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Tari, Recep; Büyükakin, Figen; Aydin, Seda

## Article

### Analysis of factors make Turkish economy fragile by LOGIT and PROBIT models (1990.01-2018:05)

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#### Kontakt/Contact

ZBW – Leibniz-Informationszentrum Wirtschaft/Leibniz Information Centre for Economics  
Düsternbrooker Weg 120  
24105 Kiel (Germany)  
E-Mail: [rights\[at\]zbw.eu](mailto:rights[at]zbw.eu)  
<https://www.zbw.eu/econis-archiv/>

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**Analysis of factors make Turkish economy fragile by  
LOGIT and PROBIT models (1990.01-2018:05)**

By Recep TARI <sup>a</sup> Figen BÜYÜKAKIN <sup>bt</sup>  
& Seda AYDIN <sup>c</sup>

**Abstract.** The globalization movements that started towards the end of the 20th century influenced many areas of the economy. As a result of the globalization, despite the persistence of the political borders, countries have established borderless relationships in the economic arena. On the other hand, along with globalization, financial crises have become more frequent in the world economy. In particular, the fact that the 2008 Global Crisis reached serious dimensions made it necessary to take measures to stabilize the markets and to evaluate the factors that would shake the market and make the market fragile. Financial fragility is a concept that is often concurrently used with the concepts of financial instability and financial crisis. Financial fragility is a hypothesis which was developed by Hyman Minsky and is different from both concepts and also is interactively affected by instability and crises. In this study, unlike other studies with reference to Minsky's financial fragility hypothesis, we aimed to identify the factors that make fragile the financial markets in Turkey. Logit and probit models were studied with the data of 1990:01-2018:05 period. With reference to the study results, the increase in ratios of the volume of bank loans and M2 occur reserves increases the possibility of future crises. Besides, it is found at the end of the study that a decrease in the composite leading indicators index and in M2 in the BIST 100 index will strengthen the probability of a crisis.

**Keywords.** Financial fragility, Minsky hypothesis, Logit model, Probit model.

**JEL.** G00, C12, B23.

## 1. Introduction

**F**inancial fragility that launches the crisis in the financial system is a hypothesis which was developed by Hyman Minsky. This hypothesis is based on Keynes and Fisher's opinion that financing the investments by debts make the markets unstable and fragile (Boğa, 2017). Especially reaching the 2008 Mortgage crises to a global extent brought Minsky's financial fragile hypothesis into the forefront; it has been addressed to this hypothesis in studies about the financial crises.

<sup>a†</sup> Department of Economics, Faculty of Economics and Administrative Sciences, Kocaeli University, Kocaeli, Turkey.

☎ . +90(262)303 15 69

✉ . rtari@kocaeli.edu.tr

<sup>b</sup> Department of Economics, Faculty of Economics and Administrative Sciences, Kocaeli University, Kocaeli, Turkey.

☎ . +90(262)303 15 62

✉ . bfigen@kocaeli.edu.tr

<sup>c</sup> Institute of Social Sciences, Kocaeli University, Kocaeli, Turkey.

☎ . +90(262)303 15 62

✉ . sedaaydin@gmail.com

## Journal of Economics and Political Economy

First of all, Minsky reviewed the concept of financial fragility by analyzing the regulatory structure of the financial system, the presence of governments and the organizations in the finance system. Minsky explained becoming clear of the financial instability in years following World War II by the failures<sup>1</sup> in financial institutions between the years of 1960 and 1970; he also argued that the factor that worsens the market is the capital system seeks much profit (Minsky, 1986). Minsky who emphasized that the factors which destabilize the economy are not the external shocks or the available policies, it is the complex structure of the capitalist system mentioned that reflecting increasing innovations to the financial instruments make the economy more fragile against the crises (Minsky, 1995; Minsky, 1986).

According to Minsky who identified the instability with stability when explaining the stabilization hypothesis, financial stability also causes to be made moves create financial fragility while establishing an optimistic environment. Namely, increasing the borrowing of the companies (increasing the opportunity of borrowing via the capitalist system) who do not want to fall behind of competitors creates the financial bubble. While the irrational borrowing causes a decrease in liquid assets, it also causes exploding the bomb when being liquidity shortage even though there is not a problem of finding the liquid assets. Thereafter, sacrifice sales and reducing the asset prices follow the process (Minsky, 1976).

Fragile intensity is based on the safety and power of the market. If speculation and Ponzi finance<sup>2</sup> is weighted and also if the confidence margin is poor in an economy, the financial fragility increases to a large extent (Minsky, 1986). Besides, the fragility intensity also varies by the structure of the country. Especially in emerging market economies, while recovering of the economy takes more time after an economic shock, the recovery takes a shorter time in countries with less fragility (Bayraktar & Elüstü, 2016). Therefore, the macroeconomic variables are crucial when the fragility in the finance market of a country is analyzed. The macroeconomic variables to be used in analyses should be selected based on the structure of the country.

## 2. Literature review

It is seen when the related literature is reviewed that Minsky's fragility and instability hypothesis have not been sufficiently inserted in the analyses. The reason is that he used historical events more than the quantitative evidence in the economy; he also preferred to appeal to the formulas constrictedly. Therefore, a new calculation method could not be developed in the literature to analyze the fragility.

The studies on fragility hypothesis after Minsky are predominately based on the estimation methods. The studies that use the estimation methods are established by simultaneously analyzing more than one variables. Studies analyzed are chronologically shown below.

Frankel & Rose (1996) reviewed crises for 105 developing countries by using the data belong to the 1971-92 period by FR Probit regression analysis. Commercial bank deposits, the ratio of international reserves to the importation, the ratio of current accounts item to GDP, ratio of external debt to GDP, real exchange rate, the ratio of total budget to GDP, credit increase and GDP growth rate variables were utilized in the research. It was concluded that crises decrease the foreign direct

<sup>1</sup> Failure of Franklin National Bank, Continental Illinois Bank and collapsing several institutions are accepted as the unsuccessful developments of the period.

<sup>2</sup> Ponzi Finance: Ponzi financing that is a special status of speculative finance is increasing the loan burden of the debtor by borrowing again because of the failure in making the interest payments in the short term. Shortly, it is the effort to pay off the debt by debt.

investments; the crises also emerge in periods when the reserves reduce and the local credit growth increase.

Graciela Kaminsky conducted a study to analyze money and bank crises of 20 countries by the signal approach that is remembered as KLR approach in literature; Lizondo & Reinhart (1998) contributed to the study. The study which analyzed the monthly data belong to the period of 1970-95 used real exchange rate, the ratio of M2 to gross international reserves, capital market index, production, export, import, M2 money multiplier, M1 surplus, the ratio of domestic loans to GDP, real interests, international reserves and external term of trade. Effect of all the variables in research was separately reviewed by using the threshold values as the base. It was concluded that the changes in the ratios of the real exchange rate and M2 to the international reserves are the variables that give the signal best.

İşik *et al.*, (2004) reviewed the financial crises through Turkey sample by using quarterly data belong to the 1991-2001 period by using VAR analyses. The research used the ratio of the budget deficit to GDP, IMKB (İstanbul Stock Exchange) 100 index, real exchange rate index, the ratio of real exchange rate to GDP, the ratio of public sector borrowing requirement to GDP, portfolio investment, jobless rate, real overnight interbank interest rate, M2YR/MB foreign exchange reserves and the variables relating to banking system. With reference to the research results, the reasons for April 1994 and February 2001 crises were the currency substitution, rising conjuncture and open interest tendency of the banking system; populist policies create mistrust for the policies by increasing the fragility.

Ersan & Taşpunar (2011) studied for crises estimation in Turkish economy by using the monthly data belong to 1997:01-2009:12 period via probit and logit models. The variables that were used in research are as follows; current accounts deficit, the share of the current accounts deficit in MB reserves, the ratio of short-term external debt to foreign exchange reserve and total debt, rate of exports meeting imports, the ratio of MB reserves to import, rate of capacity utilization. It was concluded that the increase in current accounts deficit and the decrease in export increase the crisis possibility in Turkey.

Yamak & Korkmaz (2015) scrutinized the instability in Turkey's finance market by using the data belong to the periods of 1987-2007 and 1998-2012 via VAR analysis. The ratio of foreign credits to the income and 6-quarter moving standard deviation of real GDP were used as the variables in the research. It was concluded that Minsky's hypothesis is not valid in Turkey for the first period. For the second period, economic instability may cause financial instability when external credit/income is considered; the financial instability may cause economic instability when internal credit/income is considered.

### 3. Data set and methodology

Logit and probit models were utilized in the study. The reason for being preferred the models mentioned is that the crisis variable defined among the variables was inserted in the research as the dependent variable

This study used the monthly data. However, there are advantages and disadvantages of utilizing monthly data. Namely, using more detailed monthly data in the period close to the crisis provides an advantage. However, the presence of incomplete data significantly affects the variables in the model and restricts to establish the model because of the difficulty in reaching the monthly data.

The dataset of the research was constituted by considering these circumstances. First of all, Minsky's financial fragility hypothesis was utilized; the variables that can be beneficial at the end of the literature review and history of crises were used. Variables used in research are the variables that were detailed in the 1st chapter.

3.1. Data set

The dataset used is the monthly data includes the periods of 1990:1 and 2018:05. Again, the data set was obtained from the Central Bank of the Turkish Republic, Organization for Economic Co-operation and Development (OECD), International Financial Statistics (IFS) and the Turkish Statistical Institute. The transformation was not applied in data. Data of exchange rate, foreign exchange reserves, and overnight interest rates were utilized in computing the crisis that is the dependent variable of the model. Independent variables as follows; industrial production index, BIST closing index, banking sector domestic credit volume, M2 money supply, internal debt stock, net errors and omissions, consumer price index, import, export, interest rates, and composite leading economic indicators index. Rates of change of the same period of the previous year of all the variables except composite leading economic indicators index and industrial production index were used. Variables used, abbreviations and databases can be seen in Table 1.

Table 1. *Defining data set*

Variable	Abbreviation	Data source
Dependent Variable	Fbe	
TL Interest Rate	İnt	OECD
Gross International Reserves	Rzv	TCMB
Exchange rate	Kur	TCMB
Composite Leading Indicators	Cli	OECD
Consumer Price Index	Tufe	OECD
Bist Closing Index	Bist	TCMB
M2 Money Supply	M2	TCMB
Internal Debt Stock (treasury)	Iborc	TCMB
Banking Sector Domestic Credit Volume	Bkh	TCMB
Central Bank Foreign Exchange Reserves	Mbdrzv	TCMB
İmport	İmp	OECD
Real Interest	Faiz	IFS
Export	Exp	OECD
Total Commercial Bank Deposits	Mev	TCMB
M2/Reserves	M2rzv	

3.2. Methodology

3.2.1. *Logit (Logistic regression) model*

Another model that is the alternative of the linear probability model is a particular case that is established under the specific conditions of the generalized linear model. Again, the model is derived from a model logistic distribution function (Gujarati, 1999: 555). This function is a semi-logarithmic model that can be treated as the linear relationship (Tari, 2008: 257). While the value of the independent variable goes forever, the dependent variable is asymptote to 1 (İnal *et al.*, 2006). Moreover, P probability value in the logit model remains between 0 and 1 contrary to the linear probability model.

The dependent variable in the logit model is composed of qualitative values. Dummy variable that is also known as data binary is added to the bistable (there is- there is not, girl-boy, student-graduate) dependent variable (Gujarati, 1995: 297). Dummy variable generally takes 1 and 0 values as well as it takes values of more than 1 and 0. Y=1 in case of the crisis for the dependent variables established via dummy variable; Y=0 in case of there is no crisis.

Equations below are shown to explain the Logit model with reference to the linear probability model and Gujarati's (1995) sample called 'being a homeowner';

Linear Probability Model;

$$P_i = E(Y = 1 | X_i) = \beta_1 + \beta_2 X_i \tag{1}$$

## Journal of Economics and Political Economy

X represents the income; Y=1 represents that the family has a home. If being a home owner is written as follows;

$$P_i = E(Y=1 | X_i) = \frac{1}{1 + e^{-(\beta_1 + \beta_2 X_i)}} \quad (2)$$

When the notation becomes apparent ;

$$\begin{aligned} P_i &= 1 / (1 + e^{-Z_i}) = e^{Z_i} / (1 + e^{Z_i}) \\ Z_i &= \beta_1 + \beta_2 X_i \end{aligned} \quad (3)$$

Equation (3) shows the thing that is known as logistic distribution function (cumulative). The range of  $Z_i$  varies from  $-\infty$  to  $+\infty$ ; the range of  $P_i$  varies between 0 and 1.  $P_i$  is about non linear  $Z_i$ . As is seen in Equation (2),  $P_i$  is not linear both at  $X_i$  and  $\beta_i$ . This means that the least squares method that is used to estimate the parameters cannot be utilized. There is a need for linearization processes.

If the probability of being a home owner that is given in Equation 4 is  $P_i$ , the probability of not to have a home will be  $1 - P_i$

$$1 - P_i = 1 / (1 + e^{Z_i}) \quad (4)$$

$$L_i = \frac{P_i}{1 - P_i} = (1 + e^{Z_i}) / (1 + e^{-Z_i}) = e^{Z_i} \quad (5)$$

Logit model is derived when the natural logarithm of Equation (5) is taken.

$$L_i = \ln \left( \frac{P_i}{1 - P_i} \right) = Z_i = \beta_1 + \beta_2 X_i \quad (6)$$

### 3.2.2. Probit Model

Probit model that is used as an alternative for the linear probability model is also known as the normit model in the literature (Gujarati, 1995: 608). Probit model which benefits from the cumulative normal function is based on the utility theory and rational choice approach (Güriş & Çağlayan, 2000: 659). The function is linearized by taking its reciprocal to make a prediction by the reason for being cumulative distribution function abnormal (Güriş & Çağlayan, 2005: 685).

The dependent variable in the probit model is composed of qualitative values. The dependent variable in the probit model is accepted as Y=1 in case of a crisis; Y=0 in case of the absence of the crises. P probability values remain between 0 and 1 just as the logit model in contrast with the linear probability model; error terms have a normal distribution (Hsiao, 2003: 224).

The rate of change in the probit model is more complex in comparison with the logit model. Equation (7) shows the formula of the model (Greene, 2002);

$$Prob(Y=1 | X) = \int_{-\infty}^{x\beta} \Phi(t) dt = \Phi(x\beta) \quad (7)$$

$\Phi$ , represents the cumulative normal distribution.

#### 4. Empirical Analysis

First of all, financial crises as the dependent variable and the Financial Pressure Index (FPI) were determined in the research. FPI calculation is as follows (Avcı & Altay, 2013: 52);

$$FBE_t: \frac{(e_t - \mu_e)}{\sigma_e} + \frac{(r_t - \mu_r)}{\sigma_r} + \frac{(i_t - \mu_i)}{\sigma_i} \quad (8)$$

$E_t$ : % Change in exchange rate

$R_t$ : % Change in Gross Foreign Exchange Reserves

$I_t$ : % Change in Overnight Interest Rates

After computing the percentage change in raw data of the index, the data were standardized<sup>3</sup> before determining whether there was a crisis; afterward, the data were inserted in the equation below;

$$\begin{aligned} FBE \geq \mu + 1,5 \sigma &\rightarrow \text{There is a financial crisis, } D= 1 \\ FBE < \mu + 1,5 \sigma &\rightarrow \text{There is no financial crisis, } D= 0 \end{aligned} \quad (9)$$

$\mu$  shows the average of FPI in FPI definition that is accepted as the threshold value;  $\sigma$  represents the standard deviation of FPI (Kaya & Yilmaz, 2007).

FPI threshold value for the period between 1990:1 and 2018:05 was calculated as 2,76. Table 2 shows ( $Y=I$ ) values that are accepted as the crisis period when the index is exceeded. The periods in which the index value is not exceeded, there is no signal were inserted in the analysis with a dummy variable.

**Table 2.** Financial Pressure index crisis periods

FPI Value: 2,76		
Period	Value	D: 1
Jan.91	3,94	There is a crisis
Feb.92	10,68	There is a crisis
Feb.94	4,59	There is a crisis
Mar.94	5,49	There is a crisis
Apr.94	3,85	There is a crisis
Jun.97	3,96	There is a crisis
Aug.98	3,81	There is a crisis
Aug.99	6,61	There is a crisis
Nov.00	5,52	There is a crisis
Feb.01	18,35	There is a crisis
Nov.01	3,97	There is a crisis
Jan.02	2,87	There is a crisis
Nov.05	11,67	There is a crisis
Oct.11	4,72	There is a crisis

It is seen when Table 2 is analyzed that the periods in which FPI threshold value, 2,76 is exceeded show the presence of a crisis in Turkey. Established financial pressure index gives significant results because of moving away from the standard deviation in terms of the history of financial crises in Turkey.

It is good to mention that 2008 crisis is an external crisis based on spreading into other countries by starting from the USA; FPI gave no signal before and after the

<sup>3</sup>Standardizing process is proportioning all the variables to the standard deviation by subtracting from the arithmetic means (Jia & Li, 2015: 587). For X variable is  $\frac{x-\mu}{\sigma}$  this process were separately calculated for three variables in the index.



global crisis period that is known as 2008 Mortgage Crisis. 2008 crisis did not give any signal before starting and it was beaten easily. Some of the authors accept this circumstance as the success of Transition to the Strong Economy Program applied after the 2001 crisis.

#### 4.1. Stationarity analysis

Reliability and validity of analysis in time series analyses are closely associated with the stationarity of the series. The series need to be steady in time series analyses. Stationarity of the series means that average and variance of the series are independent from time; average and variance of the series do not change in time (Yavuz, 2011: 241). Nonstationarity series causes *Spurious Regression*<sup>4</sup> problem and removes the reliability of the analyses. Enders (1995) shows the formulation for a stationary time series as follows;

$$\text{Average: } E(Y_t) = E(Y_{t-j}) = \mu \quad (11)$$

$$\text{Variance: } E[(y_t - \mu)^2] = E[(y_{t-s} - \mu)^2] = \sigma_y^2 \quad (12)$$

$$\text{Covariance: } E[(y_t - \mu)(y_{t-j} - \mu)] = E[(y_{t-j} - \mu)(y_{t-j-s} - \mu)] = Y_s \quad (13)$$

Equation 1 refers that the average of time series is constant. Equation 2 ( $\sigma_y^2$ ) refers that the variance of time series is constant. About Equation 3, it expresses that the covariance of time series is not based on a specific time, it is based on the time between two variables. In equation 3,  $Y_k$  is the common variance with k delay count; again,  $Y_k$  is the common variance between  $y_t$  and  $y_{t-s}$  that has a s-period difference between each other. If  $S=0$ , variance of  $y_t$  equals to  $y_0$ . For ( $\sigma^2$ ),  $y_t$  is found in case of  $s=1$ . This equation shows the common variance between two successive values of  $y$  (Enders, 1995: 294-295). These 3 factors confirm whether the time series is a function of the time (Yavuz, 2011).

Several tests are utilized in the determination of stationarity. The most common ones of these tests are unit root tests (Augmented Dickey-Fuller, Phillips Perron, Zivot-Andrews), Portmanteau tests (Q Statistics) and reviewing autocorrelation functions. Differences or logarithms of the series are taken to make series stationary if the series are nonstationary.

Augmented Dickey-Fuller (ADF) unit root tests were used in Eviews program to specify the stationarity in the research. The program was benefited to determine the proper lag lengths have importance for the test. Akaike Information Criterion-AIC was used for the proper lag length. Being series nonstationary established the null hypothesis; being series stationary establish the alternative hypothesis.

$$H_0: p = 0 \text{ There is a unit root, (the series is not stationary)}$$

$$H_1: p \neq 0 \text{ There is no unit root, (the series is stationary)}$$

Table 3 shows ADF unit root test results of the variables

<sup>4</sup> Spurious Regression emerges when the time series have a unit root. Spurious Regression means that test statistics lose its reliability because of high determination coefficient ( $R^2$ ), high t-statistics values, low Durbin-Watson values.



Table 3. ADF test results for the variables

VARIABLE	LEVEL VALUE			DIFFERENCES
	WITH CONSTANT	WITH CONSTANT AND TRADE	WITHOUT CONSTANT	WITHOUT CONSTANT
FBE			-10,59**(1)	
BİST	-17.86*(0)	-5.86*(13)	-3.76**(9)	
CLİ	-2.85**(15)	-2.94(15)	-1.42(16)	-6.38**(16)
IBORC	1.64(9)	-2.11(9)	2.93(9)	-2.07**(10)
TUFE	-0.74(15)	-1.51(15)	-1.23(15)	-4.86**(16)
BKH	-2.43(16)	-2.73(16)	-2.39**(16)	
M2	-1.73(0)	-2.50(0)	0.36(0)	-18.00**(0)
MBDRVZ	-16.7*(0)	-16.8*(0)	-16.6**(0)	
MEVD	-3.03**(16)	-3.54**(16)	-2.78**(16)	
URZV	-0.56(3)	1.75(3)	-1.40(3)	-3.77*(11)
IMP	-0.39(16)	-2.39(16)	1.16(16)	-5.07*(13)
EXPO	-0.03(16)	-2.21(16)	1.81(16)	-3.93**(16)
M2RZV	-2.79*** (0)	-2.80(0)	-2.11(0)	-19.77**(0)
SIGNIFICANCE LEVEL VALUES				
1%*	-3.45	-3.98	-2.57	-2.57
5%**	-2.87	-3.42	-1.94	-1.94
10%***	-2.57	-3.13	-1.61	-1.61

$H(0)$  main hypothesis is denied for cli, iborc, m2, sue, nhn, mevd, urzv, expo, imp, ihrith variables when ADF test statistics values are criticized  $H(0)$  the main hypothesis cannot be denied for Bist, tufe, bkh ve m2rzv variables. Cli, iborc, m2, sue, nhn, mevd, urzv, expo, imp, ihrith variables were stationary at level value; there was no unit root in these variables at the same time. There was found unit root in Bist, tufe, bkh and m2rzv variables. The series became stationary and they continued to be used in the model when their first differences were calculated.

#### 4.2. Research Findings

Logit and probit models were separately reviewed when the analysis results were scrutinized. First, the results of the probit model and then the results of the logit model were given.

##### 4.2.1. Probit Model Test Results

It is good to explain the values that were used relating to the estimation power and significance of the model before commenting on the variables. As the higher Mcfadden R-Squared value in percentages in the probit model increases, the estimation power of the model increases at the same time. AIC that is the other measure that can be used for in-sample and out of sample comparisons; it is based on the formula below (Zoubir *et al.*, 2014);

$$AIC = -2l(\theta) + 2k \tag{14}$$

$l(\theta)$  in equation shows log feasibility at maximum in equation  $l(\theta)$ . Being low AIC value is preferred; the model whose AIC value is low is used among the models. Test statistics result of model's goodness of fit needs to be smaller than 0.05.

The mark of coefficients of independent variables expresses the direction of the relationship between the possibility of actualizing the crisis and the dependent variable. Being positive the coefficient value of the independent variable expresses that possibility of actualizing the crisis is linearly directed; in other words, it means the increase in crisis possibility will increase the crisis possibility in the independent value. Being negative the coefficient value of the independent value expressed that the relationship is negatively directed; in other words, a decrease in independent variable will increase the crisis possibility.

## Journal of Economics and Political Economy

Another point to be emphasized is that the logit and probit models are only supposed to specify the mark of the coefficient. They do not deal with the size of the coefficient. Marginal effects analysis are used to specify the greatness and smallness of the coefficient.

**Table 4. Probit Model 1-Financial variables**

Variable	Coefficient	Standard Error	Z Statistics	Prob Value
C	-2.77	0.36	-7.63	0.00
BKH	-0.08	0.035	-2.50	0.01
M2RZV	0.26	0.06	-4.36	0.00
MEVD	0.09	0.01	0.80	0.42
MCFADDEN R-SQUARED: 0.50				
AIC: 0.14		Log Likelihood: -20.57		Prob(LR): 0.00

As is seen in Table 4, prob value of bkh, urzv and c (constant) variables are significant; however, mevd variable does not give a significant result. C variable in the model is the constant. Coefficient values of significant variables in model relatively are -2.77, -0.08 and 0.26; estimation power of the model is 0.50. AIC value is 0.14. It is concluded that an increase in the ratio of M2 in credit volume to the reserves will increase the crisis possibility.

**Table 5. Probit Model 2- Endogenous Variables**

Variable	Coefficient	Standard Error	Z Statistics	Prob Value
C	9.26	4.09	2.26	0.00
BİST	-0.02	0.00	-2.08	0.00
CLİD	-0.07	0.03	-2.61	0.00
TUFE	0.09	0.04	2.10	0.00
M2	-0.17	0.07	-2.34	0.02
MCFADDEN R-SQUARED: 0.21				
AIC: 0.29		Log Likelihood: -45.0		Prob(LR): 0.00

As is seen in Table 5, all the variables give significant results; coefficients of the variables respectively are 9.26, -0.02, -0.07, 0.09 and -0.17. Estimation power of the model is 0.21; AIC value is 0.29. It is concluded that a decrease in the BIST 100 index, composite leading indicators index and M2 will increase the crisis probability; an increase in CPI (consumer price index) will increase the crisis possibility.

**Table 6. Probit Model 3- Exogenous Variables**

Variable	Coefficient	Standard Error	Z Statistics	Prob Value
C	-2.1	0.20	-10.8	0.00
İMP	-2.79	0.01	-1.87	0.00
EXPO	0.02	0.01	0.51	0.20
MBDRZV	-11.44	0.04	-5.07	0.00
MCFADDEN R-SQUARED: 0.40				
AIC: 0.22		Log Likelihood: -34.9		Prob(LR): 0.00

In Table 6, while c, imp and mbdrzv variables are significant, expo variable gives an insignificant result. Estimation power of the model is at 40% level. AIC value is 0.22. It is surprising that a decrease in import refers to the crisis in contrast to the expectations in literature. The export variable does not give a significant result. It is an expected assumption that a decrease in foreign exchange reserves will increase the crisis.

**Table 7. Probit Model 4- Multiple Combination**

Variable	Coefficient	Standard Error	Z Statistics	Prob Value
C	-6.97	2.97	-2.34	0.00
BIST	-0.02	0.01	-1.72	0.01
MBDRZV	-11.92	2.71	-4.39	0.00
TUFE	0.64	0.27	2.32	0.00
İMP	-2.66	1.13	-4.39	0.00
CLI	-0.39	0.22	1.75	0.00
MEVD	0.096	0.08	1.12	0.26
MCFADDEN R-SQUARED: 0.52				
AIC: 0.20	Log Likelihood: -28.22		Prob(LR): 0.00	

It was aimed to be simultaneously used more than one variables while the model was established. The significance of combinations was specified as highest in Table 7. Estimation power of the model is 46%; prob value is significant. AIC value is 0.20. c, bist, mbdzrv, tufe, imp, cli give significant results. The mevd variable does not give significant results. c variable in the model is the constant. Coefficient values of significant variables in model respectively are -6.97, -0.02, -11.92, 0.64, -2.66, 0.39 and 0.096. BIST 100 index, import, a decrease in foreign exchange reserves of Central Bank increase the crisis possibility. An increase in consumer price index is linear with the crises as well as it increases the crisis possibility.

**3.4.2.2. Logit Model Test Results**

Akaike information criteria and McFadden-Squared test results were utilized to evaluate the model results. The models established are similarly coordinated with the probit tests.

**Table 8. Logit Model 1- Financial variables**

Variable	Coefficient	Standard Error	Z Statistics	Prob Value
C	-5.56	0.89	-6.18	0.00
BKH	-0.18	0.06	-2.59	0.00
M2RZV	0.55	0.13	-4.25	0.00
MEVD	0.01	0.02	0.79	0.42
MCFADDEN R-SQUARED: 0.51				
AIC: 0.14	Log Likelihood: -20.21		Prob(LR): 0.00	

Display of the logit model established is as follows;

$$L_i = \frac{P_i}{1 - P_i} = \beta_1 - \beta_2 BKH_i - \beta_3 M2RZV_i + \beta_4 MEVD_i + \mu_i; \tag{16}$$

As is seen in Table 8, prob value of bkh, m2rzv and c (constant) is significant; mevd variable does not give a significant result. C variable in the model is the constant. Coefficient values of the significant variables in the model respectively are -5.56, -0.18 and 0.55; estimation power of the variables is 0.51. AIC value is 0.14. It is concluded that an increase in the ratio of M2 in bank credit volume to the reserves will increase the crisis possibility. Probit model provided to be obtained similar results.

**Table 9. Logit Model 2- Endogenous variables**

Variable	Coefficient	Standard Error	Z Statistics	Prob Value
C	18.15	8.54	2.12	0.00
BİST	-0.06	0.02	-2.59	0.00
CLİD	-0.14	0.07	-1.93	0.00
TUFE	0.17	0.08	1.97	0.00
M2	-0.36	0.16	-2.23	0.02
MCFADDEN R-SQUARED: 0.22				
AIC: 0.29	Log Likelihood: -45.0		Prob(LR): 0.00	

Display of the logit model established is as follows;

$$L_i = \frac{P_i}{1 - P_i} = \beta_1 - \beta_2 BIST_i - \beta_3 CLID_i + \beta_3 M2_i + \mu_i \quad (17)$$

As is seen in Table 9, all the variables give significant result; coefficients of the variables relatively are 18.15, -0.06, -0.14, 0.17 and -0.36. Estimation power of the model is 0.22; AIC variable is 0.29. It is pointed out that a decrease in the BIST 100 index, composite leading indicators index and M2; an increase in consumer price index will increase the crisis possibility.

**Table 10.** *Logit Model 3- Exogenous variables*

Variable	Coefficient	Standard Error	Z Statistics	Prob Value
C	-4.14	0.85	-8.73	0.00
İMP	-0.04	0.02	-2.03	0.03
EXPO	0.05	0.04	1.31	0.18
MBDRZV	-2.	0.09	-4.74	0.00
MCFADDEN R-SQUARED: 0.41				
AIC: 0.22		Log Likelihood: -30.48		Prob(LR): 0.00

Display of the logit model established is as follows;

$$L_i = \frac{P_i}{1 - P_i} = \beta_1 - \beta_2 IMP_i + \beta_3 EXPO_i - \beta_3 URZV_i + \mu_i \quad (18)$$

As is seen in Table 10, while c, imp and mbdzrv variables are significant, expo variable gives an insignificant result. Estimation power of the model at 41% level. AIC value is 0.22. It is concluded via the logit model that a decrease in import refers to a crisis; similar results can be obtained by the probit model as well. The export variable does not give a significant result. As is expected, the decrease in Central Bank foreign exchange reserves.

**Table 11.** *Logit Model 4- Multiple combination*

Variable	Coefficient	Standard Error	Z Statistics	Prob Value
C	-14.04	6.13	-2.28	0.00
BİST	-0.05	0.02	-1.94	0.03
MBDRZV	-24.26	6.05	-4.00	0.00
TUFE	1.33	0.64	2.86	0.00
İMP	-4.89	2.09	-2.33	0.00
CLI	-0.95	0.49	1.94	0.00
MEVD	0.19	0.17	1.12	0.24
MCFADDEN R-SQUARED: 0.52				
AIC: 0.20		Log Likelihood: -28.02		Prob(LR): 0.00

Display of the logit model established is as follows;

$$L_i = \frac{P_i}{1 - P_i} = \beta_1 - \beta_2 BKH_i - \beta_3 URZV_i + \mu_i \quad (19)$$

The model established is the same as the probit model; the highest significance level is observed in this model. Estimation power of the model is at 56% level. AIC value is 0.13; prob values are significant. c, bist, mbdzrv, tufe, imp, cli variables give significant results. However, the mevd variable does not give a significant result. C variable in the model is the constant. Coefficient values of significant variables relatively are -6.97, -0.02, -11.92, 0.64, -2.66, 0.39 and 0.096. A decrease in the

BIST 100 index, import, Central Bank foreign exchange reserves increase the crisis possibility. Moreover, an increase in consumer price index is linearly directed; it increases the crisis possibility at the same time.

### 5. Conclusion

Neo-liberal policies and globalization moves that started towards the end of the twentieth century have shaped socio-economic system today. Transition process which began this period has affected several areas. However, applying neo-liberal policies in developing countries without control brought financial crisis anon. The crisis that successively happened in the 1990s because of different reasons and produced different results necessitated more attention for the factors cause crisis by reducing the effectiveness of the markets and making system fragile. Therefore, various measurement analyses and early warning system have been developed; economics literature concentrates on such studies.

In this study, it was aimed to make analysis for the variables that make Turkey's financial system fragile. Logit and probit models were used to estimate the financial crises. The reason for being preferred the models mentioned is that the crisis is the dummy dependent variable. Dummy dependent variable is defined as the periods as follows; there is a crisis, there is no crisis. The financial crisis that is the dependent variable was constituted by Financial Pressure Index (FPI). Following variables were utilized for the index; exchange rate, foreign exchange reserves, overnight interest rates. Independent variables are as follows; industrial production index, BIST closure index, banking sector domestic credit volume, M2 money supply, domestic debt stock, net error omission, consumer price index, import, export, interest rate, composite leading indicators index

Periods of 1990:01-2018:05 were selected as the data range. The reason for being selected data as monthly is that the monthly data gain an advantage due to being more detailed. Becoming frequent the financial crises in Turkey started by the period after 1990 is the reason for being selected the period of 1990:01-2018:05 as the starting point. January 24 (1980) decisions are the point of origin that laid the groundwork for orientation period to neo-liberal policies.

Seasonality in variables by time series assumption was surveyed after being determined the variables to be used in the research. Besides, it was also reviewed the stationarity in series and also the degree of stationarity if any. Nonstationary series became stationary by computing their first differences. First of all, the logit model was applied after all the variables were made prepared to be used in the analysis. Afterward, the logit model was applied.

Variables were classified based on their types. A different model was established from each of the variables that were grouped as financial, endogenous and exogenous. The significance of the models were separately reviewed and multiple combination was established. Same estimation models were reviewed when applying logit and probit analyses were applied to the models established.

Both the models gave similar results at the end of the analysis. According to our research findings, a rise in the ratio of M2 in bank credit volume to reserves increases the crisis possibility. Besides, a decrease in the BIST 100 index, composite leading indicators and M2 increases the crisis possibility in the model established with endogenous variables. With reference to another finding, a decrease in reserves can increase the crisis in the model established with exogenous variables. In addition to all there, a decrease in bank credit volume and international reserves increases the crisis possibility in multiple combinations; besides, an increase in interest is linearly directed and will increase the crisis possibility. The rate of exports meeting imports did not give a significant result.

## **Journal of Economics and Political Economy**

As is mentioned, crises result from many different factors and develop in many different manners. However, the reaction of variables selected in studies can be estimated by benefiting from previous crisis experiences. Herein, it will be good to follow macroeconomic variables that give statistically significant results. Notably, Central Bank and other financial institutions should control revenue flows and balance sheets of economic units. Besides, organizing and auditing the financial institutions is essential for a strong and a stabilized economy; fiscal discipline is crucial.

### **Notes**

This study was prepared in Department of Economic Policy in Institute of Social Sciences of Kocaeli University and also derived from Minsky's postgraduate theses called "Financial Fragility Hypothesis and Estimation of the Factors that Make Turkish Economy Fragile by Logit and Probit Models (1990:01-2017:08)"

### References

- Avcı, M.A., & Altay, N.O. (2013). Finansal krizlerin sinyal yaklaşımı ile öngörülmesi: Türkiye, Arjantin, Tayland ve İngiltere için bir analiz. *Pamukkale Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 14, 47-58.
- Enders, W. (1995). *Applied Econometrics Time Series*. New York: John Wiley Sons.
- Frankel, J.A., & Rose, K. (1996). Currency crashes in emerging markets: Empirical indicators. *Journal of International Economics*, 41(3-4), 351-366. doi. [10.1016/S0022-1996\(96\)01441-9](https://doi.org/10.1016/S0022-1996(96)01441-9)
- Gujarati, N.D. (1995). *Basic Econometrics* (3th ed.). New York: McGraw-Hill International.
- Güriş, S., & Çağlayan, E. (2000). *Ekonometri*. İstanbul: Der Yayınları.
- Hsiao, C. (2003). *Analysis of Panel Data*. UK: Cambridge University Press.
- Işık, S., Duman, K., & Korkmaz, A. (2004). Türkiye ekonomisinde finansal krizler: Bir faktör analizi uygulaması. *Dokuz Eylül Üniversitesi İktisadi İdari Bilimler Fakültesi Dergisi*, 19(1).
- Kaminsky, G., Lizondo, S., & Reinhart, C.M. (1998). Leading indicators of currency crisis. *IMF Staff Papers*, 45(1), 1-48. [Retrieved from].
- Kaya, V., & Yılmaz, Ö. (2007). Para krizleri öngörüsünde logit yaklaşımının değeri: Türkiye tecrübesi. *Turkish Economic Association Discussion Paper*, 1, 1-16. [Retrieved from].
- OECD. (2017). Data [Retrieved from].
- Tarı, R. (2008). *Ekonometri*. (5. Baskı). İstanbul: Avcı Ofset Basım.
- World Bank. (2017). World Development Indicators. [Retrieve from].
- Yavuz, N.Ç. (2011). Durağanlığın belirlenmesinde KPSS ve ADF testleri: İMKB Ulusal-100 endeksi ile bir uygulama. *İstanbul Üniversitesi İktisat Fakültesi Mecmuası*, 54(1), 239-247.
- Zoubir, M., Viberg, M., Chellappa, R., & Theodoridis, S. (2014). *Array and Statistical Signal*. Elsevier.



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