International Journal of Social Inquiry *16*(1), 2023, pp.13–27
journal homepage: https://dergipark.org.tr/en/pub/ijsi

International Journal of Social Inquiry
International Peer-Reviewed Open Access Electronic Journal
E-ISSN: 1307-9999
Volume 16 Issue 1 June 2023

RESEARCH ARTICLE
https://doi.org/10.37093/ijsi.1190098

Prediction of Economic Crisis Period with Logistic Regression Analysis Based on the Trading Volume of Companies in the Stock Exchange Istanbul

Erkan Işığıçok[*] Savaş Tarkun[**]

Abstract

The prediction of an economic crisis is the most critical area of study for all actors related to the economy. Crises, a sign of uncertainty, do not have a specific timeline, but they can be predicted by analyzing particular indications. Studies on predicting the crisis are commonly related to macroeconomic variables. This study addresses an alternative approach to predicting crisis periods, which involves analyzing changes in the trading volumes of companies listed on Borsa Istanbul (BIST) instead of relying solely on macroeconomic variables. The study aims to examine the transaction volume data from 169 firms that regularly traded in BIST between 2000 and 2018. The predictability of economic crises in Türkiye has been investigated by applying binary logistic regression analysis, a methodology commonly employed in the literature as a signal approach for detecting economic crises. Some statistically significant parameters were discovered positive, and some were found negative in estimated logistic regression models, and the companies to which the statistically insignificant parameters belonged were evaluated as companies that did not give a signal for the economic crisis model. The findings suggest that changes in the trading volume of many companies, not just a few ones, can be a valuable predictor of crises.

Keywords: Binary logistic regression, economics crisis, Stock Exchange Istanbul, crisis prediction, early warning

JEL Codes: C01, C1, C10, C25, C40

Cite this article: Işığıçok, E., & Tarkun, S. (2023). Prediction of economic crisis period with logistic regression analysis based on the trading volume of companies in the Stock Exchange Istanbul. *International Journal of Social Inquiry*, *16*(1), 13–27. https://doi.org/10.37093/ijsi.1190098

[*] Prof. Dr., Faculty of Economics and Administrative Sciences, Department of Econometrics, Bursa Uludağ University, Bursa, Türkiye. E-mail: eris@uludag.edu.tr, ORCID: https://orcid.org/0000-0003-4037-0869

[**] Ph.D. Candidate, Institute of Social Sciences, Department of Econometrics, Bursa Uludağ University, Türkiye (Corresponding author). E-mail: 711817007@ogr.uludag.edu.tr, ORCID: https://orcid.org/0000-0002-2684-184X

Article Information

Received 16 Oct 2022; Revised 22 Nov 2022; Final Revised 15 Dec; Accepted 27 Dec 2022; Available online 30 June 2023

1. Introduction

Economic crises, one of the essential factors of economic history, emerged in the 19th century and showed their existence in different dimensions (war, financial speculation, famine, etc.) in the 20th and 21st centuries. These crises include the ones that occurred in 1900, 1907, 1920, 1929's Great Depression, and 1973's energy shocks. Due to the acceleration of globalization after the 1990s, crises have been frequently created in various regions of the world depending on the change in size. For instance, depending on the European Monetary System, in 1992–1993 Europe; in 1994, Mexico; and in 1997–1998, the "tequila effect" 1998 in Asia, 1999 in Russia 2000–2001 in Brazil Thailand, 2001, and Argentina experienced the "2008 American mortgage crisis," which has expanded to other countries (Yücel & Kalyoncu, 2010, p. 54).

The term "crisis" is used in economic language to refer to a situation where events occur suddenly and unexpectedly, considerably shaking the nation's economy. This relates to terms like "depression," "recession," "difficult period," or "depression."

Numerous studies on the definition of a financial crisis have been published in the literature. The following list of some of these is an overview: *Financial crisis*, according to Mishkin (1999), is the non-linear distortions that come from inefficient use of funds as a result of moral hazard and adverse selection issues getting worse in financial markets with good investment possibilities. Another definition says that it generally refers to the extreme variations that surpass the acceptable range of change for any good, service, production factor, price, or quantity in the financial market (Erdoğan, 2006, p. 5). According to Goldstein and Turner (1996), the financial crisis is the rapid, abrupt, sudden, and visible deterioration of all or most financial indicators, such as short-term interest rates, asset values, payment declines, and bankruptcies with the bankruptcy of financial institutions. On the other hand, Kindleberger et al. (2005) defines financial crises as a fundamental element of the turn at the apex of the conjuncture and an inevitable result of the previous expansion. According to a different study, financial crises are shocks that have a contagious and widespread impact on a country's economy at the macro level and firms and individuals at the micro level due to some previously unanticipated and unexpected developments in the macroeconomic balances of a country's economy (Yavaş, 2007).

Prediction of crises constitutes one of the most important agenda items for individuals, companies, and states, as well as institutions that we can define as transnational institutions. It has emphasized the value of crises being predictable after previous or upcoming crises. Studies on this topic have been done in the literature for a very long time in academic circles. In addition to the academic setting, it is well known that government organizations like central banks and the Treasury are in charge of overseeing risk, as well as organizations that conduct studies on the world's economic and financial condition, such as the IMF.

This study discusses the level of analysis of the stock exchange, which is one of the variables used in economic crisis studies. Knowing which variables or businesses react during a crisis can be seen as a leading indicator of the economic crisis, at least for the foreseeable future.

Although there are varying views regarding the start and end dates (periods) of the crisis periods, the following methodology has been used to identify the crisis periods. According to the CBRT (Central Bank of the Republic of Türkiye), November 20, 2000, when there was a 7.1% decrease in the ISE (BIST) index, was taken as the start date of the crisis and immediately after the crisis, the CBRT is to reduce its deposit provisions from 6% to 4% as of January 12, 2001,

the fact that 1.688 trillion funds were provided to the market with the API on November 22, 2000, and that it brought some conveniences to banks in liquidity applications the effect of the crisis has not to be alleviated. On November 29, 2000, it announced that decreasing the CBRT's net reserve value of 13.5 billion dollars, which was targeted as the year-end figure, would return to the old practice in monetary policy by fixing net domestic assets and that liquidity would be released only in exchange for foreign currency. When this was added, turning their portfolios of foreign investors into liquidity, Demirbank, one of the market makers, was transferred to the SDIF (TCMB-CBRT, 2002, pp. 93–94).

Before February 2001, the Treasury's heavy domestic debt redemption to meet the excessive domestic foreign exchange demand the CBRT's selling 7.6 billion one-day sales, and the cancellation of 6.1 billion dollars of this amount due to the Bank's tight monetary policy, interest rates in the Interbank Money Market by Caused it to rise to %2300. The Central Bank sold USD 3.5 billion in foreign currency on February 21 in order to fulfill the rising demand for foreign currency, which increased the severity of the liquidity crisis in the market (TCMB-CBRT, 2003, p. 89).

2. Literature Review

As a result of the comprehensive literature review, it is noteworthy that studies on the prediction of the economic crisis are commonly related to macroeconomic variables. In the literature, studies developed for logistic regression and macroeconomic variables and the estimation of crisis periods are mentioned.

The Frankel and Rose model (1996, p. 3) is one of the most popular probit models used to calculate the likelihood of a crisis. This model defines a crisis as a 25% depreciation of the currency rate or a 10% yearly devaluation.

Frankel & Rose (1996), using the probit model and annual data, estimated the crisis models of 102 countries between 1970 and 1992. They discovered evidence in favor of the first-generation models.

In 1998, Esquivel and Larrain (1998) conducted a probit model analysis. Only successful speculative attacks are considered crises in the model, and the term "crisis" is defined as abrupt fluctuations in the nominal exchange rate.

In their 2001 study, Kamin, Schindler, and Samuel tried to determine which exchange rate system "flexible or fixed" is more beneficial when designing economic strategies in emerging nations (Kamin et al., 2001). This model accepts that if internal imbalances cause financial crises, economic policies based on fixed exchange rates will be meaningful, and if they are caused by external variables, it will be more expensive to implement a fixed exchange rate. The "crisis" is defined as the average change in the real exchange rate and international reserves (Gür & Tosuner, 2002, p. 28).

Woo et al. (2000) used the logit model to investigate the currency crises that occurred in Malaysia, the Philippines, South Korea, Thailand, and Indonesia between 1997 and 1998. They claimed that financial contagion was the primary cause of the Asian crisis and that macroeconomic indicators were insufficient for gauging the crisis (Woo et al., 2000).

Using the logit model, analyze Türkiye's crises between 1994 and 2001. They have demonstrated that economic crises occur where political instability increases risk premiums and false welfare enhancements are created by supporting interest rate scissors used in

expansionary policies (Gerni et al., 2005). Also, he looked into the causes of the economic crisis in Türkiye by examining the relationship between several macroeconomic indicators and the real exchange rate (Demirhan et al., 2010).

In another study, they examined various macroeconomic variables to determine the leading indicators that allow the estimation of the 2008 economic crisis using annual data from Türkiye, Greece, the United States, England, and Italy from 2005 to 2011, as well as trend analysis. The study's findings revealed that, with the exception of GNP per capita and current account deficit/GNP, all ratios can be used as crisis warning indicators (Aktaş & Şen, 2013).

Undoubtedly, they have been included in the logistic regression applications in studies on banking crises. Caggiano et al. (2016) used binomial and multinomial logit models to develop an early warning system for banking crises. They compared the binomial and multinomial logit models in their study, which examined macroeconomic indicators from various countries, and concluded that the multinomial logit model outperformed the binomial logit model (Caggiano et al., 2016). They conducted a similar study for low-income countries in Sub-Saharan Africa and found similar results (Caggiano et al., 2014). Using the indicators recommended by the European Commission, it was carried out with logistic regression and annual observations covering the period 2005–2019. He proposed that this model, which has an accuracy rate of 89%, be used as an early warning system (Străchinaru, 2022). In their study, they proposed an early warning system for bank crises. In their study, they used multinomial logistic regression to classify banks based on their liquidity (Chen et al., 2022). Studies also look at the brittleness of the Turkish banking system (Akkaya & Kantar, 2019; Telli, 2016). Banking crises were analyzed by Yüksel (2017) in terms of bank loans (Yüksel, 2017).

In their study of the BIST manufacturing sector, Aksoy and Boztosun (2018) used discriminant and logistic regression methods to estimate financial failure. The study's findings revealed that, while the logistic model had a similar classification rate as the discriminant model three years ago, it had a higher classification performance than the discriminant model two and one year ago (Aksoy & Boztosun, 2018).

Dibo and Ulusoy (2018) used logistic regression to examine some basic variables in order to test the existence of external borrowing and the existence of this effect in Türkiye's financial crises. They discovered a significant relationship between the external debt stock/GDP ratio, the central bank reserves/short-term external debt ratio, and the financial crises experienced as a result of the study (Dibo & Ulusoy, 2018). On the other hand, the factors affecting the risks of an economic crisis are analyzed in terms of the current account deficit (Uslu, 2019).

In order to identify the leading indicators of financial crises, Akkaya and Kantar (2018) developed a financial pressure index and applied logit/probit models. The most dependable model among the developed logit and probit models was chosen based on its high R2 value, low Akaike Information Criteria, and high log-likelihood value. The output of the developed logit and probit models also produced relative values (Akkaya & Kantar, 2018).

Akkaya (2021) investigated the validity of the data from the foreign exchange market pressure index developed by Kaminsky and Reinhart in 1999 for Türkiye for the period January 1999–December 2019. In their studies, they tried to determine the leading indicators that may cause financial crises by using this index with the logit model. A significant relationship was discovered between the BIST return index, domestic debt stock, stock portfolio of foreign residents, and index of currency market turbulence in the study, which was examined with various macroeconomic variables (Akkaya, 2021).

In the study of Kaakeh and Gökmenoğlu (2022), Türkiye used probit and logit models as leading indicators of financial crises in 1994, 2000/2001, and 2009. They used a common set of leading indicators such as the current account balance, domestic debt, exports, external debt, and real effective exchange rate. It demonstrates that the three crises in Türkiye are structurally distinct and have distinct characteristics. According to their findings, many basic macroeconomic variables, banking sector stability, and global economic developments are the primary leading indicators for the crisis (Kaakeh & Gökmenoğlu, 2022).

In Tomczak's (2022) study, commercial and financial relations, crisis contamination from the USA and EU countries, and domestic and foreign economic vulnerabilities of countries were examined using logistic regression over the period 2002-2012 to determine the factors that caused the development of the 2007/2008 crisis and its spread in ten European Union countries. According to their findings, the crisis was spread by contagion from the United States and other EU countries, and high inflation, a drop in the exchange rate, and a drop in US long-term interest rates all increased the likelihood of the 2007/2008 financial crisis (Tomczak, 2022).

In their study, Wang and Li (2022) looked at regional economic resilience in 2007-2008 by country and province. They developed a multilevel logistic regression model for the period 2003-2018 after discovering the inequality of province effects on regional performance during the economic crisis. Income inequality, innovation, government intervention, human capital, and financial development variables were investigated as five important indicators of economic resilience. They concluded that it is necessary to focus on regional-based policies based on the findings (Wang & Li, 2022).

Ceci and Silvestrini (2022) in their study, which takes into account the COVID-19 period, focused on the latest periods of the epidemic and made their predictions with the help of a probit model with more than 130 variables belonging to the financial markets in order to make weekly forecasts of the recession probabilities in Italy (Ceci & Silvestrini, 2022).

Many early warning system models, including logit models, have been investigated to predict crises. However, most studies on logit models in the literature are comparable to one another, and in each study, the researchers examined the effects of different model variables on the situation. Concerning the effectiveness of the studies, significant advancements in crisis prediction have been made over time. The most effective and influential of these investigations is the 2002 study by Fratzscher and Bussiere for the European Central Bank (Kıran, 2009, p. 18).

3. Method: Binary Logistics Regression

The independent variables are converted into a linear function to better create a model with categorical dependent variables and to provide the condition $0 \leq E(Y|X) \leq 1$. It is essential to presume that this transformation impacts on the likelihood that $Y = 1$. The most straightforward logit function can be used for this (Hosmer & Lemeshow, 2000, p. 6). The likelihood that Y will have values of 1 and 0 for the following is given by the logit function's values $X1, X2, \ldots, Xk$ (Işığıçok, 2003, p. 2):

$$P(Y = 1|X_1, \ldots, X_k) = \frac{exp\left(\beta_0 + \sum_{j=1}^{k} \beta_j X_j\right)}{1 + exp\left(\beta_0 + \sum_{j=1}^{k} \beta_j X_j\right)} \quad (1)$$

In this way,

$$P(Y=0|X_1,\dots,X_k)=1-\frac{exp\left(\beta_0+\sum_{j=1}^{k}\beta_jX_j\right)}{1+exp\left(\beta_0+\sum_{j=1}^{k}\beta_jX_j\right)}=\frac{1}{1+exp\left(\beta_0+\sum_{j=1}^{k}\beta_jX_j\right)} \quad (2)$$

happens (Işığıçok, 2003, p. 3). Using both equations, the expected value of Y is,

$$E(Y|X_1,\dots,X_k)=1.P(Y=1)+0.P(Y=0)=P(Y=1)$$

obtained and

$$g(X)=\beta_0+\sum_{j=1}^{k}\beta_jX_j \quad (3)$$

including,

$$P(Y=1|X_1,\dots,X_k)=\pi(X)=\frac{exp[g(X)]}{1+exp[g(X)]}=\frac{1}{1+e^{-[g(X)]}} \quad (4)$$

An obtained logit regression model (Hosmer & Lemeshow, 2000, pp. 31–32). The expression g(X) here is called the logit of the logit regression model (Işığıçok, 2003, p. 4). and logit transform between $\pi(X)$ and g(X),

$$g(X)=ln\left[\frac{\pi(X)}{1-\pi(X)}\right]=\beta_0+\sum_{j=1}^{k}\beta_jX_j \quad (5)$$

is possible using the form (Hosmer & Lemeshow, 2000, p. 6). Moreover,

$$Odds\ Ratio=OR=\left[\frac{\pi(X)}{1-\pi(X)}\right]=exp[g(X)]=exp(\beta_0).exp(\beta_1)\dots exp(\beta_k) \quad (6)$$

expression can also be written (Gujarati, 2004, pp. 614–615). The odds ratio is the antilogarithm of the logit expression, as may be seen. The odds value, $e^{\beta}=Exp(\beta)$ is, and its value indicates e^{β_k} value how many times more or how many percent more probability the β_k dependent variable Y is observed with the effect of its X_k variable. $OR_k=Exp(\beta_k)$ is regarded as a test of the coefficient's importance as well (Özdamar, 1999, p. 477).

The logistic regression model's error term is

$$\text{Value } Y=\pi(X)+\varepsilon \quad (7)$$

form of. Here, while its value is ε probability $\varepsilon=1-\pi(X)$ for Y=1, it takes its value with $\pi(X)$ probability $\varepsilon=-\pi(X)$ for Y=0 $1-\pi(X)$. Thus, the error term (ε) of the logistic regression model has a mean of zero and $\pi(X).[1-\pi(X)]$ variance equal to. This means that the conditional distribution of the dependent variable $\pi(X)$ fits the Binomial distribution with the probability given by the conditional mean (Hosmer & Lemeshow, 2000, p. 7).

4. Application and Findings

This analysis uses data on 228 monthly trading volumes of companies traded continuously (on the trading board) at the Istanbul Stock Exchange over the January 2000- December 2018 periods. The dependent variable, crisis, has two possible categorical values: "1 = there is a crisis" and "0 = there is no crisis" (Caggiano et al., 2014, 2016; Tomczak, 2022). On the other hand, while the crisis variable takes the value of 1 in periods of crisis, it takes the value of 0 in periods (months) when there is no crisis

4.1 Data and Variables Used in the Logistic Regression Model

Using this information base, the months that made up the crisis-era were determined to be 2000:01–2000:07 (7 months), 2000:11–2002:02 (16 months), 2008:09–2009:09 (13 months), and 2018:08–2018:12 (5 months). The number of months with a crisis phase out of 228 months is 41 months, whereas the number without a crisis period is 187 months.

After the dependent variable was coded according to the definition above, 20 different models (according to the sector) were estimated with Equations (5) and (6): According to this Equation (5), twenty logistic regression models have been created for the enterprises in question, which are arranged in accordance with the sector-based index separation specified by BIST (Stock Exchange Istanbul). It has been determined which companies are effective predict the crisis for each sector. Since there are many transactions, logarithmic values have been employed. The trading volumes of 169 businesses continuously traded on the stock market during the study period are also included in the models, along with the other research restrictions. Moreover, the data of the daily trading volumes of these companies traded on the stock exchange have been obtained by taking their monthly averages and converting them to monthly data. The companies included in this study, along with the sectors they belong to (indices), are listed in Table 1.

Table 1

The List of Companies and Their Sectors Analysed in This Research.

SECTOR/INDEX	NUMBER	COMPANY
1. BANK	9	AKBNK, GARAN, ICBCT, ISCTR, KLNMA, QNBFB, SKBNK, TSKB, YKBNK
2. ELECTRICITY	1	AKSUE
3. FIN. LEAS. FACT.	3	CRDFA, GARFA, VAKFN,
4. FOOD & BEVERAGE	13	BANVT, KENT, KERVT, KNFRT, KRSTL, MERKO, PENGD, PINSU, PNSUT, TATGD, TBORG, TUKAS, ULKER
5. REIT	13	AKSGY, ALGYO, ATAGY, AVGYO, DGGYO, DZGYO, ISGYO, NUGYO, OZGYO, PEGYO, VKGYO, YGYO, YKGYO
6. HOLDING	16	ALARK, BOYP, BRYAT, DOHOL, ECILC, ECZYT, GSDHO, IEYHO, IHLAS, KCHOL, METRO, NTHOL, SAHOL, SISE, TRCAS, GLYHO
7. CONSTRUCTION	3	EDIP, ENKAI, YYAPI
8. PAPER, FOREST, PRINTING	10	BAKAB, DGKLB, DURDO, GENTS, HURGZ, KAPLM, KARTN, OLMIP, TIRE, VKING
9. CHEMICAL, OIL	16	AKSA, AYGAZ, BAGFS, BRISA, DEVA, DYOBY, EGGUB, EGPRO, GOODY, GUBRF, HEKTS, MRSHL, PETKM, SASA, TUPRS, IHLGM
10. MINING	2	PRKME, BRSAN
11. METAL MAIN	13	BURCE, CELHA, CEMTS, DMSAS, ERBOS, EREGL, IZMDC, KRDMA, KRDMB, KRDMD, SARKY, DOKTA, ALCTL
12. METALWARE	17	ALCAR, ARCLK, ASUZU, BFREN, DITAS, EGEEN, EMKEL, FMIZP, FROTO, IHEVA, KLMSN, MAKTK, OTKAR, PARSN, PRKAB, TOASO, VESTL
13. INSURANCE	4	AKGRT, ANSGR, GUSGR, RAYSG
14. STONE, SOIL	23	ADANA, ADBGR, ADNAC, AFYON, AKCNS, ANACM, ASLAN, BOLUC, BTCIM, BUCIM, CIMSA, CMBTN, CMENT, DENCM, DOGUB, EGSER, GOLTS, KONYA, KUTPO, MRDIN, TRKCM, UNYEC, USAK
15. TECHNOLOGY	2	ASELS, NETAS
16. TEXTILE	11	ARSAN, ATEKS, BOSSA, BRMEN, DERIM, KORDS, KRTEK, SKTAS, SNPAM, YATAS, YUNSA
17. TRADE	5	INTEM, MGROS, MIPAZ, VAKKO, CRDFA
18. TOURISM	2	MAALT, MARTI
19. TRANSPORTATION	3	CLEBI, GSDDE, THYAO
20. OTHER	3	ADEL, DGZTE, SONME
TOTAL	**169**	

4.2 Estimation Results by Sector Indices of Listed Companies

This study has examined the stocks that are traded on the stock market. The analysis excludes stocks recently added or removed from the BIST. 20 binary logistic regression models relating to the crisis variable were estimated based on the 228 monthly transaction volumes of 169 companies operating in the banking, electricity, leasing factoring, food and beverage, real estate investment trust, holding, construction, paper forest and printing, chemistry, petroleum, mining, main metal, metalware, insurance, stone soil, technology, textile, commerce, tourism, transportation, and other sectors (sector indices). Table 2 displays the outcomes of the estimated models.

Table 2's findings show that some firms (indices) breakdown crisis periods as positive or negative, or to put it another way, some companies have a similar relationship to the crisis periods or the opposite relationship, while some companies have no link at all. The parameters of the companies (indices) in Table 2 with Sig. (p) values less than 5% are considered statistically significant at the 5% level while those with a Sig. (p) value higher than 5% are considered to be inconsequential.

The companies (indices) that the statistically significant parameters belong to and the associated lines are bolded since the p-values are less than 5%. The changes in the transaction volumes of the companies to which the statistically significant parameters with positive or negative signs belong can be considered a leading indicator for the prediction of crises. Companies (variables) to which the statistically insignificant parameters belong were evaluated as companies that did not give a signal for the economic crisis model.

It can be said that the possible sudden increases in the transaction volumes of the companies whose sign belongs to positive and meaningful parameters indicate the possibility of a crisis. In contrast, it can be stated that the possible sudden decreases in the transaction volumes of the companies whose sign belongs to negative and meaningful parameters indicate the possibility of a crisis. In other words, it can be said that during times of crisis, the transaction volumes of the companies to which the statistically significant parameters with positive marks rise, and the transaction volumes of the companies to which the statistically significant parameters with negative sign belong fall. Thus, while there is an increase in the trading volumes of the shares of companies to which the parameters with positive marks belong in crisis periods. Undoubtedly, there is a decrease in the trading volumes of the shares of companies to which the parameters with negative marks belong. As a result, potential abrupt changes in the trading volume of stocks of companies with statistically significant parameters might be viewed as a crisis indicator. The research's companies can be divided into three categories based on the findings, as follows:

i) Companies to which statistically insignificant parameters belong: These are businesses that do not change course during crises and cannot foresee crises. These companies are as follows from Model 1 to Model 20, respectively: AKBNK, ICBCT, ISCTR, QNBFB, YKBKN, KERVT, KNFRT, PENGD, PNSUT, TATGD, TBORG, TUKAS, ULKER, AKSGY, ATAGY, DZGYO, ISGYO, OZGYO, PEGYO, VKGYO, YKGYO, ALARK, BOYP, DOHOL, ECZYT, GSDHO, KCHOL, METRO, SAHOL, SISE, GLYHO, YYAPI, DGKLB, GENTS, HURGZ, KAPLM, OLMIP, TIRE, AKSA, AYGAZ, BRISA, DEVA, DYOBY, GUBRF, HEKTS, MRSHL, PETKM, SASA, IHLGM, BURCE, CELHA, CEMTS, DMSAS, KRDMA, KRDMB, KRDMD, SARKY, DOKTA, ALCTL, ASUZU, BFREN, DITAS, EMKEL, FMIZP, MAKTK, OTKAR, PARSN, PRKAB, GUSGR, RAYSG, ADANA, ADBGR, ADNAC, AFYON, AKCNS, ANACM, ASLAN, BUCIM, CIMSA, CMBTN, CMENT, DENCM, DOGUB, GOLTS, KUTPO, MRDIN, UNYEC, NETAS, ATEKS, BOSSA, KORDS, KRTEK, SKTAS, SNPAM, YATAS, YUNSA, INTEM, MIPAZ, VAKKO, THYAO and SONME. There are 101 of these businesses. The sectors to which the questioned companies belong can also be ascertained.

Table 2

The Results of Binary Logistic Regression Models

SECTOR/MODEL	COMPANY	β	SE	Wald	df	Sig.	Exp (β)	Nagelkerke R^2
	AKBNK	-0,581	1,676	0,120	1	0,729	0,559	
	GARAN	**6,065**	**1,805**	**11,291**	**1**	**0,001**	**430,538**	
	ICBCT	-0,347	0,572	0,368	1	0,544	0,707	
	ISCTR	-3,202	1,722	3,457	1	0,063	0,041	
BANK MODEL 1	**KLNMA**	**2,253**	**0,458**	**24,252**	**1**	**0,000**	**9,521**	0,510
	QNBFB	-0,747	0,520	2,065	1	0,151	0,474	
	SKBNK	**-1,348**	**0,609**	**4,899**	**1**	**0,027**	**0,260**	
	TSKB	**-2,306**	**0,972**	**5,634**	**1**	**0,018**	**0,100**	
	YKBNK	-0,456	1,773	0,066	1	0,797	0,634	
	Constant	-0,488	10,189	0,002	1	0,962	0,614	
ELECTRIC. MODEL 2	**AKSUE**	**1,372**	**0,390**	**12,346**	**1**	**0,000**	**3,943**	0,097
	Constant	**-9,412**	**2,291**	**16,880**	**1**	**0,000**	**0,000**	
	CRDFA	**-0,919**	**0,395**	**5,418**	**1**	**0,020**	**0,399**	
LEASING FAC. MODEL 3	**GARFA**	**-1,638**	**0,342**	**23,009**	**1**	**0,000**	**0,194**	0,324
	VAKFN	**1,418**	**0,447**	**10,072**	**1**	**0,002**	**4,129**	
	Constant	3,218	2,401	1,797	1	0,180	24,978	
	BANVT	**1,591**	**0,672**	**5,601**	**1**	**0,018**	**4,907**	
	KENT	**1,164**	**0,434**	**7,208**	**1**	**0,007**	**3,204**	
	KERVT	-0,598	0,627	0,911	1	0,340	0,550	
	KNFRT	-1,333	0,703	3,590	1	0,058	0,264	
	KRSTL	**-2,179**	**0,792**	**7,566**	**1**	**0,006**	**0,113**	
	MERKO	**1,832**	**0,774**	**5,602**	**1**	**0,018**	**6,247**	
FOOD & BEVERAGE MODEL 4	PENGD	-0,777	0,786	0,978	1	0,323	0,460	0,560
	PINSU	**-2,069**	**1,008**	**4,216**	**1**	**0,040**	**0,126**	
	PNSUT	1,540	0,967	2,537	1	0,111	4,663	
	TATGD	1,029	0,973	1,119	1	0,290	2,798	
	TBORG	0,454	0,714	0,404	1	0,525	1,574	
	TUKAS	-0,093	0,889	0,011	1	0,916	0,911	
	ULKER	-0,612	0,713	0,738	1	0,390	0,542	
	Constant	-2,176	4,385	0,246	1	0,620	0,114	
	AKSGY	1,033	0,809	1,633	1	0,201	2,810	
	ALGYO	**3,668**	**1,079**	**11,567**	**1**	**0,001**	**39,189**	
	ATAGY	-0,653	0,653	0,999	1	0,317	0,520	
	AVGYO	**-2,201**	**0,663**	**11,023**	**1**	**0,001**	**0,111**	
	DGGYO	**-2,692**	**1,113**	**5,851**	**1**	**0,016**	**0,068**	
	DZGYO	1,095	0,655	2,796	1	0,095	2,989	
	ISGYO	1,836	1,305	1,981	1	0,159	6,274	
RSIT MODEL 5	**NUGYO**	**-2,442**	**0,912**	**7,165**	**1**	**0,007**	**0,087**	0,658
	OZGYO	0,609	0,562	1,175	1	0,278	1,838	
	PEGYO	0,130	0,655	0,039	1	0,843	1,138	
	VKGYO	-0,015	0,818	0,000	1	0,986	0,985	
	YGYO	**-3,011**	**0,786**	**14,661**	**1**	**0,000**	**0,049**	
	YKGYO	1,017	1,018	0,999	1	0,318	2,766	
	Constant	4,274	5,978	0,511	1	0,475	71,795	
	ALARK	0,884	1,118	0,625	1	0,429	2,421	
	BOYP	0,287	0,652	0,194	1	0,660	1,333	
	BRYAT	**-2,160**	**0,863**	**6,258**	**1**	**0,012**	**0,115**	
	DOHOL	1,362	1,013	1,807	1	0,179	3,904	
	ECILC	**-2,349**	**1,034**	**5,164**	**1**	**0,023**	**0,095**	
	ECZYT	1,953	1,079	3,276	1	0,070	7,053	
	GSDHO	-0,711	0,855	0,692	1	0,406	0,491	
	IEYHO	**-2,194**	**0,745**	**8,680**	**1**	**0,003**	**0,111**	
HOLDING MODEL 6	**IHLAS**	**-3,022**	**0,767**	**15,538**	**1**	**0,000**	**0,049**	0,55
	KCHOL	-1,982	1,939	1,045	1	0,307	0,138	
	METRO	0,439	0,566	0,603	1	0,438	1,551	
	NTHOL	**1,680**	**0,845**	**3,948**	**1**	**0,047**	**5,364**	
	SAHOL	-0,729	1,913	0,145	1	0,703	0,482	
	SISE	1,188	1,520	0,611	1	0,434	3,281	
	TRCAS	**2,328**	**1,142**	**4,152**	**1**	**0,042**	**10,253**	
	GLYHO	-0,182	0,870	0,044	1	0,835	0,834	
	Constant	**19,508**	**9,385**	**4,321**	**1**	**0,038**	**296523076,788**	
	EDIP	**-1,537**	**0,373**	**16,984**	**1**	**0,000**	**0,215**	
CONSTC. MODEL 7	**ENKAI**	**1,489**	**0,647**	**5,297**	**1**	**0,021**	**4,431**	0,209
	YYAPI	0,658	0,437	2,268	1	0,132	0,518	
	Constant	-0,282	4,249	0,004	1	0,947	0,754	
	BAKAB	**-1,177**	**0,552**	**4,542**	**1**	**0,033**	**0,308**	
	DGKLB	-0,775	0,458	2,857	1	0,091	0,461	
	DURDO	**-1,836**	**0,546**	**11,298**	**1**	**0,001**	**0,160**	
	GENTS	1,266	0,754	2,818	1	0,093	3,546	
PAPER, FOREST, PRINT MODEL 8	HURGZ	1,307	0,792	2,726	1	0,099	3,695	
	KAPLM	0,131	0,427	0,095	1	0,758	1,141	0,426
	KARTN	**-0,866**	**0,291**	**8,872**	**1**	**0,003**	**0,421**	
	OLMIP	-0,161	0,596	0,073	1	0,787	0,852	
	TIRE	0,525	0,470	1,250	1	0,264	1,691	
	VKING	**1,034**	**0,462**	**5,007**	**1**	**0,025**	**2,811**	
	Constant	-1,018	5,393	0,036	1	0,850	0,361	

Table 2

The Results of Binary Logistic Regression Models (Continued)

SECTOR/MODEL	COMPANY	β	SE	Wald	df	Sig.	Exp (β)	Nagelkerke R^2
CHEMICAL, OIL MODEL 9	AKSA	1,082	1,137	0,906	1	0,341	2,951	0,635
	AYGAZ	-2,639	1,514	3,038	1	0,081	0,071	
	BAGFS	**5,398**	**1,493**	**13,066**	**1**	**0,000**	**221,037**	
	BRISA	-1,405	0,927	2,298	1	0,130	0,245	
	DEVA	0,171	0,682	0,063	1	0,802	1,186	
	DYOBY	-1,025	0,865	1,404	1	0,236	0,359	
	EGGUB	**-3,252**	**0,940**	**11,974**	**1**	**0,001**	**0,039**	
	EGPRO	**1,473**	**0,703**	**4,393**	**1**	**0,036**	**4,360**	
	GOODY	**-4,953**	**1,116**	**19,697**	**1**	**0,000**	**0,007**	
	GUBRF	0,424	0,727	0,340	1	0,560	1,528	
	HECTS	-1,523	1,012	2,265	1	0,132	0,218	
	MRSHL	1,012	0,818	1,530	1	0,216	2,751	
	PETKM	1,453	1,171	1,542	1	0,214	4,278	
	SASA	0,709	0,870	0,664	1	0,415	2,031	
	TUPRS	**3,254**	**1,628**	**3,997**	**1**	**0,046**	**25,895**	
	IHLGM	0,210	0,593	0,126	1	0,723	1,234	
	Constant	-13,438	10,305	1,700	1	0,192	0,000	
MINING MODEL 10	**PRKME**	**-1,809**	**0,402**	**20,277**	**1**	**0,000**	**0,164**	0,303
	BRSAN	**-0,966**	**0,382**	**6,415**	**1**	**0,011**	**0,380**	
	Constant	**15,219**	**2,952**	**26,577**	**1**	**0,000**	**4071352,095**	
METAL MAIN MODEL 11	BURCE	-1,082	0,678	2,547	1	0,111	0,339	0,589
	CALHA	0,471	0,728	0,418	1	0,518	1,601	
	CEMTS	1,100	0,860	1,637	1	0,201	3,003	
	DMSAS	1,040	0,820	1,611	1	0,204	2,831	
	ERBOS	**-1,323**	**0,626**	**4,471**	**1**	**0,034**	**0,266**	
	EREGL	**3,322**	**1,329**	**6,245**	**1**	**0,012**	**27,719**	
	IZMDC	**-3,628**	**0,862**	**17,699**	**1**	**0,000**	**0,027**	
	KRDMA	-2,578	1,836	1,972	1	0,160	0,076	
	KRDMB	0,769	1,687	0,208	1	0,649	2,157	
	KRDMD	-1,402	0,964	2,114	1	0,146	0,246	
	SARKY	1,540	0,881	3,055	1	0,080	4,667	
	DOKTA	-0,971	0,646	2,260	1	0,133	0,379	
	ALCTL	-0,256	0,655	0,153	1	0,696	0,774	
	Constant	14,260	7,844	3,305	1	0,069	1560021,297	
METALWARE MODEL 12	**ALCAR**	**-3,513**	**1,306**	**7,232**	**1**	**0,007**	**0,030**	0,701
	ARCLK	**7,985**	**1,864**	**18,347**	**1**	**0,000**	**2935,692**	
	ASUZU	-0,805	1,005	0,642	1	0,423	0,447	
	BFREN	0,550	0,759	0,527	1	0,468	1,734	
	DITAS	-1,216	0,786	2,394	1	0,122	0,296	
	EGEEN	**4,088**	**1,222**	**11,199**	**1**	**0,001**	**0,017**	
	EMKEL	0,392	0,889	0,194	1	0,659	1,480	
	FMIZP	0,662	0,915	0,523	1	0,470	1,938	
	FROTO	**4,299**	**1,919**	**5,018**	**1**	**0,025**	**73,644**	
	IHEVA	**-3,854**	**0,827**	**21,694**	**1**	**0,000**	**0,021**	
	KLMSN	**-3,014**	**1,256**	**5,755**	**1**	**0,016**	**0,049**	
	MAKTK	-0,272	0,654	0,173	1	0,677	0,762	
	OTKAR	-1,289	1,092	1,394	1	0,238	0,276	
	PARSN	-0,007	0,803	0,000	1	0,993	0,993	
	PRKAB	0,954	0,897	1,133	1	0,287	2,597	
	TOASO	**-4,777**	**1,359**	**12,351**	**1**	**0,000**	**0,008**	
	VESTL	**6,494**	**2,262**	**8,244**	**1**	**0,004**	**661,222**	
	Constant	**-8,055**	**8,338**	**0,933**	**1**	**0,334**	**0,000**	
INSURANCE MODEL 13	**AKGRT**	**2,355**	**0,676**	**12,129**	**1**	**0,000**	**10,538**	0,148
	ANSGR	**-2,861**	**0,747**	**14,679**	**1**	**0,000**	**0,057**	
	GUSGR	-0,566	0,382	2,203	1	0,138	0,568	
	RAYSG	0,659	0,381	2,991	1	0,084	1,933	
	Constant	0,524	3,228	0,026	1	0,871	1,689	
STONE, SOIL MODEL 14	ADANA	2,913	3,211	0,823	1	0,364	18,419	0,815
	ADBGR	0,320	2,215	0,021	1	0,885	1,377	
	ADNAC	-0,023	1,825	0,000	1	0,990	0,978	
	AFYON	0,329	1,278	0,066	1	0,797	1,389	
	AKCNS	2,982	2,479	1,447	1	0,229	19,735	
	ANACM	1,373	1,661	0,684	1	0,408	3,948	
	ASLAN	0,865	1,482	0,341	1	0,559	2,376	
	BOLUC	**-5,296**	**2,331**	**5,163**	**1**	**0,023**	**0,005**	
	BTCIM	**3,304**	**1,372**	**5,799**	**1**	**0,016**	**27,216**	
	BUCIM	3,235	2,529	1,637	1	0,201	25,413	
	CIMSA	0,579	2,892	0,040	1	0,841	1,783	
	CMBTN	-0,571	1,662	0,118	1	0,731	0,565	
	CMENT	0,772	1,115	0,480	1	0,489	2,165	
	DENCM	-0,867	1,175	0,544	1	0,461	0,420	
	DOGUB	1,827	1,282	2,031	1	0,154	6,213	
	EGSER	**-6,253**	**2,195**	**8,116**	**1**	**0,004**	**0,002**	
	GOLTS	-0,238	1,330	0,032	1	0,858	0,789	
	KONYA	**-6,211**	**1,802**	**11,876**	**1**	**0,001**	**0,002**	
	KUTPO	-1,441	1,289	1,248	1	0,264	0,237	
	MRDIN	1,765	1,802	0,959	1	0,327	5,840	
	TRKCM	**8,717**	**3,356**	**6,748**	**1**	**0,009**	**6106,458**	
	UNYEC	0,096	1,570	0,004	1	0,951	1,101	
	USAK	**-3,997**	**1,853**	**4,652**	**1**	**0,031**	**0,018**	
	Constant	**-31,397**	**19,962**	**2,474**	**1**	**0,116**	**0,000**	

Table 2

The Results of Binary Logistic Regression Models (Continued)

SECTOR/MODEL	COMPANY	β	SE	Wald	df	Sig.	Exp (β)	Nagelkerke R^2
TECHN. MODEL 15	**ASELS**	**-1,375**	**0,389**	**12,509**	**1**	**0,000**	**0,253**	0,171
	NETAS	-0,431	0,341	1,602	1	0,206	0,650	
	Constant	**10,532**	**2,758**	**14,583**	**1**	**0,000**	**37483,449**	
TEXTILE MODEL 16	**ARSAN**	**-3,516**	**0,765**	**21,121**	**1**	**0,000**	**0,030**	0,558
	ATEKS	0,865	0,610	2,009	1	0,156	2,374	
	BOSSA	0,958	0,833	1,323	1	0,250	2,607	
	BRMEN	**1,162**	**0,505**	**5,285**	**1**	**0,022**	**3,196**	
	DERIM	**-1,656**	**0,763**	**4,706**	**1**	**0,030**	**0,191**	
	KORDS	1,032	0,899	1,317	1	0,251	2,805	
	KRTEK	0,272	0,494	0,303	1	0,582	1,312	
	SKTAS	-1,074	0,559	3,690	1	0,055	0,342	
	SNPAM	-0,112	0,547	0,042	1	0,838	0,894	
	YATAS	0,584	0,639	0,837	1	0,360	1,794	
	YUNSA	-0,642	0,729	0,775	1	0,379	0,526	
	Constant	9,364	5,562	2,835	1	0,092	11664,483	
TRADE MODEL 17	INTEM	0,748	0,510	2,149	1	0,143	2,112	0,302
	MGROS	**-2,045**	**0,494**	**17,125**	**1**	**0,000**	**0,129**	
	MIPAZ	-0,074	0,424	0,030	1	0,862	0,929	
	VAKKO	-0,163	0,423	0,149	1	0,700	0,849	
	CRDFA	**-1,533**	**0,444**	**11,942**	**1**	**0,001**	**0,216**	
	Constant	**17,339**	**4,081**	**18,053**	**1**	**0,000**	**33909276,448**	
TOURISM MODEL 18	**MAALT**	**-0,589**	**0,226**	**6,796**	**1**	**0,000**	**0,555**	0,252
	MARTI	**-1,442**	**0,456**	**10,020**	**1**	**0,009**	**0,236**	
	Constant	**10,064**	**2,370**	**18,029**	**1**	**0,002**	**23485,236**	
TRANSPORT MODEL 19	**CLEBI**	**1,181**	**0,572**	**4,266**	**1**	**0,039**	**3,259**	0,200
	GSDDE	**-1,456**	**0,373**	**15,252**	**1**	**0,000**	**0,233**	
	THYAO	-0,278	0,287	0,937	1	0,333	0,757	
	Constant	0,793	2,286	0,120	1	0,729	2,210	
OTHER MODEL 20	**ADEL**	**-1,815**	**0,423**	**18,445**	**1**	**0,000**	**0,163**	0,581
	DGZTE	**-1,248**	**0,414**	**9,097**	**1**	**0,003**	**0,287**	
	SONME	-0,460	0,341	1,823	1	0,177	0,631	
	Constant	**18,148**	**3,681**	**24,305**	**1**	**0,000**	**76114689,479**	

ii) Companies whose parameters are statistically significant and positively marked: These companies have those who have boosted transaction volumes during times of crisis and, in this regard, have anticipated the crisis. These companies are in order from Model 1 to Model 20: GARAN, KLNMA, AKSUE, VAKFN, BANVT, KENT, MERKO, ALGYO, NTHOL, TRCAS, ENKAI, VKING, BAGFS, EGPRO, TUPRS, EREGL, ARCLK, AKGRT, BTCIM, TRKCM, BRMEN, CLEBI, FROTO, and VESTL. The number of companies in this group is 24, but it can also be determined which sectors the companies in question belong.

iii) Companies to which statistically significant and negative-signed parameters belong: These businesses anticipate crises since their transaction volumes decline during these times. These companies are as follows from Model 1 to Model 20, respectively: SKBNK, TSKB, CRDFA, GARFA, KRSTL, PINSU, AVGYO, DGGYO, NUGYO, YGYO, BRYAT, ECILC, IEYHO, IHLAS, EDIP, BAKAB, DURDO, KARTN, EGGUB, GOODY, PRKME, BRSAN, EMBOS, IZMDC, ALCAR, EGEEN, IHEVA, KLMSN, TOASO, ANSGR, BOLUC, EGSER, KONYA, USAK, ASELS, ARSAN, DERIM, MGROS, CRDFA, MAALT, MARTI, GSDDE, ADEL, DGZTE. The number of companies in this group is 44. Without a doubt, the sectors to which the questioned companies belong can also be determined.

Last but not least, specific models' constant terms have been shown to be statistically significant, while others have not. Again, based on the findings, it is possible to collect the models (sectors) related to the constant term in two groups as follows:

i) Models (sectors) for which the constant term is meaningless: Model 1 (Bank), Model 3 (Leasing Factoring), Model 4 (Food & Beverage), Model 5 (REIT), Model 7 (Construction), Model 8 (Paper, Forestry, Printing), Model 9 (Chemistry, Petroleum), Model 11 (Main Metal), Model 13

(Insurance), Model 14 (Stone, Soil), Model 16 (Textiles), Model 19 (Transportation). As observed, 12 out of 20 models (industries) have been shown to have insignificant constant terms.

ii) Models (sectors) for which the constant term is statistically significant: Model 2 (Electricity), Model 6 (Holding), Model 10 (Mining), Model 12 (Metalware), Model 15 (Technology), Model 17 (Trade), Model 18 (Tourism), Model 20 (Other). As can be observed, 8 out of 20 models (industry) have statistically significant constant terms.

As a result, in some of the models developed, it was discovered that all of the company coefficients were zero. While this can accurately anticipate the crisis periods, some cannot provide a good enough explanation for the economic crisis periods (sig>0.05).

5. Conclusion

Based on the trading volumes of companies at the Istanbul Stock Exchange, logistic regression analysis has been used in this study to attempt to anticipate times of economic crisis. For this purpose, 228-month transaction volumes of 169 businesses operating in a total of 20 different sectors in the stock exchange during the period 2000–2018 were used to estimate a total of 20 binary logistic regression models, with a separate model for each sector (index). While the dependent variable in the model is the crisis variable, which shows whether there is a crisis (1 or 0), the independent variables are the monthly transaction volumes of the companies in the relevant sector.

Companies that belong to statistically significant parameters are expressed as companies that give signals about the crisis time. In contrast, companies that belong to statistically insignificant parameters are viewed as companies that do not provide signals for the economic crisis model. However, during the crisis, there was unquestionably a decline in the transaction volumes of the companies with negative signals. At the same time, there is an increase in those with statistically significant parameters with positive signs.

According to estimations, in the banking industry (Model 1) GARAN (+), KLNMA (+), and SKBNK (-), which represent the transaction volume increasing and decreasing respectively during crisis periods TSKB (–); in the electricity sector (Model 2) AKSUE (+), leasing factoring (Model 3): CRDFA (–), GARFA (–), VAKFN (+), food and beverage industry (Model 4): BANVT (+), KENT (+), KRSTL (–), MERKO (+), PINSU (–); in the REIT sector (Model 5): ALGYO (+), AVGYO (–), DGGYO (–), NUGYO (–), YGYO (–), in the holding sector (Model 6): BRYAT (–), ECILC (–), ILEYHO (–), IHLAS (–), NTHOL (+), TRCAS (+), in the construction industry (Model 7): ENKAI (+), in the paper, forestry and printing industry (Model 8): BAKAB (–), DURDO (–), KARTN (–), VKING (+), chemical and petroleum industry (Model 9): BAGFS (+), EGGUB (–), EGPRO (+), GOODY (–), TUPRS (+), mining industry (Model 10): PRKME (–), BRSAN (–), metal main industry (Model 11): ERBOS (–), EREGL (+), IZMDC (–), metalware industry (Model 12): ALCAR (–), ARCLK (+), EGEEN (–), IHEVA (–), KLMSN (–), TOASO (–), FROTO(+), VESTL(+), in the insurance industry (Model 13): AKGRT (+), ANSGR (–), in the stone and soil sector (Model 14): BOLUC (–), BTCIM (+), EGSER (–), KONYA (–), TRKCM (+), USAK (–), technology sector (Model 15): ASELS (–), textile industry (Model 16): ARSAN (–), BRMEN (+), DERIM (–), trade sector (Model 17): MGROS (–), CRDFA (–), tourism sector (Model 18): MAALT (–), MARTI (–),in the transportation sector (Model 19): CLEBI (+), GSDDE (–) and finally companies in the other sector (Model 20): During times of crisis, ADEL (-) and DGZTE (-) have demonstrated their influence as statistically significant and significant changes in transaction volumes. While the said changes are an increase in the

transaction volumes for the companies with + in parentheses, they are realized as a decrease for the companies with -.

In addition, companies with high Exp (β) values are the variables (companies) that contribute the most to the estimated model. The results show that all parameters with Exp (β) values above 1 have been estimated to have positive signs, while parameters with Exp (β) values below 1 have been discovered to have negative signs. The highest Exp (β) value is TRKCM company, and it is 6106.458. Other Exp (β) values in descending order are ARCLK with 2935.692, VESTL with 661.222, GARAN with 430.538, BAGFS with 221,037, FROTO with 73.644, ALGYO with 39.189, EREGL with 27.719, BTCIM with 27.216, TUPRS with 25.895, AKGRT with 10.538, TRCAS with 10.253, KLNMA with 9.521, MERKO with 6.247, NTHOL with 5.364, BANVT with 4.907, ENKAI with 4.431, EGPRO with 4.360, VAKFN with 4.129, AKSUE with 3.943, CLEBI with 3.259, KENT with 3.204, BRMEN with 3.196 and VKING come with 2,811. On the other hand, there are dramatic rises in the transaction volumes of these companies during crisis moments since the coefficients of these companies are statistically significant and have positive signals. Companies with negative coefficients and low Exp (β) values decrease their transaction volumes during crisis periods.

The sectors with the highest Nagelkerke R^2 value (models) are the stone and soil sector (Model 14) with 0.815, the metal goods sector with 0.701, the REIT sector with 0.658, the chemical and petroleum sector with 0.635, the main metal sector with 0.589, the other sector with 0.581, the food and beverage industry with 0.560, the textile sector with 0.558, the holding sector with 0.550, and the banking sector with 0.510.

The sectors that have Nagelkerke R^2 values of less than 0.5 are, respectively, as follows: the paper, forestry, and printing sector with a value of 0.426; the leasing factoring sector with a value of 0.324; the mining sector with a value of 0.303; the trade sector with a value of 0.302; the tourism sector with a value of 0.252; the construction sector with a value of 0.209; the transportation sector with a value of 0.200; the technology sector with a value of 0.171; the insurance sector with a value of 0.148; and the electricity sector with a value of 0.097.

As a result, it can be said that there are significant changes in the trading volumes of the stocks of companies with statistically significant parameters and high Exp (β) values during crisis periods. From this point of view, sudden and significant changes in the transaction volumes of companies with large Exp (β) values and statistically significant parameters can be considered as a signal that the relevant period is a crisis period.

There are various economic crises. In this study, the transaction volumes of businesses that consistently traded in BIST over the relevant time were analyzed. There could undoubtedly be a variety of factors influencing changes in the trading volumes of companies listed on the stock exchange. In this regard, the study's findings can be contrasted with instances of economic crisis that took place at various points in history. Therefore, evaluating the macroeconomic factors along with the effects of global indices will strengthen the study and help to broaden the scope of the economic crisis.

ACKNOWLEDGEMENT
—

FUNDING
No financial support was received from any person or institution for the study.

ETHICS
The authors declare that this article complies with the ethical standards and rules.

AUTHOR CONTRIBUTION
Erkan Işığıçok | Concept/idea; Literature review; Design; Data Collection/Analysis; Interpretation of data/findings; Drafting; Supervising; Critical review; Final approval and accountability. Contribution rate 50%

Savaş Tarkun | Concept/idea; Literature review; Design; Data Collection/Analysis; Drafting; Supervising; Final approval and accountability. Contribution rate 50%

CONFLICT OF INTEREST
The authors declare no conflict of interest.

References

Akkaya, M. (2021). Döviz Piyasası Baskı Endeksi ve Kriz göstergelerinin Tahmini: Türkiye Uygulaması [Index of Curreny Market Turbulance and Estimation of Crisis Indicators: Turkey Case]. *Ankara Hacı Bayram Veli Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *23*(1), 67–92. https://dergipark.org.tr/tr/pub/ahbvuibfd/issue/61592/729391

Akkaya, M., & Kantar, L. (2018). Finansal Krizlerin Tahmininde Öncü Göstergelerin Logit-Probit Model ile Analizi: Türkiye Uygulaması. [An Analysis of Leading Indicators with Logit-Probit Model to Estimate Financial Crisis: The Case of Turkey]. *Uluslararası Yönetim İktisat ve İşletme Dergisi*, 14(3), 575–590.

Akkaya, M., & Kantar, L. (2019). Bankacılık Kırılganlık Endeksinin Logit-Probit Model ile Analizi: Türkiye Uygulaması. [An Analysis of The Banking Fragility Index with Logit-Probit Model: The Case of Turkey]. *Finans Politik & Ekonomik Yorumlar*, Aralık(650), 2019.

Aksoy, B., & Boztosun, D. (2018). Diskriminant ve Lojistik Regresyon Yöntemleri Kullanılarak Finansal Başarısızlık Tahmini: BIST İmalat Sektörü Örneği [Financial Failure Prediction by Using Discriminant and Logistics Regression Methods: Evidence from BIST Manufacturing Sector]. *Finans Politik & Ekonomik Yorumlar*, Aralık(646), 9–32.

Aktaş, M., & Şen, B. (2013). 2008 Global Ekonomik Krizinin Öncü Göstergeleri ve Ülkeler Üzerinde Bir Uygulama. [Leading Indicators of The 2008 Global Economic Crisis and an Application on The Countries]. *Niğde Üniversitesi İİBF Dergisi,* 6(1), 137–147.

Caggiano, G., Calice, P., & Leonida, L. (2014). Early warning systems and systemic banking crises in low income countries: A multinomial logit approach. Journal of Banking and Finance, 47, 258–269. https://doi.org/10.1016/j.jbankfin.2014.07.002

Caggiano, G., Calice, P., Leonida, L., & Kapetanios, G. (2016). Comparing logit-based early warning systems: Does the duration of systemic banking crises matter? *Journal of Empirical Finance*, 37, 104–116. https://doi.org/10.1016/j.jempfin.2016.01.005

Ceci, D., & Silvestrini, A. (2022). Temi di discussione. In February (No. 1362; Vol. 35, Issue 442). http://onlinelibrary.wiley.com/doi/10.1111/j.1538-4616.2010.00331.x/full

Chen, T. H., Lee, C. C., & Shen, C. H. (2022). Liquidity indicators, early warning signals in banks, and financial crises. *North American Journal of Economics and Finance,* 62(October 2020), 101732. https://doi.org/10.1016/j.najef.2022.101732

Demirhan, E., Altay, B., & Inkaya, A. (2010). Türkiye'de Reel Döviz Kuru ile Makro Ekonomik Değişkenler Arasındaki İlişkinin Ekonometrik Analizi [Econometric Analysis of the Relationship between Real Exchange Rate and Maroeconomic Variables in Turkey]. *Finans Politik & Ekonomik Yorumlar, 47*(546).

Dibo, M., & Ulusoy, A. (2018). Türkiye'de 1990 Sonrası Finansal Krizlerin Dış Borçlarla İlişkisinin Analizi. [The Analysis of the Relationship Between External Debts and the Financial Crises in Turkey After 1990]. *Karadeniz Teknik Üniversitesi Sosyal Bilimler Enstitüsü Sosyal Bilimler Dergisi, 8*(15), 27–39.

Erdoğan, B. (2006). Gelişmekte Olan Ülkelerde Finansal Krizler ve Finansal Kriz Modelleri. [Financial Crisis in Developing Countries and Models of Financial Crisis]. Kahramanmaraş Sütçü İmam University.

Esquivel, G., & Larraín, F. (1998). Explaining Currency Crises. HIID Development Discussion Paper, 666.

Frankel, J. A., & Rose, A. K. (1996). Currency crashes in emerging markets: An empirical treatment. *Journal of International Economics*, 41(3–4), 351–366. https://doi.org/10.1016/S0022-1996(96)01441-9

Gerni, C., Emsen, S., & Değer, M. K. (2005). Erken Uyarı Sistemleri Yoluyla Türkiye'deki Ekonomik Krizlerin Analizi. [Early Warning Systems Analysis of the Economic Crises in Turkey]. *İstanbul Üniversitesi İktisat Fakültesi Ekonometri ve İstatistik Dergisi*, 2, 39–62.

Goldstein, M., & Turner, P. (1996). Banking crises in emerging economies: Origins and policy options. In Bank for International Settlements (Issue 46). https://doi.org/10.1142/9789814749589_0008

Gujarati, D. N. (2004). *Basic Econometrics* (Fourth). The McGraw−Hill Companies.

Gür, T. H., & Tosuner, A. (2002). Para ve Finansal Krizlerin Öncü Göstergeleri. *Hacettepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 20*(1), 9–36. http://dergipark.gov.tr/huniibf/issue/7884/103594

Hosmer, D. W., & Lemeshow, S. (2000). *Applied Logistic Regression* (Second). Wiley.

Investing.com. (2023). https://www.investing.com

Işığıçok, E. (2003). Bebeklerin Doğum Ağırlıklarını ve Boylarını Etkileyen Faktörlerin Lojistik Regresyon ile Araştırılması. [Investigation of Factors Affecting Birth Weights and Heights of Babies by Logistic Regression]. IV. Ulusal Ekonometri ve İstatistik Sempozyumu.

Kaakeh, M., & Gökmenoğlu, K. K. (2022). Leading Indicators of Turkey's Financial Crises. In N. Özataç, K. K. Gökmenoğlu, & B. Rustamov (Eds.), New Dynamics in Banking and Finance (pp. 15–44). https://doi.org/10.1007/978-3-030-93725-6_2

Kamin, S. B., Schindler, J. W., & Samuel, S. L. (2001). The Contribution of Domestic and External Factors to Emerging Market Devaluation Crises: An Early Warning Systems Approach. SSRN Electronic Journal, 711. https://doi.org/10.2139/ssrn.286279

Kindleberger, C. P., Aliber, R. Z., & Wiley, J. (2005). Manias, Panics, and Crashes A (Fifth). Wiley. https://delong.typepad.com/manias.pdf

Kıran, Ü. (2009). Gelişmekte Olan Ülkelerde Finansal Krizlerin Tahmini. [Forecasting Financial Crises in Emerging Market] [İstanbul Teknik Üniversitesi]. https://acikbilim.yok.gov.tr/bitstream/handle/20.500.12812/713450/yokAcikBilim_335669.pdf?sequence=-1&isAllowed=y

Mishkin, F. S. (1999). Lessons from the Asian Crisis. Journal of International Money and Finance, 18(4), 709–723. http://www.nber.org/papers/w7102.pdf

Özdamar, K. (1999). Paket Programlar ile İstatistiksel Veri Analizi-1. [Statistical Data Analysis with Package Programs-1]. Kaan Kitapevi.

Străchinaru, A.-I. (2022). Early Warning Systems for Banking Crisis and Sovereign Risk. Journal of Financial Studies and Research, 2022, 1–9. https://doi.org/10.5171/2022.441237

TCMB-CBRT. (2002). Yıllık Rapor-2001. [Annual Report-2001]. https://www.tcmb.gov.tr/wps/wcm/connect/bc0a0a4f-12cb-453e-9700-1aaccfae6a67/2001_Yillik_Rapor.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-bc0a0a4f-12cb-453e-9700-1aaccfae6a67-mh5zaN7

TCMB-CBRT. (2003). Yıllık Rapor-2002. [Annual Report-2002]. https://www.tcmb.gov.tr/wps/wcm/connect/6832b8f2-f5f1-45a3-b63c-097e9167f0d4/2002_Yillik_Rapor.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-6832b8f2-f5f1-45a3-b63c-097e9167f0d4-mh5zkN7

Telli, A. (2016). 1999, 2000, 2001 ve 2008 Kriz Dönemlerinde Türk Ticari Bankalarının Karlılıklarının Lojistik Regresyon Analizi ile İncelenmesi. [Examining The Profitability of Turkish Commercial Banks with The Logistic Regression Analysis in Crisis Years 1999, 2000, 2001. *Marmara Üniversitesi Öneri Dergisi, 12*(45), 61–92.

Tomczak, K. (2022). Transmission of the 2007–2008 financial crisis in advanced countries of the European Union. Bulletin of Economic Research, April 2021, 1–25. https://doi.org/10.1111/boer.12338

Uslu, H. (2019). Logit-Probit Modeli Yardımıyla Türkiye'de Cari Açık Kaynaklı Kriz Riskini Etkileyen Farktörlerin Belirlenmesi. [Determination of The Factors Affecting the Risk of Current Deficit Induced Crisis in Turkey by Logit and Probit Model]. *Uluslararası Ekonomi ve Yenilik Dergisi,* 5(2), 153–178.

Wang, X., & Li, M. (2022). Determinants of Regional Economic Resilience to Economic Crisis: Evidence from Chinese Economies. Sustainability (Switzerland), 14(2). https://doi.org/10.3390/su14020809

Woo, W. T., Carleton, P. D., & Rosario, B. P. (2000). The Unorthodox Origins of the Asian Currency Crisis: Evidence from Logit Estimation. Asean Economic Bulletin, 17(2), 120–134. https://doi.org/10.1355/ae17-2b

Yavaş, H. (2007). 1980 Sonrasi Gelişmekte Olan Ülkelerde Yaşanan Finansal Krizler, Finansal Kriz Modelleri Ve Çözüm Önerileri. [The Financial Crises Occured in The Developing Countries After 1980, The Models of Financial Crises and Solution Suggestions]. Kadir Has University.

Yücel, F., & Kalyoncu, H. (2010). Finansal Krizlerin Öncü Göstergeleri ve Ülke Ekonomilerini Etkileme Kanalları: Türkiye Örneği. [Leading Indicators of Financial Crises and Affecting Channels of Countries Economies: The Case of Turkey]. *Maliye Dergisi*, 159, 53–69.

Yüksel, S. (2017). Determinants of the credit risk in developing countries after economic crisis: A case of Turkish banking sector. Contributions to Economics, 2018, 401–415. https://doi.org/10.1007/978-3-319-47021-4_28