016	ARDL, FMOLS, DOLS, CCR	Short-run and long-run results confirm a negative relationship between the gold price and stock prices and a positive relationship between crude oil and stock prices.
Harb and Abdelsalam (2019)	Oil price, stock market index, nominal exchange rate, and inflation rate for Egypt and Turkey	January 1995 June 2018 (Egypt) December 1986 June 2018 (Turkey)	STAR, TVSTAR, FSSTAR	The impact of oil price on the stock market index has a significant positive effect on stock market in Turkey and Egypt.
Polat (2020)	BIST index, West Texas Intermediate (WTI) spot crude oil prices, Global real economic activity the Kilian Index	February 1988 December 2018	TVP-VAR	Oil price shocks have a negative and significant impact on positive oil price shocks on the BIST returns. Positive global economic activity shocks lead to an increase in the BIST returns.
Gok et al. (2020)	BIST index, terrorism attacks	01.01.2012 12.31.2016	E-GARCH model	The terrorist attacks that occurred during trading hours had the most significant negative effects in the first 30 min
Kartal et al. (2022)	BIST100 index, REPO volume, foreign portfolio flows, volatility index, credit default swap spreads, and foreign exchange rates	02.01.2017 20.10.2020	NARDL cointegration, Markov Switching Regression (MSR)	Foreign portfolio flows and REPO volume have a statistically significant effect on BIST100 index
Alp et al. (2022)	Stock returns of 364 firms in Turkey, crash risk measure variables, stock liquidity measure variables	2009–2019	Fixed Effect Panel model	Higher stock liquidity increases the likelihood of stock price crashes.

given the limited number of studies, the present paper aims to fill this gap by assessing the impacts of global market change and local economic shocks on the airline sector.

## Methodology design

This section discusses the appropriate analysis process to determine the relationship between stocks' price series. The analysis processes that we will follow are summarized in Fig. 1.

### Unit root test with and without structural breaks

In the first phase, the stationary properties of the variables are examined with the help of Augmented Dickey Fuller (ADF), PhillipsPerron (P.P.), Kurozumi (2002) KPSS test with one break, and KPSS (2007) test with two structural breaks. Firstly, applying the augmented Dickey and Fuller (1979) and Phillips and Perron (1988) unit root tests to determine whether variables are stationary. This step is essential for confirming that the variables generated from the same Data Generation Process (DGP) and determining the integration degree of series. Throughout extensive literature concerning unit root tests, the ADF test and the P.P. test are perhaps the most renowned. When put into the simulation, the P.P. test enjoys higher power than the ADF test but suffers greater size distortion, especially under negative Moving Average (M.A.) noise. In addition, compared with the ADF test, the P.P. test makes a correction to the test statistics and is robust to the unspecified autocorrelation and heteroscedasticity in the errors. The choice of unknown structural break unit root tests avoids the false rejection problem caused by Perron (1989) and Zivot and Andrews (1992), which allow ADF-type structural breaks. Some authors recommend reversing the hypotheses and testing the stationarity null hypothesis against the unit root alternative hypothesis to determine the robustness of the unit root tests' conclusions - see Park (1990), Amano and Van Norden (1992), Maddala and Kim (1998), and Carrion-i-Silvestre, Sansó, and Arts (2001). There are stationarity tests in Park (1990), Tanaka (1990, 1999), and Kwiatkowski, Phillips, Schmidt and Shin (1992), among other theoretical developments. Unfortunately, these stationarity tests are not structurally independent. Lee, Huang and Shin (1997) have demonstrated the inconsistent KPSS test developed by Kwiatkowski, Phillips, Schmidt and Shin (1992) when structural breaks are ignored. Leybourne and McCabe's (1994) test produces comparable outcomes. Buseti and Harvey (2001), Lee and Strazicich (2001), and Kurozumi (2002) extend the KPSS-type test to account for the presence of a single shift in the level and/or slope of the time series. Buseti and Harvey (2001) also compute a small set of critical values for the KPSS test with two structural breaks for non-trended variables and propose a simple test that permits up to four structural breaks, but only for two distinct deterministic specifications - they permit level shifts for non-trended variables and both level and slope shifts for trended variables. Carrion-i-Silvestre and Sansó's

(2007) extend the KPSS test to the case where two structural breaks change the level and/or slope of a time series.

### Maki cointegration test with unknown structural breaks

To test for cointegration in this study, we apply Maki (2012) cointegration test with multiple structural breaks. This is based on the premise that the conventional cointegration tests, which do not accommodate structural breaks perform poorly if the series exhibit structural break (Gregory & Hansen, 1996, Maki, 2012). In order to perform this test, four regression models are proposed by Maki (2012), which include: "(1) model 0, which includes a break in intercept and no trend. (2) Model 1 includes a break in intercept and coefficients and no trend. (3) Model 2 includes a break in intercept and coefficients and with a trend, and (4) Model 3 includes a break in intercept, coefficient, and trend" (Maki, 2012):

$$\text{Model 0 : } z_t = \mu + \sum_{i=1}^k \mu_i D_{i,t} + \beta' y_t + \mu_{t,1} \quad (1)$$

$$\text{Model 1 : } z_t = \mu + \sum_{i=1}^k \mu_i D_{i,t} + \beta' y_t + \sum_{i=1}^k \beta_i y_t D_{i,t} + \mu_{t,2} \quad (2)$$

$$\text{Model 2 : } z_t = \mu + \sum_{i=1}^k \mu_i D_{i,t} + \gamma t + \beta' y_t + \sum_{i=1}^k \beta_i y_t D_{i,t} + \mu_{t,3} \quad (3)$$

$$\text{Model 3 : } z_t = \mu + \sum_{i=1}^k \mu_i D_{i,t} + \gamma t + \sum_{i=1}^k \gamma_i t D_{i,t} + \beta' y_t + \sum_{i=1}^k \beta_i y_t D_{i,t} + \mu_{t,4} \quad (4)$$

where  $D_{i,t}$  is the dummy variable,  $D_{i,t} = 1$  if  $t > T_{Bi}$ , and 0 if otherwise.  $T_{Bi}$  represents the break years in the series.  $\mu_{t,1}, \mu_{t,2}, \mu_{t,3}, \mu_{t,4}$  are the error terms for equations (1)-(4), which are independently and identically distributed with zero means. The null hypothesis perhaps states that no cointegration is found among captured variables.

### Causality test with structural breaks

The causality test is applied based on Toda and Yamamoto (1995). This test examines the directional causality among the variables using a modified Wald Statistic. The test, therefore, has desirable advantages over the conventional Granger causality approach, such as its ability to perform causality in the presence of mixed order of integration of the variables and their cointegration (Toda and Yamamoto, 1995). Therefore, this test is performed within the framework of Autoregressive Distributed Lag (VAR) model. Granger causality approach proposed by Toda and Yamamoto (1995). The approach is based on estimating a VAR( $p+d$ ) model where  $p$  is the lag length, and  $d$  is the maximum integration degree of the variables. The VAR( $p+d$ ) model is written as:

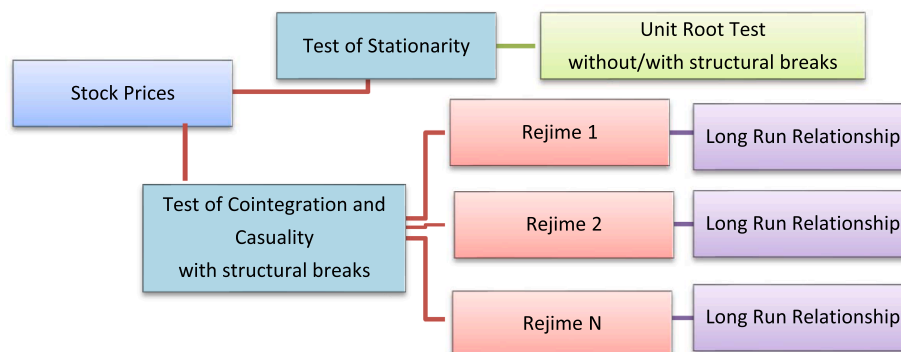


Fig. 1. Methodology design.

$$y_t = \alpha + \beta_1 y_{t-1} + \dots + \beta_{p+d} y_{t-(p+d)} + \epsilon_t \quad (5)$$

where  $y_t$  consists of  $K$  endogenous variables,  $\alpha$  is a vector of intercept terms,  $\beta$  are coefficient matrices and  $\epsilon_t$  are white noise residuals. The null hypothesis of Granger non-causality is based on zero restriction on first  $p$  parameters ( $H_0 : \beta_1 = \dots = \beta_p = 0$ ) of the  $K$ th element of  $y_t$ . Wald statistic for this hypothesis has an asymptotic  $\chi^2$  distribution with  $p$  degrees of freedom.

Nazlioglu et al. (2016) extend the Toda and Yamamoto approach overcomes structural break problems and is robust to cointegration properties of the VAR system. By extending the Toda-Yamamoto framework with gradual structural shifts by means of a Fourier approximation, they propose a novel and simple approach to consider breaks in Granger causality analysis. In order to account for structural changes, we relax the assumption of the intercept terms  $\alpha$  being constant over time and modify the VAR model in Eq. (6) as.

$$y_t = \alpha(t) + \beta_1 y_{t-1} + \dots + \beta_{p+d} y_{t-(p+d)} + \epsilon_t \quad (6)$$

where the intercept terms  $\alpha(t)$  are the functions of time and denote any structural shifts in  $y_t$ . In order to capture structural shifts as a gradual process with an unknown date, number, and form of breaks, the Fourier expansion is defined by:

$$\alpha(t) = \alpha_0 + \sum_{k=1}^n \gamma_{1k} \sin\left(\frac{2\pi kt}{T}\right) + \sum_{k=1}^n \gamma_{2k} \cos\left(\frac{2\pi kt}{T}\right) \quad (7)$$

where  $n$  is the number of frequencies,  $\gamma_{1k}$  and  $\gamma_{2k}$  measures the amplitude and displacement of the frequency, respectively. On a side note, the large value of  $n$  is most likely to be associated with a stochastic parameter variation, decreasing the degrees of freedom and leading to an over-fitting problem. A single Fourier frequency on the other hand, mimics a variety of breaks in deterministic components regardless of date, number, and form of breaks (Becker et al., 2006). We, therefore, use a single frequency component and hence define  $\alpha(t)$  as.

$$\alpha(t) = \alpha_0 + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) \quad (8)$$

where  $k$  denotes the frequency for the approximation. We obtain:

$$y_t = \alpha_0 + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + \beta_1 y_{t-1} + \dots + \beta_{p+d} y_{t-(p+d)} + \epsilon_t \quad (9)$$

In this specification, testing the null hypothesis of Granger non-causality is the same as in Eq. (5), and the hypothesis can be tested using the Wald statistic. Lütkepohl (2005) suggests using the F-statistic instead of Wald test because  $\chi^2$  distribution is often a poor approximation of the small sample distribution of the causality statistics, and the tail of  $F$  distribution is fatter than that of the  $\chi^2$  distribution. The recent works in the Granger causality literature have relied on bootstrapping critical values in order to increase the power of test statistics in small samples as well as being robust in the unit root and cointegration properties of the data (see Mantalos, 2000, Hatemi-J, 2002, Hacker and Hatemi-J, 2006, Balcilar et al., 2010). We use the bootstrap distribution of F-statistics by employing the residual sampling bootstrap approach originally proposed by Efron (1979).

## Empirical results

### Dataset and variables

We aim examine effect the fluctuations of global airline stock market on the Turkey airlines market. Hence, we investigate the impact of the USA and Europe Airlines Market on the Turkey airlines market. The dataset include stock prices of United Airlines Holdings (UAL.O), Southwest Airlines (LUV), Allegiant Travel (ALGT.O), Delta Air Lines

(DAL), American Airlines Group (AAL.O), SkyWest (SKYW), Ryanair (RYAAY.O), Copa Holdings (CPA), Gol Linhas Aéreas Inteligentes (GOL), Hawaiian Holdings (HA.O), Alaska Air Group (ALK), JetBlue Airways (JBLU.O), Spirit Airlines (SAVE.K) and Volaris Airlines (VLRS.N) from Nyse and Nasdaq markets, easyJet (EZJ), Jet2 PLC (JET2), International Airlines Group (ICAG), Icelandair Group (ICEAIR), Wizz Air (WIZZ), TUI AG (TUIGN), Deutsche Lufthansa (LHAG), Air France (AIRF) and Aegean Airlines (AGNR) from London and local market and Turkish Airlines (THYAO.IS) and Pegasus (PGSUS.IS) from Borsa Istanbul. Because Pegasus airlines (PGSUS.IS) have been trading on the market since 2016, the emergence of numerous Fintech startups, increasing internet access, and the ease of stock trading with banking applications in recent years, the data set for the past six years has been analyzed. All stock prices covered the daily adjusted close price from 04.01.2016 to 17.06.2022. On days when the price is not determined, the closing price of the previous day is considered. In order to calculate the return series, the difference was taken by taking the logarithm of the stock prices by considering the regions. Table 2 shows the descriptive statistics of the variables.

Table 2 shows that the stock return of the USA (RUSA) airline companies varied widely: the lowest value is  $-27.271\%$ , while the highest is  $19.100\%$ , with an average of  $-0.08\%$  and a standard deviation of 2.424. The stock return of the Europe (RUER) airline companies also varied widely from  $-28.313\%$  to  $20.416\%$  with an average of  $-0.020\%$  and a standard deviation of 2.723. In addition, the average stock return of Turkish (RTUR) airline companies is positive by  $0.137\%$ , with a standard deviation of 2.755, while the minimum and maximum values are  $-12.086\%$  and  $11.333\%$ , respectively. In addition, Fig. 2 shows Pearson correlation heatmap for variables.

Fig. 2 shows Pearson's Correlation coefficient for variables. Calculated Pearson's correlation coefficients indicate the stock price of the USA airlines companies (USA) has a moderate positive correlation with the stock price of the Europe (EUR) airlines companies ( $\rho = 0.329$ ) and a negative correlation with the stock price of the Turkey (TUR) airlines companies ( $\rho = -0.200$ ). The stock price of the Turkey airlines companies (TUR) has a moderate positive correlation with the stock price of the Europe (RER) airlines companies ( $\rho = 0.535$ ). In addition, calculated Pearson's correlation coefficients indicate the stock returns of the USA airlines companies (RUSA) have a moderate positive correlation with the stock returns of the Europe (RUER) airlines companies ( $\rho = 0.560$ ) and the stock returns of the Turkey (RTUR) airlines companies ( $\rho = 0.241$ ). Furthermore, the stock returns of the Turkey airlines companies (RTUR) have a moderate positive correlation with the stock returns of the Europe (RER) airlines companies ( $\rho = 0.325$ ). Fig. 3 shows the timeline graph of stock price (a) and returns (b) series from different regions.

Fig. 3 (a) shows stock return prices are a non-stationary process on average and includes a stochastic trend. In addition, Fig. 3 (b) reveals that the stock return series is a stationary process on average, whereas the variance clustering, or conditional heteroskedasticity, is apparent. Especially after the first quarter of 2020, when the global effects of the COVID-19 outbreak became apparent, volatility appears to have increased even further.

### Unit-root test result

It is well known that most of the time-series data are characterized as non-stationary (Greene, 2003; Nelson and Plosser, 1982), and this renders the regression results to be spurious (Granger and Newbold, 1974; Drebee et al., 2014; Drebee and Razak, 2018). For this reason, the stationarity of the series had been determined prior to estimate the effect of global airline stock price fluctuation on the Turkish airline market of the study. Table 3 indicates the ADF and P.P. test results of the variables.

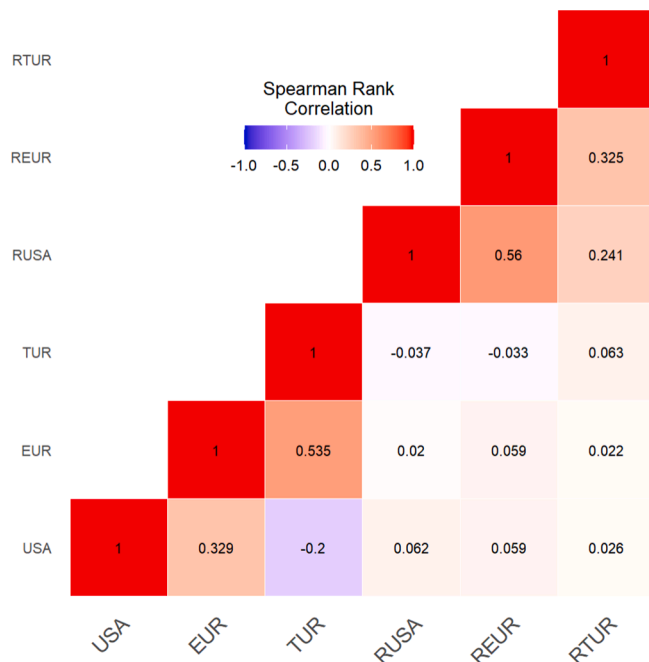
Table 3 shows the ADF and P.P. unit root test results for the stock prices (level) series. Maximum lag length in the augmented Dickey-



**Table 2**

Descriptive statistics of stock price and returns.

	Mean	SD	Median	Min	Max	Skewness	Kurtosis
USA	52.453	9.000	54.353	22.086	67.387	-1.129	1.016
EUR	615.799	145.519	606.916	306.198	982.255	0.130	-0.714
TUR	29.655	18.406	24.737	7.985	110.440	1.328	2.179
RUSA	-0.008	2.424	-0.011	-27.271	19.100	-0.892	21.016
REUR	-0.020	2.723	0.064	-28.313	20.416	-1.060	16.967
RTUR	0.137	2.755	0.137	-12.086	11.333	-0.041	2.377

**Fig. 2.** Pearson correlation heatmap.

Fuller regression uses the sample size-based rule  $12 \cdot (T/100)^{0.25}$  and selects the lag length with MAIC (Ng and Perron, 2001) rescaled information criteria of Cavaliere et al. (2015). In the P.P. test process, we use the number of Newey-West lags calculated with  $4 \cdot (T/100)^{0.25}$  formula. ADF and P.P. unit roots test results show that calculated *t*-statistics values less than 5% critical value and stock prices series are the findings show that the null hypothesis of series have a unit root or series non-stationarity at a level. Therefore, it is possible that the mean and trend of stock prices depend on time, and these series follow a random walk process.

Table 4 shows the ADF and P.P. unit root test results for the stock returns (1st difference) series. We only test the “none model” because the mean of the stock returns series close to zero and does not include a deterministic trend (Fig. 3b). Consequently, to the ADF and P.P. unit root test results of the USA, EUR, and TUR series in a level, we do not reject the  $I(0)$  null hypothesis at the 5% level. However, the first difference of the series (return series) follows a white-noise process and rejects the  $I(1)$  null hypothesis at the 1% level. Hence variables in the analysis have unit roots at the level, and the series are stationary at  $I(1)$  results of traditional unit root tests.

The results of the Kurozumi (2002) KPSS test for the null of stationarity with one structural break are given in Table 5. In the KPSS test, the null hypothesis for Model 1 is “ $H_0$ : Series is stationarity with one structural break in intercept” and the null hypothesis for the USA, EUR, and TUR is rejected. As a result, break dates of 25/02/2020, 04/07/2017, and 27/02/2020, which are found respectively for the series, are statistically significant individually, and the series have unit roots in  $I(0)$  level or series are not stationary with one break. In addition, the null

hypothesis for model C is “ $H_0$ : Series is stationarity with one structural break in intercept and trend” and the null hypothesis for the USA, EUR, and TUR are rejected. As a result, the series has a unit root in  $I(0)$  level, or the series is not stationary with one break in intercept and trend.

Table 6 indicates Carrion-i-Silvestre and Sansó's (2007) KPSS test with two structural breaks. In the KPSS test, the null hypothesis for Model 1 is “ $H_0$ : Series is stationarity with two breaks in intercept” and the null hypothesis for the USA, EUR, and TUR are rejected. The series have unit roots in  $I(0)$  level, or the series are not stationary with two breaks. In addition, the null hypothesis for model C is “ $H_0$ : Series is stationarity with two breaks in intercept and trend” and it is rejected for USA, EUR, and TUR. As a result, the series has a unit root in  $I(0)$  level, or the series is not stationary with two breaks in the intercept and trend model.

#### Cointegration and causality analysis

At this stage of the study, it is determined how the stock price of airline companies in the USA and Europe affect the Turkish airline stock market. The long-run relationship regression model is determined as follows:

$$TUR_t = \beta_0 + \beta_1 USA_t + \beta_2 EUR_t + \varepsilon_t \quad (10)$$

To look at the cointegration relationship between variables, variables need to be at the same integration. Although the USA, EUR and TUR closing stock price series, in which the cointegration relationship is tested, is not stationary at its level  $I(0)$  but their first difference  $I(1)$  is stationary (Table 2-4). In this study, the Maki's (2012) cointegration test, which considers multiple unknown structural breaks, is used. Maki's (2012) cointegration with structural breaks test results are given in Table 7.

Table 7 shows that the test statistics calculated for models with a maximum number of breaks. Maki's (2012) cointegration test indicate that a cointegration relationship between the series for  $m = 2$ ,  $m = 4$ , and  $m = 5$  models at a 5% level. However,  $m = 3$  model has greater statistical significance (at a 1% level) than other models and we accept the optimal break number is three. The breakpoint dates of the model are known to be 15/05/2017, 02/05/2019, and 04/11/2021. We visualities different regimes in Fig. 4.

Fig. 4 shows regime change in the relationship between the Turkish airlines stock market and the U.S. and Europe airlines stock markets, with breakpoints determined by the Maki (2012) cointegration test. On May 17, 2017 (a), there was the first regime change. On this date, the BIST-100 index values reached an all-time high of 98,795 because of the improved positive risk perception towards Turkey. The positive atmosphere on global markets in the following days and the dollar's depreciation in May 2017 (b) revealed a positive trend in airline company stock prices. The second regime change coinciding with the first days of May 2019, the developments in relations between Turkey with the United States, as well as the CBRT's (Central Bank of the Republic of Turkey) elimination of election uncertainty during these periods, also had a positive impact on the stock market's performance. The news that a trade agreement between the United States and China was upcoming enhanced global markets. Importantly, the decline in oil prices during this time rushed an upward trend in airline stock prices. Due to the

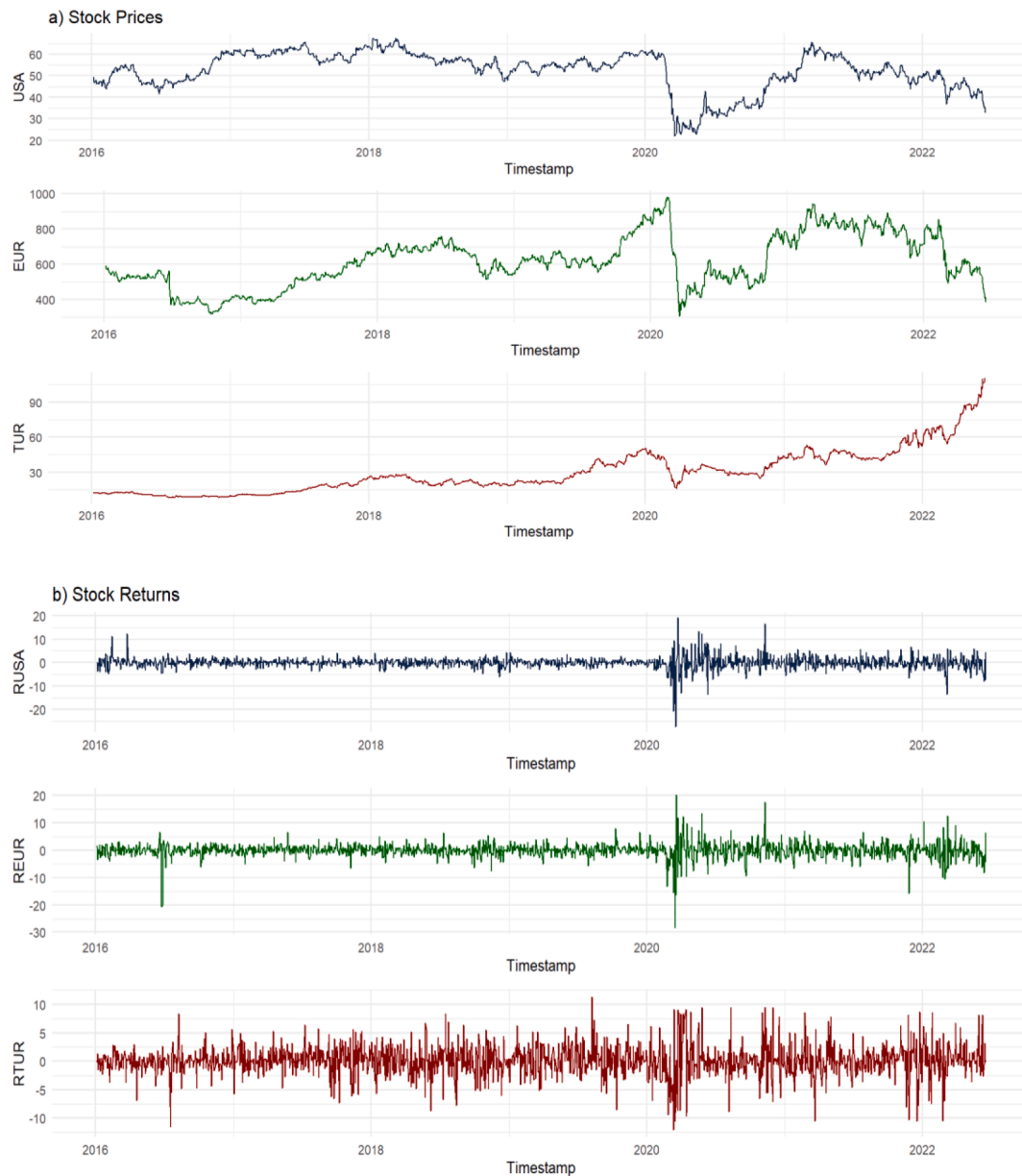


Fig. 3. Timeline graph of variables.

Table 3

Unit root test results for stock prices.

Variables	Intercept Model			Intercept and Trend Model			
	ADF test statistics	P.P. test statistics	Critical Values	ADF test statistics	P.P. test statistics	Critical Values	
USA	-2.098	-10.483	%1	-3.429	-2.502	-12.977	%1
EUR	-2.280	-11.539	%5	-2.855	-2.400	-15.198	%5
TUR	0.119	0.103	%10	-2.564	-2.619	-15.266	%10

\*\*\*1%, \*\*5%, \*10% significant level

starting of the recovery period following the COVID-19 pandemic and the removal of restrictions on international flights, the stock prices of Turkish airline companies increased after October 2021 (c).

Table 8 shows the main causal relationships detected by Toda & Yamamoto (1995) and Nazlioglu, Gormus and Soytas (2016), augmenting the Toda–Yamamoto method with a Fourier approximation procedure. The significance of the p-values for the Wald statistic reveals that the one-way and bidirectional Granger causality is predominant. It

is apparent the central role played by the stock prices of the USA and Europe airline companies in the functioning of the global financial system. In cases in  $USA \rightarrow TUR$  and  $EUR \rightarrow TUR$ , one-way causality and  $USA \rightleftharpoons EUR$  bidirectional Granger causality are observed.

To determine whether Turkish airline stock prices are influenced by the global market, a cointegration relationship with structural breaks and a causal relationship were discovered. Consequently, the Fully Modified Ordinary Least Squared (FMOLS) estimator is used to estimate

**Table 4**

Unit root test results for stock returns series.

Variables	ADF test statistics	KPSS test statistics	Critical Values	
RUSA	− 9.321***	−39.571	%1	−3.434
REUR	− 9.512***	−38.623	%5	−2.863
RTUR	− 11.873***	−39.242	%10	−2.568
***1%, **5%, *10% significance level				

**Table 5**

KPSS test for the null of stationarity with one structural break.

Series	Model 1			Model 2		
	Break Date	KPSS test stat.	cv %1; %5; %10	Break Date	KPSS test stat.	cv %1; %5; %10
USA	25/02/2020	5.400***	0.302; 0.201; 0.160	02/03/2020	5.400***	0.091; 0.066; 0.056
EUR	04/07/2017	2.765***	0.483; 0.302; 0.229	04/05/2020	2.237***	0.142; 0.120; 0.097
TUR	27/02/2020	4.257***	0.302; 0.201; 0.160	23/05/2017	3.605***	0.142; 0.120; 0.097
Trim Rate = 0.10, and critical values for test statistics was taken from KPSS (2002) test.						
* %10; ** %5; ***%1 is significance level						

**Table 6**

The KPSS test with two structural breaks.

Variable	Model 1			Model 2		
	Break Dates	KPSS statistics	cv %1 %5 %10	Break Dates	KPSS statistics	cv %1 %5 %10
USA	04/03/2020 06/11/2020	7.489***	0.286 0.185 0.144	04/03/2020 06/11/2020	5.743***	0.126 0.090 0.074
EUR	29/06/2017 06/11/2020	3.705***	0.361 0.237 0.179	18/09/2017 06/11/2020	2.476***	0.126 0.090 0.074
TUR	13/06/2017 16/06/2019	15.981***	0.183 0.129 0.105	06/06/2016 27/02/2020	4.478***	0.127 0.091 0.075
Trim Rate = 0.10 and critical values for test statistics was taken from KPSS (2007) test.						
* %10; ** %5; ***%1 is significance level						

long-term relationships in different regimes.

Table 9 investigate integration of airline stock prices of Turkey with the USA and Europe airlines stock prices. We use Full Modified Ordinary Least Squared (FMOLS) for long-run relationship in 4 different regimes for Equation (10). The table demonstrates the stock prices of airline companies in Turkey seem to be positively and statistically significantly affected by American and European airline stock prices in Regime 1. In this period, Turkey's foreign trade balance also contributed positively to growth in 2017, and export growth reached 12 percent, while the increase in imports was 10.3 percent (TUIK, 2018). The rise in Turkey's globalization tendencies in during 2016–2017 accelerated the adaptation of the airline stock markets to the world markets. On the contrary, Table 9 shows in Regime 4 after the COVID-19 pandemic, the airline's stock prices in the USA and Europe are not statistically significant effect on the airline stock prices of Turkey. In this period, several factors eliminate globalization, such as higher volatility of the Turkish Lira, lack

**Table 7**

Maki test for cointegration with an unknown number of breaks.

m	Maki test statistics	Break Dates	cv 1%	cv 5%	cv 10%	Decision
1	−4.981	02/05/2019	−6.020	−5.558	−5.287	no integration
2	−6.275**	02/05/2019; 04/11/2021	−6.628	−6.093	−5.833	cointegration at the 5% level
3	−7.180***	15/05/2017; 02/05/2019; 04/11/2021	−7.031	−6.516	−6.120	cointegration at the 1% level
4	−7.354**	15/05/2017; 10/07/2018 02/05/2019; 04/11/2021	−7.470	−6.872	−6.653	cointegration at the 5% level
5	−7.354**	15/05/2017; 10/07/2018 02/05/2019; 16/10/2020 04/11/2021	−7.839	−7.228	−6.976	cointegration at the 5% level

m indicated maximum breaks number and critical values for test statistics was taken from Maki (2012)

of strong financial and political institutions, political risk, and current account deficits. Beyond these factors, the recent depreciation of the exchange value of the Turkish Lira against major currencies such as the U.S dollar and Euro has drastically affected all aspects of the economy: from the amount of debt in foreign currency to interest rates, inflation, liquidity, and asset prices. All these economic uncertainties have eliminated the adaption of the airline stock prices to global market trends, making the stock price volatility dependent only on local economic changes.

## Conclusion

The focus of the present study was on the evaluation of the association between the stock prices of airline companies in Turkey and the global market. The concept of previous research for stock prices has been developed as the relationship between stock prices and oil prices, exchange rates, and macroeconomic variables. Firstly, this study explored the long-run cointegration and causal impact of airlines' stock prices in Turkey and global market changes (the USA and Europe), and structural changes in the economy as a moderator. Hence, the study provided novel findings. The following is a summary of the findings of the study:

- It was determined that there is a correlation between the stock prices and returns of airline companies in Turkey and the stock market of Nyse and Nasdaq (USA) and London (Europe) (Fig. 2). The causality relationship was examined for support to the correlation results and was investigated bidirectional Granger causality was found between the USA and European stock prices, while one-way causality is found between Turkey and USA, Turkey, and Europe (Table 8).
- To confirm the existence of a long-term relationship between airline stock prices in Turkey and global markets, the process was first started with unit-root tests. Unit root tests were showed that the price



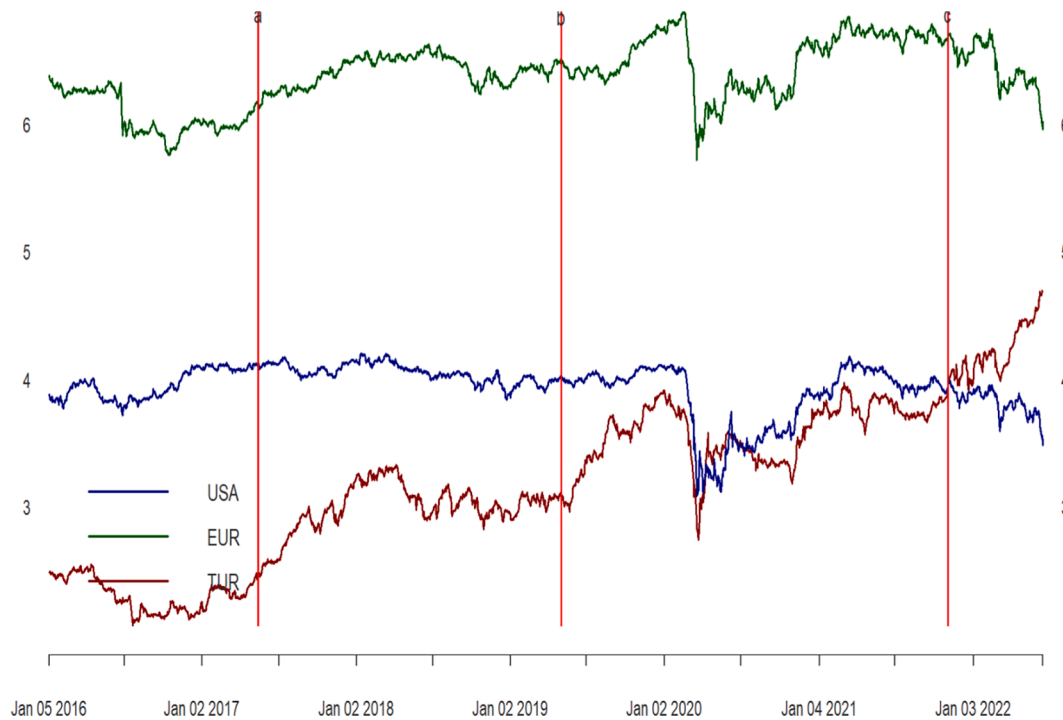


Fig. 4. Regime change of the relationship between stock markets.

**Table 8**  
Causality test results.

Direction	Toda & Yamamoto (1995) Granger Causality Test			Flexible Toda & Yamamoto (2016) Causality Test		
	Wald stat.	p-val	lags	Wald	p-value	frequency
USA=>TUR	29.218	0.000	8	29.130	0.000	2
EUR=>TUR	17.252	0.028	8	17.261	0.028	2
TUR=>USA	4.904	0.768	8	4.885	0.770	2
EUR=>USA	66.863	0.000	8	65.698	0.000	2
TUR=>EUR	11.768	0.162	8	11.792	0.161	2
USA=>EUR	58.963	0.000	8	58.851	0.000	2

**Table 9**  
Long-run relationship with structural breaks.

Dependent Var:	Regime 1	Regime 2	Regime 3	Regime 4
TUR	05/01/2016 15/05/2017	16/05/2017 02/05/2019	02/06/2019 04/11/2021	05/11/2021 17/06/2022
Constant	-3.851	-5.365***	-3.249	11.588***
USA	0.338**	-0.366	-0.451***	-1.080
EUR	0.795***	1.535***	1.316***	-0.501
R <sup>2</sup>	0.622	0.529	0.696	0.228

\* 10%; \*\* 5%; \*\*\*1% is significance level

variables included in Table 3-6 model are not stationary even when structural breaks were included, however, variables were stationary at the first difference. The same degree of integration of the series has led to the discovery of long-term relationships. Using a 6-year (2016–2022) daily data set for stock closing prices and the fact that the analyzed data set covers periods that will cause structural breaks such as COVID-19 motivated us to use structural break cointegration tests. According to Maki's (2012) cointegration test with multiple unknown structural breaks, the existence of a long-term relationship was determined (Table 7).

- The integration of the stock prices of Turkish airline companies with the global markets had undertaken regime changes at different times (15/05/2017, 02/05/2019, and 04/11/2021). Structural break

dates found were determined to be compatible with the beginning of general upward trends in stock prices, and structural breaks determined externally by the model were explained. However, the point we will draw attention to here shows the structural breaks in the long-term relationship, not the individual breaks in the stock prices of Turkish airline companies. Therefore, the high trend in the price series is not always caused by the global markets. When the long-term relationships in different regimes are determined with the FMOLS estimator (Table 9), it has been determined that the increase in airline stock prices in Turkey's economic rise periods 2016–2017 (Regime 1) is integrated with the global markets. However, in Regime 4, when there are financial risks such as exchange rate and interest rate, it has been concluded that the determinants of stock prices are caused only by local changes, and global market effects are eliminated.

The current study extends the theory by contributing to the literature on airlines' stock prices and the global market, as it is an emergent research area and a hot topic of interest. As Turkey is a country that is high in structural regime shifts in the economy, the conduction of this study in Turkey provides a theoretical expansion as well. From our main results, as a policy proposal, we suggest to Turkey needs implement new monetary policies that will re-adapt its financial markets to global markets. In addition, our study has several practical implications as well. Firstly, it indicates the importance and results of local financial risks for globalization in Turkey. Second, it provides practical guideline for econometric structural break tests and motivate to use it more in financial research for new insights. The current study has limited in terms of context and scope. The stock price scope is limited to the airline industry and only Turkey, and the findings can be non-generalizable in all sectors.

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## CRedit authorship contribution statement

**Hasraddin Guliyev:** Conceptualization, Methodology, Resources, Visualization, Investigation, Writing – original draft.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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