

## THE IMPACT OF MACROECONOMIC VARIABLES ON THE STOCK MARKET IN THE TIME OF COVID-19: THE CASE OF TURKEY

### COVID-19 Döneminde Makroekonomik Değişkenlerin Borsa Üzerindeki Etkisi: Türkiye Örneği

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#### Abstract

Along with the ongoing efforts to understand the effects of the COVID-19 pandemic on economies through various simulations and forecasts, the severe trauma experienced in financial markets has already manifested itself in market data. Besides the uncertainty created by the pandemic, fluctuations in macroeconomic variables have increased volatility in the developed and emerging stock markets. In this context, this study aims to examine the effect of macroeconomic variables on the BIST 100 index before and during the COVID-19 pandemic. Hence, the effects of interest rate, exchange rate, CDS premium, VIX, and oil prices on BIST 100 are estimated using the Flexible Least Squares method, which allows for the time-varying coefficient estimation, for the period of 13 September 2019 to 11 September 2020. Empirical findings indicate that interest rate, VIX, and oil prices had significant effects on BIST 100 for certain periods. On the other hand, the exchange rate and CDS premium significantly and negatively affect BIST 100 in the whole sample. Moreover, it is determined that the exchange rate is the macroeconomic variable with the highest impact on BIST 100 based on the quantitative magnitude of the coefficients.

#### Keywords:

BIST 100, COVID-19,  
Flexible Least Squares,  
Macroeconomic Variables

#### JEL Codes:

C32, E44, I10

#### Özet

COVID-19'un ekonomilerin geneli üzerindeki etkileri çeşitli simülasyonlar ve tahminler ile anlaşılmaya çalışılırken finansal piyasalarda yaşanan şiddetli travma piyasa verilerinde şimdiden kendini göstermiştir. Pandeminin yarattığı belirsizliğin yanı sıra makroekonomik değişkenlerdeki dalgalanmalar gelişmiş ve yükselen hisse senedi piyasalarındaki volatilitiyi arttırmıştır. Bu bağlamda çalışmanın amacı, COVID-19 öncesinde ve sırasında makroekonomik değişkenlerin BIST 100 endeksi üzerindeki etkisini incelemektir. Bu doğrultuda faiz oranı, döviz kuru, CDS primi, VIX ve petrol fiyatlarının BIST 100 üzerindeki etkisi 13 Eylül 2019 ve 11 Eylül 2020 arası dönem için zamanla değişen katsayı tahminine olanak sağlayan Esnek En Küçük Kareler yöntemiyle tahmin edilmiştir. Ampirik bulgulara göre, faiz oranı, VIX ve petrol fiyatlarının belirli dönemler için BIST 100 üzerinde anlamlı etkileri bulunmaktadır. Döviz kuru ve CDS primi ise BIST 100'ü örneklem dönemi boyunca anlamlı ve negatif yönde etkilemiştir. Bununla birlikte, katsayıların niceliksel boyutu açısından BIST 100 üzerinde en yüksek etkiye sahip makroekonomik değişken döviz kuru olmuştur.

#### Anahtar Kelimeler:

BIST 100, COVID-19,  
Esnek En Küçük Kareler,  
Makroekonomik  
Değişkenler

#### JEL Kodları:

C32, E44, I10

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## 1. Introduction

The coronavirus disease 2019 (COVID-19) was first reported in Wuhan, China in December 2019. It quickly spread to other cities in China and then the other countries and became a global health problem. As a result of the rapid spread of the virus between continents, the World Health Organization (WHO) declared the COVID-19 outbreak as a pandemic on 11 March 2020 (World Health Organization [WHO], 2020a). As of 9 October 2020, the number of COVID-19 cases in the world has been exceeded 36 million with around 1 million deaths globally (WHO, 2020b).

COVID-19 is the most serious global health crisis since the Spanish Flu, as well as its economic costs, are expected to reach huge amounts (Boissay and Rungcharoenkitkul, 2020). In the April 2020 World Economic Outlook (WEO) of the International Monetary Fund (IMF), the global growth rate projected as -3.0% for 2020 was revised as -4.9% in June 2020 (International Monetary Fund [IMF], 2020b). The COVID-19 Crisis, which led to developed, developing, and emerging countries simultaneously into recession, is described as the worst economic recession experienced since the Great Depression in 1929 (Gopinath, 2020).

Along with the ongoing efforts to understand the effects of the COVID-19 pandemic on economies through various simulations and forecasts, the severe trauma experienced in financial markets has already manifested itself in market data. The Volatility Index (VIX) sharply increased<sup>1</sup> since mid-February 2020 due to the pandemic concerns and the equity prices started to plummet. Fire sale pressures on asset managers due to the deterioration in market liquidity and decreased risk appetite exacerbated the volatility and lowered prices. The turbulence experienced in the financial markets caused the investors to rush to liquid assets such as gold and led to substantial portfolio outflows from the emerging market economies. Stock prices in emerging market economies decreased by around 20% within a few months, while the currencies of the commodity-producing countries lost 20% against the United States Dollar (USD) in the first quarter of 2020. The financial conditions tightened remarkably due to the decline in asset prices, hence resulted in loan losses and stresses on the debt burden of households and companies with high leverage, damaged the functioning of credit channels, and increased the risk of a sudden stop in economies (IMF, 2020a).

In Turkey, where the first case of COVID-19 was confirmed later than most countries, several measures were introduced to control the spread of the virus. Before the announcement of the first official case, thermal cameras were installed at the airports in January 2020, and flights with China and high-risk countries were canceled in early February and early March, respectively. Immediately after the official announcement of the first case on 10 March 2020, 14-day quarantine became mandatory for people who traveled internationally. The following days led to a series of measures, such as school closures, the cancellation/prohibition of mass events, intercity travel restrictions, and partial curfews (Tekin-Koru, 2020). Such measures were intended to prevent the burden on the healthcare system from reaching insurmountable levels.

According to Gourinchas (2020), the cost of flattening the infection curve in the short run inevitably deepens the macroeconomic recession. Correspondingly, the policies implemented to mitigate the threats of COVID-19 on public health in Turkey rapidly led to visible negative effects on the real sector and financial markets. Measures to reduce human contact resulted in a

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<sup>1</sup> VIX was 13.68 on 14 February 2020 and reached 82.69 on 16 March 2020.

withdrawal of a sizable portion of the population from the economic activity network. Production and supply chains suffered seriously on the supply front, while the domestic demand contracted due to the losses in household income. Along with the decreasing demand, increased volatility in financial markets amplified the risks on the cash flows and balance sheets of firms. The credit default swap (CDS) premium increased while the domestic currency depreciated, resembling several emerging market economies (Central Bank of the Republic of Turkey [CBRT], 2020a, pp. 9-10). The stock of non-residents, which was \$ 34.8 billion in the week of 24 January plunged to \$ 21.5 billion in the week of 20 March (CBRT, 2020b). Due to the impact of portfolio outflows, BIST 100 index depreciated around 30% between the week of 19 January and the week of 15 March. As a result of these developments, policy authorities implemented a series of economic measures to limit the possible economic and financial costs of COVID-19, since the early periods of the pandemic.<sup>2</sup>

Sharp fluctuations in stock markets during the COVID-19 pandemic have increased the interest of researchers in these markets. It has been observed that the empirical studies that aimed to analyze the early economic effects of the pandemic have focused on stock markets due to the high frequency of market data. Studies, which conducted on multi-country groups or a single country and covered different sample periods, have mainly focused on the analysis of the stock market reactions to COVID-19 cases and deaths. They found that COVID-19 negatively affected the stock markets (Al-Awadhi, Alsaifi, Al-Awadhi and Alhammadi, 2020; Apergis and Apergis, 2020; Ashraf, 2020; Capelle-Blancard and Desroziers, 2020; Cao, Li, Liu and Woo, 2020; He, Liu, Wang and Yu, 2020; Khan et al. 2020; Lee, Jais and Chan, 2020; Sharma, Yadav, Mangla, Mohanty and Mohanty, 2020; Topcu and Gulal, 2020; Zhang, Hu and Ji, 2020).

It is also possible to state that conducted analyses and obtained empirical findings are also similar to Turkey. Studies, which focused on the main index and/or sectoral indices were in different sample periods, concluded that the number of COVID-19 cases had negative effects on stock returns. However, it was determined that the severity of the negative effects of COVID-19 differed between sectors and the negative impact was higher in sectors with higher levels of human contact (Kandil Gker, Eren and Karaca, 2020; Keleř, 2020; Kılıç, 2020; ztrk, Őřman, Uslu and ıtak, 2020; Tayar, Gmřtekin, Dayan and Mandi, 2020).

Arbitrage Pricing Theory indicates that there exist several macroeconomic variables that might create systematic risk factors on stock returns. Therefore, the analysis of the effect of macroeconomic variables on stock markets is important both for policy authorities and investors (Maysami, Howe and Hamzah, 2004; Sevinç, 2014). There has been an increase in the number of studies that investigated the effect of the reported cases and deaths of COVID-19 on the BIST 100 index and sectoral indices. However, the same increase has not been observed in studies that examined the impact of macroeconomic variables on the BIST 100 in COVID-19. Given the scope above, this study aims to examine the effect of macroeconomic variables on the BIST 100 index before and during the COVID-19 pandemic. Hence, the effects of interest rate, exchange rate, CDS premium, VIX, and oil prices on BIST 100 are estimated using the Flexible Least Squares (FLS) method, which allows for the time-varying coefficient estimation, for the period of 13 September 2019 to 11 September 2020.

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<sup>2</sup> See also CBRT (2020a, pp. 60-72), for the monetary, macroprudential and fiscal measures taken to limit the potential negative economic and financial effects of COVID-19 in Turkey.

The rest of the paper is organized as follows. In the following section, the information about the estimated model and data set are presented. The third section explains the methodology and the empirical findings are provided in the fourth section. The fifth section discusses the findings and concludes the paper.<sup>3</sup>

## 2. Model and Data

The relevant literature is taken into account for selecting the macroeconomic variables that affect the BIST 100 index. Furthermore, constraints on data frequency are also effective in variable selection. The following model is analyzed for the period of 13 September 2019 to 11 September 2020:

$$xu100_t = \beta_{1t}r_t + \beta_{2t}er_t + \beta_{3t}cds_t + \beta_{4t}vix_t + \beta_{5t}oil_t + \varepsilon_t \quad (1)$$

In this model,  $xu100_t$  refers to the BIST 100 index,  $r_t$  denotes the interest rate,  $er_t$  expresses the exchange rate,  $cds_t$  implies the CDS premium,  $vix_t$  reflects the VIX,  $oil_t$  indicates the oil prices and  $\varepsilon_t$  refers to the error term. The interbank interest rate is used for the interest rate, nominal USD/TL rate as the proxy of the exchange rate, Turkey’s 5-year CDS premium is employed for the CDS. Chicago Board Options Exchange Volatility Index and price of OPEC barrel in USD are used for the VIX and the oil, respectively. Series are transformed into logarithmic form except for the interest rate. All variables used in the analysis are obtained from the Thomson Reuters Datastream database.

The interest rate, which is one of the explanatory variables used in the model, is the opportunity cost of cash holdings and directly affects investment decisions. An increase in the interest rate might render assets with interest returns, such as bonds, more attractive when compared to equities. On the other hand, increased financing costs and decreased sales, which are the outcomes of increased interest rates, might negatively affect the profitability of businesses. Therefore, in theory, interest rates are expected to affect stock prices negatively (Wongbangpo and Sharma, 2002, p. 31).

Although several studies have supported the argument that exchange rates affect the stock markets through various channels such as profitability, investments, and cash flow, it is not possible to reach a theoretical consensus on the direction and sign of the relationship between the two variables (Hajilee and Al Nasser, 2014, p. 165). The traditional flow approach (Dornbusch and Fischer, 1980) that explains the movements in exchange rates argues that an increase in the exchange rate devaluates the domestic currency and increases the competitiveness of the economy and exports. It is possible that exchange rates positively affect equity prices in stock markets dominated by exporting sectors. On the other hand, an opposite relationship is likely to occur for stock markets that are dominated by sectors with high rates of imported goods for production processes (Mishra, 2004, p. 210).

After the global financial crisis, country credit risks, which have become more important due to the pressure of monetary expansion on debt burdens, might affect stock prices (Shear and Butt, 2017, p. 52). Governments raise interest rates or raise taxes against deteriorating refinancing conditions and an increased risk of default, which in turn increases the capital costs

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<sup>3</sup> Research and publication ethics were followed in this study, which does not require permission from the ethics committee and/or legal/special permission.

of companies and lowers their expected earnings. Therefore, the increase in CDS premiums of countries has a negative impact on stock prices (Da Silva, 2014, p. 147).

The VIX is also known as the investor fear gauge. Demand for hedging increases and stock prices decrease during the periods when VIX increases. In other words, the increase in VIX affects stock prices negatively (Whaley, 2009, p. 101).

Oil prices can affect the stock market in various ways. An increase in oil prices can increase the production costs of companies and affects stock prices negatively, similar to the increases in other energy prices. On the other hand, increased oil prices in importing countries negatively affect the balance of payments, cause a deterioration in the current account, and create depreciation pressure on the domestic currency. The upward pressure caused by the increasing nominal exchange rate in inflation leads to decreasing effects in stock prices through increased discount rates. Therefore, the increases in oil prices are expected to negatively affect stock prices (Huang, Masulis and Stoll, 1996, p. 5).

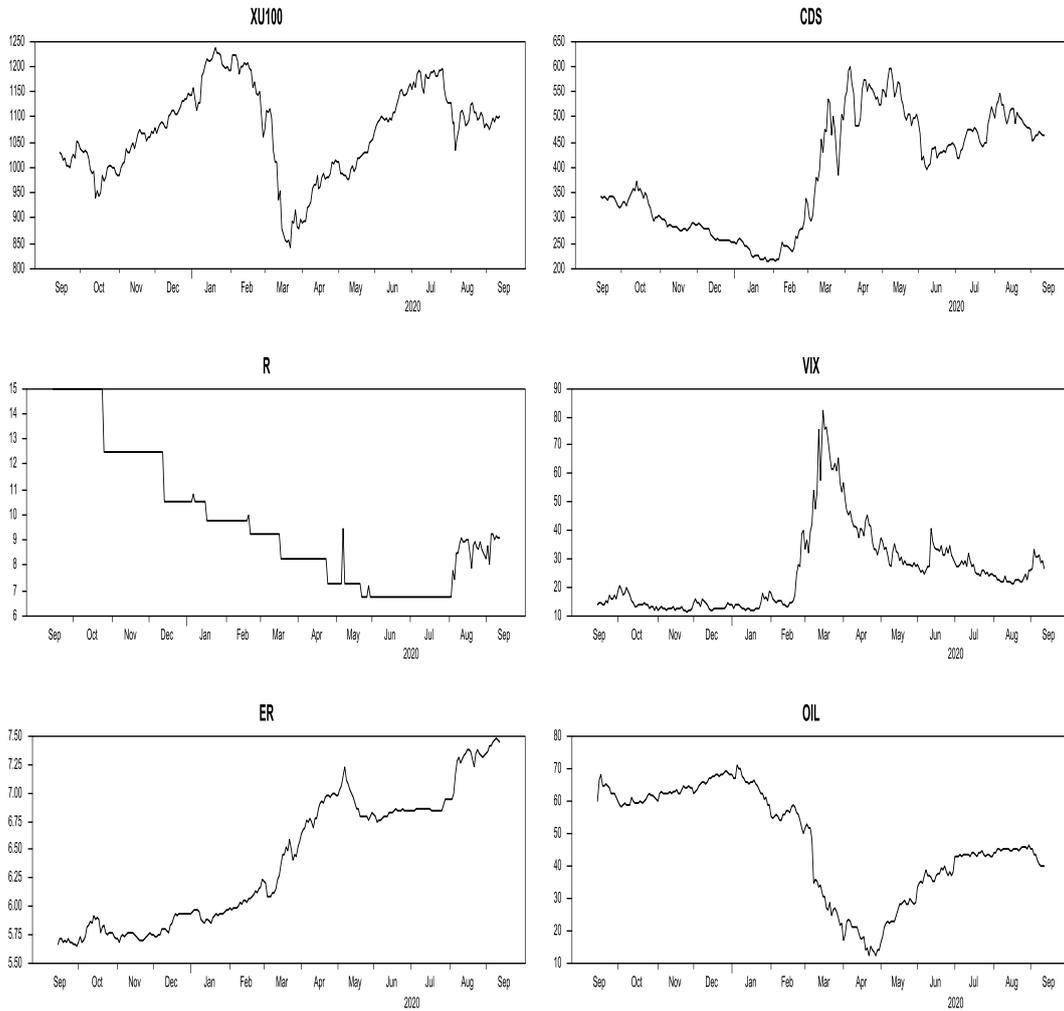
Table 1 presents the descriptive statistics of the series used in the analysis. Based on the Jarque-Bera values, the series are not normally distributed. Moreover, high standard deviations and the high difference between the minimum and maximum values indicate that the variables follow a highly volatile course.

**Table 1. Descriptive Statistics**

Variables	Obs.	Mean	Std. Dev.	Min.	Max.	Jarque-Bera	Prob.
$xu100_t$	261	1073.039	89.558	842.460	1235.560	6.583	0.037
$r_t$	261	9.703	2.631	6.750	15.000	26.496	0.000
$er_t$	261	6.402	0.569	5.648	7.473	24.326	0.000
$cds_t$	261	388.401	112.972	215.120	600.560	21.540	0.000
$vix_t$	261	25.613	14.095	11.540	82.690	170.320	0.000
$oil_t$	261	47.291	16.269	12.220	70.890	19.389	0.000

Figure 1, in which the time series paths of the variables are presented, indicates sharp increases and decreases in the BIST 100 index. Similar to the other stock markets in the world, the BIST 100, which was on the rise towards the end of 2019 and reached a historical peak with 1235 points on 21 January, rapidly fell due to pandemic concerns. After the 842 points observed in March, the recovery trend was observed in the summer of 2020 and the index moved towards the pre-pandemic level.

Interest rates, which gradually decreased since the beginning of the sampling period, slightly increased since August 2020 due to the upward trend of the exchange rate. Furthermore, there was a substantial increase in the exchange rate since the early periods of the pandemic. The exchange rate, which was under control since mid-May, continued to increase since August 2020.



**Figure 1. Time Series Plots**

CDS, which was above 570 points following the exchange rate shock in August 2018, declined the 215 in January 2020 due to the increased risk appetite in global financial markets, and sharply increased since then, similar to the VIX. Despite the VIX declined after the historical peak on March 16, CDS maintained high levels due to the continuing idiosyncratic risks of Turkey.

The sharp decline in oil prices in March 2020 was both due to the drop in demand during the pandemic and the increase in the supply amount as a result of the conflict between the oil-producing countries. Oil prices, which gradually increased in the following months, settled down around \$ 40 and have not reached the pre-pandemic levels.

### 3. Methodology

In this study, the estimation method with time-varying parameters is used to reveal the effects of the pandemic. Given such scope, the effects of macroeconomic variables on BIST 100 are estimated with the FLS method by Kalaba and Tesfatsion (1989) in a time-varying structure. FLS estimator that allows the change of coefficient signs and quantitative magnitudes of explanatory variables over time.<sup>4</sup> The methodology of the FLS estimator is explained in this section.

The standard linear regression model includes the dependent variable  $y_t$  and the  $p$  number of independent variables between  $x_1, \dots, x_p$ . These explanatory variables include a predictor column vector  $(x_{1t}, \dots, x_{pt})'$ . In the model, where  $y_t$  is assumed to be successfully explained by  $x_t'\beta$ ,  $\beta$  is the  $p$  – dimensional regression parameters vector. In the Ordinary Least Squares (OLS) regression estimated vector parameter  $\beta$  is obtained by minimizing the cost function:

$$C(\beta) = \sum_{t=1}^T (y_t - x_t'\beta)^2 \quad (2)$$

Both the dependent variable  $y_t$  and the estimator vector  $x_t$  are the observations of the co-evolving data stream at time  $t$  and the linear dependence between  $y_t$  and  $x_t$  can change and develop dynamically over time. The FLS estimator generalizes this standard linear regression model to allow for the time-varying regression coefficients. This approach consists of minimizing a penalized version of the OLS cost function as indicated previous equation (Montana, Triantafyllopoulos and Tsagaris, 2009, pp. 2821-2822).

A main advantage of the FLS algorithm is that it does not require any distribution assumptions. It solves the linear regression problem that changes over time with minimum assumptions. Suppose  $y_t$  is a time series appropriate for the time-varying coefficient model for period  $t$ :

$$y_t = x_t'\beta_t + \varepsilon_t, \quad t = 1, \dots, T \quad (3)$$

The endogenous variable vector  $y_t$  is estimated by  $x_t = (x_{0,t}, \dots, x_{K-1,t})'$  exogenous variables vectors with  $K \times 1$  dimension. The time-varying estimated coefficients vector and error term are indicated with  $\beta_t = (\beta_{0,t}, \dots, \beta_{K-1,t})$  and  $\varepsilon_t$ , respectively. The FLS method has two main assumptions:

$$y_t - x_t'\beta \approx 0, \quad t = 1, \dots, T \quad (4)$$

$$\beta_{t+1} - \beta_t \approx 0, \quad t = 1, \dots, T - 1 \quad (5)$$

In this model, the prior measurement specification states that the residual errors of the regression are small, and the prior dynamic specification states that the coefficient vector evolves slowly over time (Darvas and Varga, 2014, p. 1439).

These two different model specification errors, for models 4 and 5 can be associated with each possible sequence of coefficient estimates,  $\beta = (\beta_1, \dots, \beta_t)$ . First,  $\beta$  might not fulfill the prior measurement specification (4). Second,  $\beta$  might not meet the prior dynamic specification (5). Suppose the cost assigned for the first error type is measured by the sum of squares of

<sup>4</sup> In this study, the estimation of FLS is performed with the Eviews tvpuni add-in provided by Ocakverdi (2019).

residual measurement errors. Assume that the cost assigned to  $\beta$  for the first type of error is measured by the sum of squared residual measurement errors:

$$SSR_{ME}(\beta; T) = \sum_{t=1}^T (y_t - x_t' \beta_t)^2 \quad (6)$$

The cost assigned to the second type of error for  $\beta$  is measured by the sum of squared residual dynamic errors (Kalaba and Tesfatsion, 1989, p. 1218):

$$SSR_{DE}(\beta; T) = \sum_{t=1}^{T-1} (\beta_{t+1} - \beta_t)' (\beta_{t+1} - \beta_t) \quad (7)$$

The FLS method aims to assign the two types of residual errors to each possible coefficient sequence estimate. A quadratic cost function is assumed to be in the following form:

$$C(\beta_1, \dots, \beta_t, \mu, T) = \mu \sum_{t=1}^{T-1} (\beta_{t+1} - \beta_t)' (\beta_{t+1} - \beta_t) + \sum_{t=1}^T (y_t - x_t' \beta_t)^2 \quad (8)$$

Here,  $\mu$  is the weighting parameter (Darvas and Varga, 2014, pp. 1439-1440). This cost function is a linear combination of the sum of squares of measurement and dynamic specification errors. The weighting parameter is used to determine the balance between a smooth coefficient or a better model fit. If  $\mu = \infty$ , it is assumed that FLS descends to the classical least-squares problem. Furthermore, if  $\mu = 0$ , the measurement error goes to zero, thus the model exactly fits the dependent variables. These two conditions indicate that the solution to the FLS algorithm depends on the choice of  $\mu$  (Soybilgen and Eroğlu, 2019, p. 7). The FLS solution at time  $T$  can be written over the  $\mu$  condition as follows:

$$\beta^{FLS}(\mu, T) = \left( \beta_1^{FLS}(\mu, T), \dots, \beta_T^{FLS}(\mu, T) \right) \quad (9)$$

The time-varying coefficient of the  $k^{th}$  regressor at time  $t$  can be shown with  $\beta_{t,k}^{FLS}$ . Following Soybilgen and Eroğlu (2019), the confidence bands are calculated based on standard errors of the time-varying coefficients. In this context, standard deviation of time-varying coefficients over the whole sample is calculated. Then one standard error bands corresponding to the confidence interval of time-varying coefficients are calculated employing the following formula:  $[\beta_{t,k}^{FLS} \pm SE(\beta_{T,k}^{FLS})]$ , where  $SE(\beta_{T,k}^{FLS})$  represents the one standard deviation of the time-varying coefficients of  $k$  for the whole sample (Çatık, 2020, p. 67).

The sum of squares of residual measurement errors and dynamic errors that corresponds to the FLS solution can be represented as:

$$SSR_{ME}(\mu; T) = SSR_{ME}(\beta^{FLS}(\mu; T); T) \quad (10)$$

$$SSR_{DE}(\beta; T) = SSR_{DE}(\beta^{FLS}(\mu; T); T) \quad (11)$$

#### 4. Empirical Findings

The stationarity of the macroeconomic variables is examined before analyzing their impacts on BIST 100. Hence, Zivot and Andrews (1992) and Lumsdaine and Papell (1997) unit root tests<sup>5</sup>, which allow testing the stationarity of series under structural breaks, are used. Unit root test results are presented in Table 2 and Table 3.

<sup>5</sup> Unit root test methodologies are explained in the Appendix.

**Table 2. Zivot and Andrews (1992) Unit Root Test Results**

Variables	Level			First Difference		
	Intercept	Trend	Intercept and Trend	Intercept	Trend	Intercept and Trend
$xu100_t$	-3.8432 (27:02:2020)	-1.7121 (19:11:2019)	-3.7554 (27:02:2020)	-10.3405*** (24:03:2020)	-9.6003*** (10:03:2020)	-10.3301*** (24:03:2020)
$r_t$	-2.5971 (21:07:2020)	-3.7310 (03:06:2020)	-3.7898 (08:05:2020)	-22.9581*** (13:12:2019)	-22.9219*** (25:05:2020)	-23.0266*** (08:05:2020)
$er_t$	-3.7628 (11:03:2020)	-2.2214 (24:04:2020)	-3.6071 (11:03:2020)	-14.7911*** (08:05:2020)	-14.1031*** (17:03:2020)	-14.9683*** (08:05:2020)
$cds_t$	-4.8447** (05:03:2020)	-1.8524 (07:05:2020)	-4.3403 (05:03:2020)	-14.5009*** (07:04:2020)	-14.2626*** (09:03:2020)	-14.5433*** (07:04:2020)
$vix_t$	-5.1657** (20:02:2020)	-2.5648 (13:03:2020)	-5.9560*** (24:02:2020)	-19.7625*** (17:03:2020)	-18.9182*** (25:02:2020)	-19.7916*** (17:03:2020)
$oil_t$	-2.8700 (24:02:2020)	-2.4088 (02:04:2020)	-4.7565 (06:03:2020)	-18.6800*** (23:04:2020)	-16.7730*** (10:03:2020)	-18.8339*** (29:04:2020)

Note: \*\*\*, \*\* and \* indicate stationary at 1%, 5% and %10% levels, respectively.

**Table 3. Lumsdaine and Papell (1997) Unit Root Test Results**

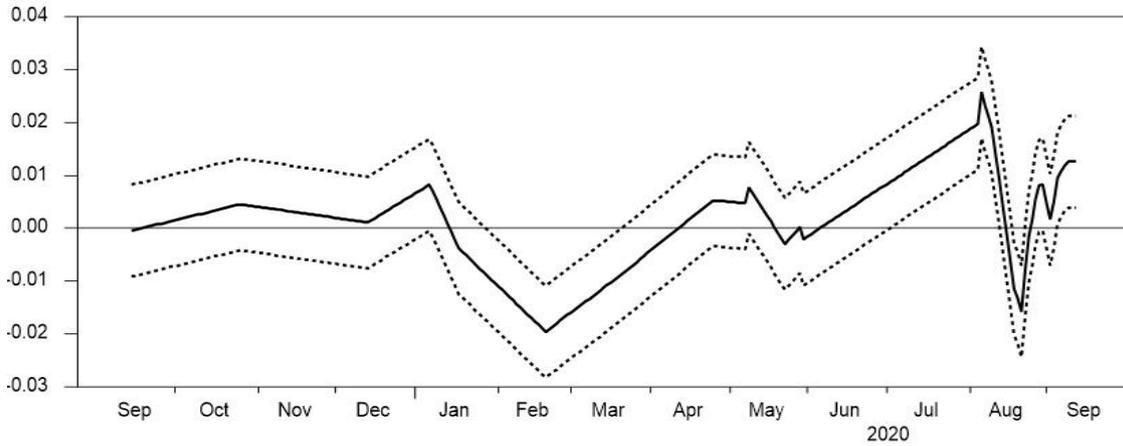
Variables	Level			First Difference		
	Model A (Intercept)	Model CA (Trend)	Model CC (Intercept and Trend)	Model A (Intercept)	Model CA (Trend)	Model CC (Intercept and Trend)
$xu100_t$	-4.7414 (26:02:2020) (21:07:2020)	-3.9679 (20:01:2020) (12:03:2020)	-5.7714 (05:03:2020) (20:07:2020)	-10.6044*** (21:01:2020) (23:03:2020)	-9.9018*** (12:03:2020) (05:05:2020)	-11.6428*** (08:01:2020) (18:03:2020)
$r_t$	-3.8443 (12:12:2019) (21:07:2020)	-5.1491 (19:12:2019) (26:06:2020)	-5.6938 (12:12:2019) (30:06:2020)	-23.1473*** (12:12:2019) (07:05:2020)	-22.8846*** (25:05:2020) (21:07:2020)	-23.1053*** (16:03:2020) (07:05:2020)
$er_t$	-4.2566 (10:03:2020) (21:07:2020)	-3.1219 (04:02:2020) (31:03:2020)	-5.2350 (10:03:2020) (07:05:2020)	-15.0076*** (19:12:2019) (07:05:2020)	-14.4393*** (31:03:2020) (22:05:2020)	-15.2325*** (10:03:2020) (07:05:2020)
$cds_t$	-5.3164 (04:03:2020) (03:07:2020)	-5.1007 (27:01:2020) (19:03:2020)	-5.9430 (10:01:2020) (05:03:2020)	-14.8825*** (06:02:2020) (03:04:2020)	-14.4022*** (12:03:2020) (18:05:2020)	-15.1716*** (07:01:2020) (18:03:2020)
$vix_t$	-6.6254** (21:02:2020) (21:04:2020)	-4.7601 (15:01:2020) (09:03:2020)	-6.6090* (21:02:2020) (10:06:2020)	-19.9985*** (20:01:2020) (16:03:2020)	-19.3029*** (27:02:2020) (21:04:2020)	-20.6881*** (20:02:2020) (14:04:2020)
$oil_t$	-5.9676* (05:03:2020) (30:04:2020)	-3.8182 (29:01:2020) (23:03:2020)	-5.8365 (05:03:2020) (30:04:2020)	-18.9449*** (20:11:2019) (22:04:2020)	-17.7314*** (23:03:2020) (14:05:2020)	-19.3899*** (05:03:2020) (28:04:2020)

Note: \*\*\*, \*\* and \* indicate stationary at 1%, 5% and %10% levels, respectively.

Table 2 and Table 3 indicate that the series had unit root at level values. However, the first differences indicate that the series became stationary at the 1% significance level. Therefore, the first differences of the series are used in the analysis.

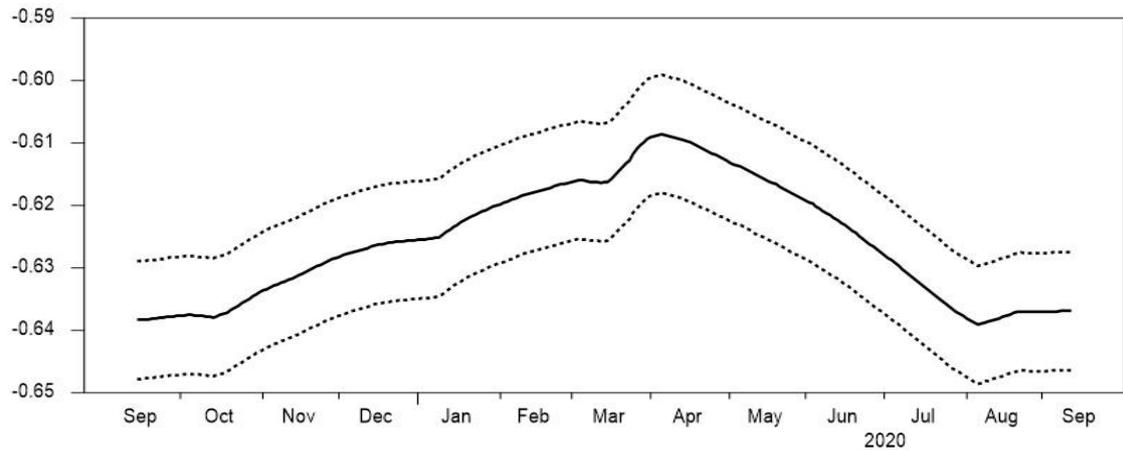
Following the testing of stationary properties of the series, the effects of macroeconomic variables on BIST 100 are analyzed using the FLS method, which allows for the coefficient

estimation that changes over time. The time-varying impacts of macroeconomic variables on BIST 100 are presented in Figures 2 to 6.<sup>6</sup>



**Figure 2. The Time-Varying Impact of Interest Rate on BIST 100**

Figure 2 indicates that the interest rate with a quite low coefficient did not have a significant effect on BIST 100, except for certain periods. There was a negative and significant effect of the interest rate on BIST 100 and this effect started right before the pandemic and lasted until the end of March 2020. Moreover, it is determined that the interest rate had a positive and significant effect on BIST 100 between the beginning of July and mid-August 2020.

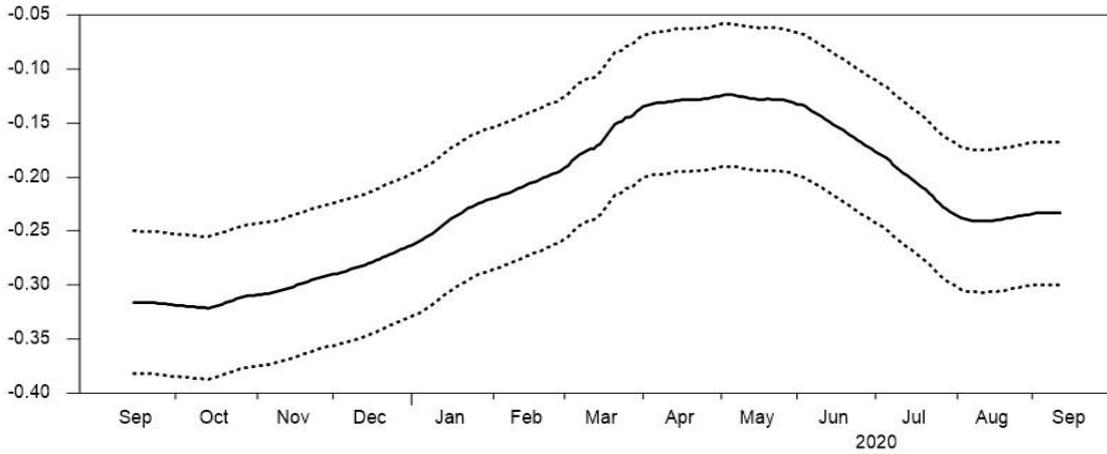


**Figure 3. The Time-Varying Impact of Exchange Rate on BIST 100**

Parallel to the findings of Acikalin, Aktaş and Unal (2008), Kaya, Çömlekçi and Kara (2013), Poyraz and Tepeli (2015), Cankal (2015), Sancar, Uğur and Akbaş (2017), Yiğiter, Karabulut and Sarı (2018), Uslu and Uzkaralar (2020) and Gülhan (2020), the exchange rate

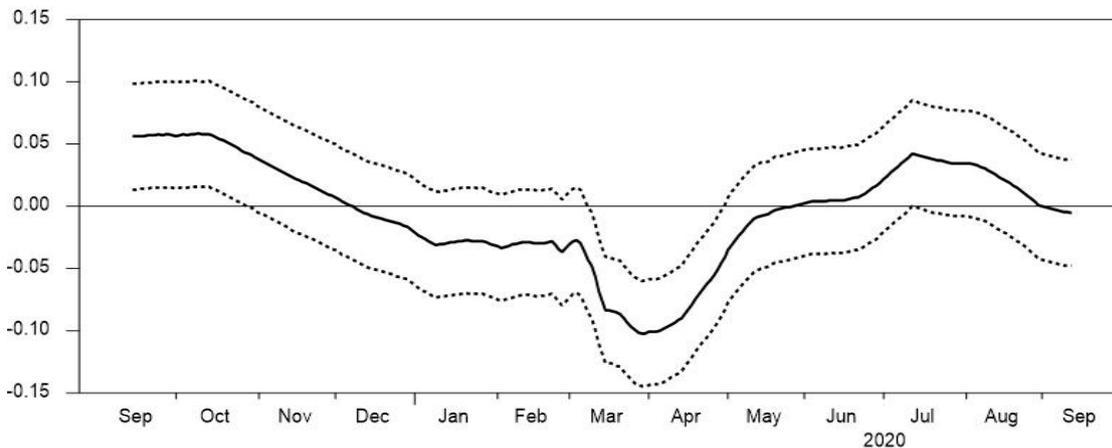
<sup>6</sup> In the figures, solid line indicates the coefficients that estimated, while dashed lines show the confidence bands. The confidence bands indicate whether the coefficients are significant. If both confidence bands are positive or negative, the coefficient is significant.

negatively affected BIST 100 in the whole sample. The highest quantitative coefficient among other explanatory macroeconomic variables in the model is the exchange rate with a mean of -0.62.



**Figure 4. The Time-Varying Impact of CDS Premium on BIST 100**

Figure 4 indicates that the CDS premium significantly and negatively affected BIST 100 before and during the pandemic. According to this finding, which consistent with the findings of Hancı (2014), Akyol and Baltacı (2018), and Topalođlu and Ege (2020), the increases in CDS had a decreasing effect on BIST 100. Furthermore, the decreasing coefficient magnitude increased during the pandemic period again.



**Figure 5. The Time-Varying Impact of VIX on BIST 100**

The studies, which analyzed the effect of VIX on BIST 100, demonstrate that the increases in VIX led to decreases in BIST 100 (Gülhan, 2020; Hatipođlu and Tekin, 2017; Kaya and Cořkun, 2015; Sakarya and Akkuř, 2018). However, it is found that VIX did not have a significant effect on BIST 100, except at the beginning of the sample and the period between 9 March and 29 April 2020.

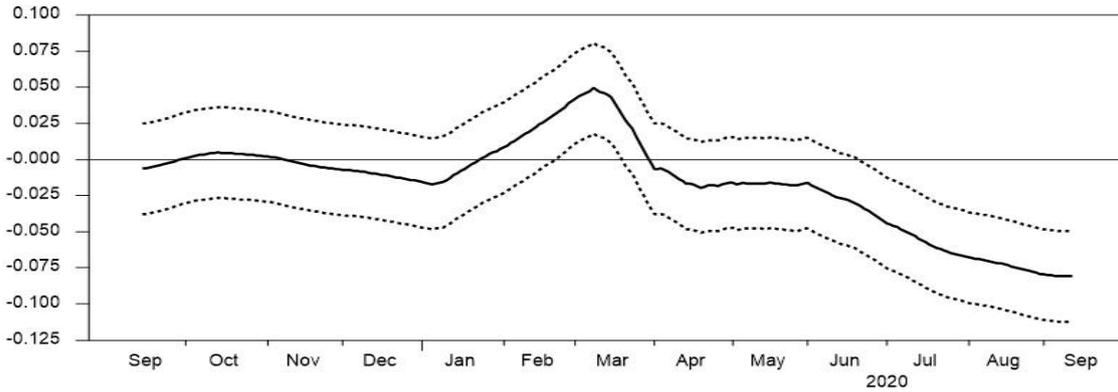


Figure 6. The Time-Varying Impact of Oil Price on BIST 100

It is determined that the effect of oil prices on BIST 100 in pre-COVID-19 was insignificant, similar to the findings of Kandir (2008), Sandal, Çemrek and Yıldız (2017), Dayıoğlu and Aydın (2019), Konuşkan and Kocabıyık (2019), Fattah and Kocabıyık (2020). However, the sharp decline in oil prices between 24 February and 19 March 2020 had a significant effect on the decreases in BIST100. It is possible to state that the effect, which was significant again after the end-June 2020, turned negative and the coefficient increased quantitatively.

## 5. Conclusion

COVID-19 pandemic, which hit the world economy, also caused severe trauma in financial markets. Besides the uncertainty created by the pandemic, fluctuations in macroeconomic variables have increased volatility in the developed and emerging stock markets. In this context, this study analyzed the effect of the macroeconomic variables on BIST 100 using the FLS method for the period of 13 September 2019 to 11 September 2020.

Based on empirical findings, it is possible to state that the pandemic influenced the time-varying impact of macroeconomic variables on BIST 100. The interest rate and VIX affected BIST 100 negatively and significantly since the right before of the pandemic until April 2020 and at the beginning of the pandemic period, respectively. The sharp decline in oil prices started right before the pandemic and had a decreasing effect on BIST 100 until mid-March 2020. On the other hand, oil prices, which gradually increased since May, negatively affected stock prices since end-June, consistent with the theoretical expectations. Although the negative effect of the exchange rate and CDS on BIST 100 did not change in the whole sample, the decreasing coefficient magnitude started to increase in the pandemic.

Once the quantitative magnitude of the time-varying coefficients is considered, it is determined that the exchange rate is the macroeconomic variable with the highest impact on BIST 100. It is possible to explain the strong negative impacts of exchange rate fluctuations on BIST 100 for several reasons. In Turkey, the share of intermediate goods in the composition of imports are quite high (Ertuğ, Özlü, Özmen and Yüncüler, 2020). Companies with considerable use of imported goods are particularly sensitive to fluctuations in exchange rates. Therefore, it is expected that the exchange rate, which sharply increased during the pandemic, will negatively affect stock prices through the cost channel. Another reason for the negative effect of exchange

rate fluctuations on BIST 100 may be the substitution relationship between stocks and foreign currency assets. Foreign exchange deposits held by residents, which were 194.1 billion dollars in the week of 3 April 2020, increased to 219.5 billion dollars in the week of 7 August 2020 (CBRT, 2020c). Hence, the exchange rate, which affects the cost channel of companies and the value of assets that are substituted for stocks, has continued to strongly affect the BIST 100 in the pandemic.

The impact of COVID-19, which strongly shakes the macroeconomic fundamentals, on stock markets is likely to continue in the near future. Besides internal risks, fluctuations in macroeconomic variables can make it difficult to stabilize prices in the stock market in COVID-19. In this context, it is possible to state that closely monitoring macroeconomic variables, notably the exchange rate, may be beneficial for policymakers and investors.

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## APPENDIX

### Unit Root Test Methodologies

In this study, Zivot and Andrews (1992) and Lumsdaine and Papell (1997) unit root tests, which allow testing the stationarity of series under structural breaks, are employed. Zivot and Andrews (1992) are estimated the structural breaks endogenously, which supposed exogenous in the unit root test developed by Perron (1989). In this test, it is assumed that there is a single structural break in constant, trend, and both. The regression equations in which the unit root is tested are as follows:

$$\text{Model A: } y_t = \mu + \beta t + \delta y_{t-1} + \theta_1 DU(\varphi) + \sum_{i=1}^k c_i \Delta y_{t-i} + e_t \quad (\text{A.1})$$

$$\text{Model B: } y_t = \mu + \beta t + \delta y_{t-1} + \theta_2 DT(\varphi) + \sum_{i=1}^k c_i \Delta y_{t-i} + e_t \quad (\text{A.2})$$

$$\text{Model C : } y_t = \mu + \beta t + \delta y_{t-1} + \theta_1 DU(\varphi) + \theta_2 DT(\varphi) + \sum_{i=1}^k c_i \Delta y_{t-i} + e_t \quad (\text{A.3})$$

According to these regression equations, Model A, Model B, and Model C reflect models with the break in constant, trend, and both, respectively. For  $t = 1, \dots, T$ ,  $\varphi = T_B/T$  in the range from  $j = 2/T$  to  $j = (T - 1)/T$  denotes the breakpoint.  $DU$  and  $DT$  are the dummy variables that reflect the structural break in level and trend, respectively are expressed as follows:

$$DU(\varphi) = \begin{cases} 1 & t > T_B \\ 0 & t \leq T_B \end{cases} \quad DT(\varphi) = \begin{cases} t - T\varphi & t > T\varphi \\ 0 & t \leq T\varphi \end{cases} \quad (\text{A.4})$$

For each value of  $\varphi$ ,  $k$  number of additional estimators are determined similar to Perron's (1989) procedure and  $t$ -statistics are calculated for  $(T - 2)$  number of regressions. Model A, Model B, and Model C are estimated by the least squares method and the time corresponding to the least  $t$ -statistic is defined as the breakpoint (Zivot and Andrews, 1992, pp. 253-255). After the breakpoint is determined if the absolute value of  $t$ -statistic obtained is less than the critical value calculated by Zivot and Andrews (1992), the null hypothesis that indicates the existence of unit root is not rejected (Yıldırım Tıraşođlu, 2014, p. 74).

Unlike Zivot and Andrews (1992), the unit root test developed by Lumsdaine and Papell (1997) is expanded to allow two structural breaks for the following models; namely, Model AA, Model CA, and Model CC. Model AA only allows two structural breaks in the constant, whereas model CA allows for one break in the trend and two at the constant. On the other hand, Model CC allows two structural breaks at both constant and trend. Accordingly, Model CC is expressed as follows:

$$\Delta y_t = \mu + \beta t + \delta y_{t-1} + \phi_1 DU1_t + \theta_1 DT1_t + \phi_2 DU2_t + \theta_2 DT2_t + \sum_{i=1}^k c_i \Delta y_{t-i} + e_t \quad (\text{A.5})$$

Here, for  $t = 1, \dots, T$ ,  $DU1_t$ ,  $DT1_t$ ,  $DU2_t$  and  $DT2_t$  are the dummy variables corresponding to the breaks at time  $T_{B1}$  and  $T_{B2}$ .  $DU1_t$ ,  $DT1_t$ ,  $DU2_t$ , and  $DT2_t$  are defined as follows:

$$DU1_t = \begin{cases} 1 & \text{if } t > T_{B1}, \\ 0 & \text{otherwise} \end{cases} \quad (\text{A.6})$$

$$DT1_t = \begin{cases} t - T_{B1} & \text{if } t > T_{B1}, \\ 0 & \text{otherwise} \end{cases} \quad (\text{A.7})$$

$$DU2_t = \begin{cases} \text{if } t > T_{B2}, & 1 \\ \text{otherwise} & 0 \end{cases} \quad (\text{A.8})$$

$$DT2_t = \begin{cases} \text{if } t > T_{B2}, & t - T_{B2} \\ \text{otherwise} & 0 \end{cases} \quad (\text{A.9})$$

Dummy variables  $DU1$  and  $DU2$  correspond to the first and second break in the constant,  $DT1$  and  $DT2$  to the first and second break in the constant and trend. Removing  $DT2$  from Model CC, the remaining model is defined as Model CA. Omitting  $DT1$  and  $DT2$  from Model CC, the remaining model is defined as Model AA. When choosing between models, rather than expanding Zivot and Andrew’s (1992) model selection; the model in which the null hypothesis is rejected at the higher significance level is considered (Lumsdaine and Papell, 1997, pp. 212-217). The null hypothesis states that the series has a unit root without a structural break, while the alternative hypothesis states that the series is stationary with two breaks (Akbaş, Zeren and Özekicioğlu, 2013, pp. 191-192).