

The effect of central bank independence on financial stability in developed countries: evidence from the Fourier procedure

Canan SANCAR

Gümüşhane Üniversitesi, Gümüşhane, Türkiye
canansancar@gumushane.edu.tr

Yusuf Ekrem AKBAŞ

Adıyaman Üniversitesi, Adıyaman, Türkiye
akbasyea@gmail.com

Esra CAN

Adıyaman Üniversitesi, Adıyaman, Türkiye
ecan@adiyaman.edu.tr

Beyhan KILINÇER

Adıyaman Üniversitesi, Adıyaman, Türkiye
bkilincer@adiyaman.edu.tr

Abstract. *In this study⁽¹⁾, it is analysed whether central bank independence or real effective exchange rate, international reserves, credits, and current account deficit are effective on financial stability in 9 developed countries between the period of 1996-2017. The Fourier procedure is applied for analysis. As a result of the analysis, it is concluded that central bank independence is not effective on financial stability. Also, it is determined that credit volume negatively affects financial stability while international reserves positively affect it.*

Keywords: Central bank independence, Financial stability, CWN index, Z-score, Fourier Methodology.

JEL Classification: E51, E52, E58, C33.

1. Introduction

After the global financial crisis, it has started to be discussed that the target of central banks should be expanded to include financial stability. In this direction, one of the generally accepted facts in today's economic environment is that crises in financial markets may also occur even when price stability is sustained. In other words, price stability is necessary for maintaining financial stability, but it cannot create a sufficient condition alone (Ozcan, 2006:1; Bernanke, 2010:1).

The main purpose of the study is to analyse whether Central bank independence (CBI) is effective in ensuring financial stability in developed countries. In this context, it is aimed to help policy authorities to choose the optimal policy instrument by evaluating developed countries independently from each other. As a sub-purpose in the study, it is attempted to determine whether other variables such as international reserves, real foreign exchange rate, credits, and current deficit except CBI are effective on financial stability.

The possible contributions of this study on the literature are:

i) In the literature there are not so many studies⁽²⁾ that focus on the effect of CBI on financial stability. In these studies, monetary policy components such as central bank policy instruments, central bank policies, etc. were generally used instead of the CBI index in the representation of the CBI. The use of monetary policy components implemented by the central bank instead of the CBI index in the representation of the CBI may not fully represent the CBI. Also, Z-score was not used to represent the financial stability, but variables determined based on factor analysis were used in some study⁽³⁾. In the literature, the Z-score of Altman (1968) has been used in many studies⁽⁴⁾ for representing the financial stability. Therefore, there is a gap in the representation of CBI and financial stability. In our study, we used the CWN index and Z-score for representing the CBI and financial stability, respectively. For this, our study is expected to make significant contributions to the issue of the representation of CBI and financial stability in the literature. ii) In some studies⁽⁵⁾, although the Z-score is used to represent financial stability and the CWN index to represent CBI for analysis of developed countries, the control variables except CBI were not used and the effect of possible different variables on financial stability was not analyzed. Since these control variables were used in our study, it is thought that an alternative can be presented to policy authorities on the issue of whether CBI or other variables are effective on financial stability. iii) In the literature, the methods applied in the studies that use CWN index in the calculation of CBI as well as Z-score as an indicator of financial stability and in other studies that study CBI and financial stability do not take into consideration the cross-section dependency, heterogeneity, and structural breaks. In our study, methods that take these three econometric problems into consideration were used.

The study is organised as follows: In the second section, there is literature regarding the independency of central banks and financial stability. In the third section, the data of variables used in this study and empirical methodology are described. The fourth section covers the empirical results, and the fifth section contains results and policy implications.

2. Literature Review

CBI has gained more importance after quantitative measurement of central bank independence. The first significant attempt to measure CBI was made by Bade and Parkin (1988). After Bade and Parkin (1988), the most widely used central bank independence indexes have been the indexes developed by Grilli et al. (1991) and Cukierman et al. (1992). After the statistical measurement of CBI became widespread; many studies were carried out in terms of whether CBI has an effect on price stability (Cukierman, Miller and Neyapti, 2002; Gutierrez, 2003; Crowea and Mead, 2008; Jácome and Vázquez, 2008; Arnone and Romelli, 2013; Trabelsi, 2016; Kokoszcznski and Mackiewicz-Lyziak, 2020). As a common result of these studies, it has been determined that there is a relationship between high CBI and low inflation.

After the global financial crisis, it has been started to discussed that the target of central banks should be expanded to include financial stability. Therefore, opinions about the necessity that central banks should focus on financial stability in addition to price stability have increased, and then limited amount of study (Herrero and Del Rio, 2003; Klomp and Haan, 2009; Doumpos et al., 2015; Dudchenko, 2020) have been done about whether the central bank independence affects financial stability. For example, Herrero and Del Rio (2003) analyzed the effects of the choice of central bank targets and monetary policy strategy on banking crises with a logit model for 79 countries during the period 1970-1999. Variables such as CWN index, total assets of banks and domestic loan growth were used in the study. The CWN index and the domestic loan growth were used to represent CBI and financial stability, respectively. The results of the study showed that the focus of central bank targets on price stability reduces the probability of a banking crisis. In addition, as a result of the study, it has been obtained that the high CBI and the assignment of regulatory and supervisory responsibilities to the central bank are directly related to financial stability. Klomp and Haan (2009) looked for the effect of CBI on financial instability in 75 developed and developing countries between 1985-2005 using panel data model. In the study, a wide data set consisting of indicators of financial system instability (credit growth rate, inflation rate, real interest rate, economic growth, change in exchange rate, budget balance) was used. The results of the study show that there is a significant and negative relationship between CBI and financial instability. Also, it was seen that there are lower financial instability levels in countries where central banks have a clearer authority for fiscal audit. It was determined that among the other economic variables affecting financial instability are high GDP increase rate, exchange fluctuation, and changes in the financial market liberalization. Also, it was concluded that political instability and lack of laws and regulations lead to financial instability. Doumpos et al. (2015) investigated the effect of CBI on bank soundness in 94 developed and developing countries. They used the Hierarchical Linear Modelling (HLM) method for analysis of the period between 2000-2011. For analysis of the other periods, they used the index developed by Cukierman et al. (CWN) (1992). For representing of CBI, CBIND index (Index of Central Bank

Independence), which was created based on CWN index, was used. On the other hand, Z-score was not used to represent the financial stability, but variables determined based on factor analysis were used in this study. For example, index of supervision unification (SUI), financial sector supervision constructed (CBFA), reel GDP growth rate, indicator of bank soundness, indicator of bank risk adjusted returns, the ratio of private credit by deposit money banks to GDP (%), and consumer price index were used for representing the financial stability. The results of the study showed that CBI has an indirect and positive effect on bank soundness and financial stability through monetary policy and inflation targeting. In the study of Dudchenko (2020), the role of CBI in ensuring the financial stability was investigated in 10 developing and 10 developed countries for the period between of 1991 - 2021. In the study, non-performing loans, bank regulatory capital to risk-weighted assets were used. Also, Z-scores of banks and CWN index were used as representative of financial stability and CBI, respectively. GDP annual growth rate, bank capitalization, and public and private sector's total debt load were used as control variables. For the analysis, panel fixed effect and random effect methods were applied. In the study, it was concluded that the relationship between CBI and financial stability is strong in developed countries where this relationship is weaker in developing countries.

3. Data and Methodology

3.1. Data

The model used for empirical analysis in this study is as follows:

$$FS_{it} = \gamma_i - \phi CBI_{it} + \varepsilon_{it} \quad (1)$$

In Equation 1, FS represents the financial stability. CBI also expresses the central bank independence. γ_i is the constant term and represents the error term which has a white noise process. In our study, control variables such as real effective exchange rate (REER), international reserves (IR), loans (CR) and current account deficit variables (CA) were also used to better determine what affects financial stability. Therefore, finally the model of Cukierman et al. (1992) and the modified model in Equation 3 can be rewritten as below:

$$FS_{it} = \gamma_i - \phi CBI_{it} + \varphi X_{it} + \varepsilon_{it} \quad (2)$$

Here, X represents the control variables that can affect the financial stability, other than CBI. Z-score was used as a representative of FS. In the calculation of CBI, CWN index⁽⁶⁾ was used.

In our study, whether four aforementioned control variables as well as central bank independence were effective on financial stability between 1996-2017 in 9 developed countries⁽⁷⁾ (Canada, Iceland, Israel, Japan, New Zealand, Norway, Switzerland, United

Kingdom, and United States) was tested. Z-score of Altman (1968) was used as a representative of financial stability. The CWN index developed by Cukierman et al. (1992) was used as a representative of central bank independence. Real effective exchange rate, international reserves, total credits, and current account balance were used as control variables. In the literature, there are many studies (Glick and Moreno, 1999; Cartapanis, 2002; Frankel and Saravelos, 2010; Akkaya and Kantar, 2018) expressing that high international reserves and stable real effective exchange rates positively affect the financial stability. Besides, there are many studies (Mendoza and Terrones 2008; Jakubík and Slačik, 2013; Yuksel and Zengin, 2016) that indicate the fact that an increase in current deficit and total credits leads to financial instability. In the literature, there are many studies that test the effects of these four control variables on financial stability. Also, CWN index was used in many studies for representing the central bank independence and Z-score of Altman (1968) was used extensively for representing the financial stability. For these reasons, these 6 variables were used in our study. The Z-score was obtained from the Global Financial Development database affiliated with the World Bank. International reserves were obtained from the IMF electronic database (IFS). The real effective exchange rate, total loans and current account balance were obtained from the World Bank electronic database (WDI). CWN index was calculated by authors by using Cukierman et al. (1992) index. Current account balance variable was evaluated as current account balance /GDP. Z-score, real effective exchange rate and CBI variables were used as index values. Total loans were used as total loans /GDP. All of the variables were used logarithmically except for the current account balance.

3.2. Methodology

3.2.1. Panel Unit Root Test

In this study, it was used the panel unit root test developed by Nazlioglu and Karul (2017). This test allows heterogeneity across cross-sectional units and captures the unknown nature of structural breaks without information about the number of breaks. The null hypothesis of this test shows the stationarity, while the alternative hypothesis indicates the non-stationarity. The test procedure of this method is based on the Fourier approximation, developed by Becker et al. (2006). This test has two statistics. These are individual and panel statistics. The individual statistic is based on Kwiatkowski, Phillips, Smith and Shin (1992) (KPSS) test allowing the Fourier frequency developed by Becker et al. (2006). The individual statistic of this test is as follows (Nazlioglu and Karul, 2017):

$$\eta_i(k) = \frac{1}{T} \frac{\sum_{t=1}^T \mathbb{S}_{it}^{\otimes}(k)^2}{\mathcal{E}_{ei}^2} \quad (3)$$

Where

$\hat{\mathcal{E}}_{it}(k) = \sum_{j=1}^t \hat{\mathcal{E}}_{ij}$ is the partial sum process by using the OLS residuals from Equation (3), and $\hat{\mathcal{E}}_{ei}^2$ is an estimation of ε_{it} 's long-run variance. This situation can be explained as follows:

$$\sigma_{\varepsilon_i}^2 = \lim_{T \rightarrow \infty} T^{-1} E(S_{it}^2) \quad (4)$$

The panel statistics can be developed by the average of individual statistics. The Fourier panel statistic $FP(k)$ can be calculated as follows:

$$FP(k) = \frac{1}{N} \sum_{i=1}^N \eta_i(k) \quad (5)$$

3.2.2. AMG estimator

The Augmented Mean Group (AMG) estimator, developed by Eberhardt and Bond (2009), takes into account cross-section dependency and homogeneity problem. This test can account for time-series data properties as well as for differences in the impact of observables and non-observables across panel groups. This estimation technique works through the Dt year dummy coefficients of the pooled regression in first difference, from which the year dummy coefficients are collected, which are relabelled as $\hat{\mu}_i^*$. Then, this variable was included in each of the N standard country regression. Consequently, the AMG estimates were derived as averages of the individual country estimates (Durusu-Ciftci et. al., 2017; Seven. et. al., 2018):

$$AMG - Stage(i) \quad \Delta y_{it} = \phi' \Delta X_{it} + \sum_{t=2}^T c_t \Delta D_t + e_{it} \quad (6)$$

$$\Rightarrow \hat{c}_t = \hat{\mu}_t^* \quad (7)$$

$$AMG - Stage(ii) \quad y_{it} = \gamma_i + \phi_i' X_{it} + c_i t + d_i \hat{\mu}_t^* + \omega_{it} \quad (8)$$

$$\hat{\phi}_{AMG} = N^{-1} \sum_i \hat{\phi}_i \quad (9)$$

Where γ_i is constant and e_{it} , ω_{it} are error terms of stage (i) and stage (ii), respectively.

4. Empirical Results

Firstly, we applied the descriptive statistics and correlation matrix tests for evaluating the data of variables in this study better. Then, we applied the Fourier panel unit root test to examine the stationarity of the series. After Fourier panel unit root test, we analysed whether there was cointegration relationship among the variables by applying the Fourier panel cointegration test. Lastly, we used the AMG estimator to determine whether there

was a significant long-run relationship among financial stability, central bank independence, reel effective exchange rate, international reserve, credit, and current account balance.

The results of correlation relationships among the variables and descriptive statistics are indicated in Table 1 for developed countries.

Table 1. *Summary Statistics*

Correlation	Z-Score	CBI	REER	IR	CR	CA
Z-Score	1	0.024	-0.14	-0.31	-0.25	-0.26
CBI	0.024	1	0.12	0.34	-0.26	-0.12
REER	-0.14	0.12	1	-0.29	-0.43	-0.37
IR	-0.31	0.34	-0.29	1	0.21	-0.30
CR	-0.25	-0.26	-0.43	0.21	1	0.14
CA	-0.26	-0.12	-0.37	-0.30	0.14	1
Sample Size	198	198	198	198	194	194
Median	2.59	-0.45	4.61	24.78	5.43	1.24
Mean	2.39	-0.63	4.62	24.65	5.37	1.03
Std.Dev.	0.96	0.394	0.14	1.80	0.32	6.63
Min.	-0.71	-1.77	4.24	19.68	3.87	-23.16
Max.	3.40	-0.22	5.05	27.89	5.89	16.18

Table 1 indicates that the minimum and maximum values of Z-score are -0.71 and 3.40 , respectively. The standard deviation is 0.96 . This result determines that Z-score does not vary significantly across the 9 developed countries. Furthermore, the median and mean values are 2.59 and 2.39 , respectively. This result shows that there are no significant outliers in 9 developed countries for Z-score. Descriptive statistics of CBI, REER, IR, CR, and CA show similarity with Z-score. Also, it is found that the minimum and maximum values are close to each other and small. This result determines that there are no outliers for CBI, REER, IR, CR, and CA in 9 developed countries. Also, the standard deviation values of CBI, REER, IR, CR, and CA are not high. This result indicates that CBI, REER, IR, CR, and CA do not vary significantly in 9 developed countries.

The correlation among the explanatory variables is low for the most of estimated coefficients. This situation determines that there are no significant multicollinearity problems in this model. Finally, it is found that there are only a few missing observations. This situation determines that the model is nearly balanced panel.

After the correlation matrix and descriptive statistics were applied, it was tested whether there were cross-section dependence and homogeneity problems before applying the panel data analysis. As a result of Table A1, the null hypothesis expressing that there is no cross-section dependence is rejected in developed countries for models and all variables. In addition, the results of homogeneity test shown in Table A1 indicate that the null hypothesis expressing that the model is homogeneous is rejected for developed countries. For this reason, these country groups have heterogeneous structure and there is a cross-section dependence problem in these countries.

After analysing the cross-section dependence and homogeneity problems, the development of structural breaks in the series is seen in Figures 1, for 9 developed countries. LM2, which shows the red lines in the graphs, represents the Fourier series, and LM1 represents the original series of financial stability, central bank independence, reel exchange rate, international reserves, and current account balance. There are some sharp structural breaks in central bank independence series. These structural breaks may result from fundamental reforms in countries' central bank laws. Except this, the graphs show that structural breaks in all series are smooth in 9 countries. Therefore, it is appropriate to apply the Fourier procedure to the series in the study since this procedure takes into account the smooth break in series.

After determining the suitability of the series to the Fourier procedure, the stationarity structure of variables was tested by the Fourier panel unit root test. The results of the Fourier panel unit root test are shown in Table 2.

Table 2. *The Results of Panel Unit Root Test*

Country	Z-SCORE		CBI		REER		IR		CR		CA	
	k=1	k=2	k=1	k=2	k=1	k=2	k=1	k=2	k=1	k=2	k=1	k=2
Canada	0.1	0.1	0.16	0.1	0.2	0.1	0.5	0.3	0.3	0.2	0.16	0.2
Iceland	0.9	0.1	0.17	0.1	0.58	0.7	0.2	0.1	0.2	0.2	0.38	0.1
Israel	0.2	0.1	0.16	0.3	0.12	0.1	0.1	0.1	0.1	0.1	0.32	0.3
Japan	0.3	0.6	8.1	2.6	0.15	0.6	0.2	0.1	0.1	0.1	0.15	0.1
N. Zealand	0.2	0.4	0.16	0.1	0.39	0.1	0.2	0.1	0.1	0.1	0.13	0.1
Norway	0.2	0.2	0.17	0.1	0.41	0	0.2	0.1	0.1	0.1	0.29	0.1
Switzerland	0.1	0.3	0.16	0.1	0.19	0.4	0.2	0.3	0.3	0.1	0.15	0.1
UK	0.2	0.1	0.16	0.4	0.2	0.4	0.4	0.1	0.1	0.1	1.13	0.3
US	0.3	0.4	0.13	0.1	0.29	0.2	0.4	0.3	0.2	0.1	0.18	0.1
Panel stat.	12	1.7	211	25	12	2.4	9.5	0.8	3.9	0.2	11.9	0.5
P-value	0	0	0	0	0	0	0	0.2	0	0.6	0	0.3

Note: Bold numbers state that the null hypothesis of stationarity cannot be rejected at least at the 10 percent level of significance. The statistics are constructed using the Bartlett kernel with the Kurozumi (2002) rule. The p-values are for a one-sided test based on the normal distribution. The constant model critical values for individual statistics are 0.1318 (10%), 0.1720 (5%), 0.2699 (1%) for k=1; 0.3150 (10%), 0.4152 (5%), 0.6671 (1%) for k=2; 0.3393 (10%), 0.4480 (5%), 0.7182 (1%) for k=3. The constant and trend model critical values for individual statistics are 0.0471 (10%), 0.0546 (5%), 0.0716 (1%) for k=1; 0.1034 (10%), 0.1321 (5%), 0.2022 (1%) for k=2; 0.1141 (10%), 0.1423 (5%), 0.2103 (1%) for k=3 (see, Becker et al. 2006, p.389; Nazlioglu and Karul, 2017:190).

The results in Table 2 show that according to panel statistics, when the Fourier frequency is one, the null hypothesis of stationary is rejected for all variables. On the other hand, when the Fourier frequency is two, IR and CR is stationary. The overall panel results differ from individual statistics of countries. According to individual statistics, when the Fourier frequency is one, all the variables are stationary in 9 developed countries. When the frequency is two, order of stationarity differs in all developed countries. For example, Z-score is stationary in five developed countries (Canada, Iceland, Israel, Norway, UK). REER is stationary in five countries (Canada, Iceland, New Zealand, Norway, and US).

CBI is stationary in six countries (Canada, Iceland, New Zealand, Norway, Switzerland, and US). For IR, except three countries (Canada, Switzerland, US) six countries are stationary. For CR, except two countries (Canada, Iceland), seven countries are stationary. Lastly, except four countries (Canada, Israel, New Zealand, UK) five countries are stationary for CA.

The results of panel statistics indicate that all the series include unit roots in developed countries. The similar result is valid for individual statistics when the Fourier frequency is one. However, individual statistics differ across the countries when the frequency is two. In some countries, the series are stationary, while in others, they are non-stationary. Since we investigate the small samples, a frequency of 1 is sufficient. While frequencies of 2 and of 3 provide better results for larger samples, frequency of 1 can yield better results for smaller samples (Nazlioglu and Karul, 2017). Therefore, the result of frequency 1 was taken into consideration. According to this, six of these variables include unit root in all the developed countries. Thus, all the variables are $I(1)^{(8)}$.

After applying the Fourier unit test, it is estimated the effect of central bank independence, reel effective exchange rate, international reserve, credit, and current account balance on financial stability. These relationships between six variables are shown in Table 3.

Table 3. *The Results of AMG Estimator*

Countries	CBI	REER	IR	CR	CA
Canada	0.509 0.413	-0.435 0.393	0.119 (0.166)	-0.163*** (0.0556)	-0.015 0.038
Iceland	0.881 3.28	-0.624 0.574	0.343*** (0.090)	-0.748** (0.398)	-0.030 0.021
Israel	0.146 0.140	-0.557* 0.330	-0.0182 0.075	-0.944** (0.470)	0.011 0.013
Japan	0.626 1.592	-0.245 0.589	0.236* 0.132	-0.018 (0.031)	0.009 0.067
N.Zealand	0.196 0.258	0.514 0.489	-0.077 0.267	0.237 (0.274)	-0.046*** 0.016
Norway	0.018 0.093	-0.926* 0.555	-0.027 0.108	-0.079 (0.265)	-0.012** 0.005
Switzerland	1.011 0.768	-1.531* 0.901	0.084* 0.047	-0.002 (0.055)	0.007 0.012
UK	0.609 0.387	-1.274 1.164	0.1293** 0.0594	-0.257*** (0.081)	0.030 0.073
US	0.155 0.181	-0.274* 0.160	0.271*** 0.089	-0.57** (0.30)	-0.023** 0.009
Panel stat.	0.506 (0.633)	-0.345 (0.451)	0.249** (0.127)	-0.556** (0.287)	-0.176 (0.140)

Note: ***, ** and * indicate the significance at the 1%, 5% and 10, respectively.

According to Table 3, IR is statistically significant and positive in five countries (Iceland, Japan, Switzerland, UK, US). As a result of the panel statistics, IR is statistically significant and positive. Accordingly, if the IR increases by 1%, the financial stability will increase by 0.249% in all the 9 developed countries. For CR, the individual statistics show that CR is statistically significant and negative in five countries (Canada, Iceland, Israel, UK, US). Also, panel statistics indicates that CR is statistically significant and negative for all of the panel. Accordingly, if the CR increases by 1%, the financial stability will decrease by 0.556% in all the 9 developed countries. CBI, REER, and CA variables are also insignificant for both individual and panel statistic. According to these results, an increase in the credit volume negatively affects the financial stability in developed countries while an increase in international reserves increase the financial stability. In addition, central bank independence, real effective exchange rate, and current deficit do not have any effect on financial stability.

According to the results of AMG estimator, it can be seen that CBI is not effective on financial stability while credit volume and international reserves are effective on financial stability in developed countries. For developed countries, this result confirms the results of the global economic crisis that started in the mortgage market in the US at the end of 2007 and spread to the whole world. Before this crisis occurred, central bank independence was high in developed countries. Moreover, price stability was endured in most of the developed countries. However, credit volume⁽⁹⁾ and amount of credit to GDP (% of GDP) were high in most of the developed countries. Also, there was a decline in reserves⁽¹⁰⁾ in many developed countries before the economic crisis in 2007. Therefore, these developments show that not central bank independence but international reserves and credits are effective on financial stability in developed countries. This result confirms the results of the AMG estimator and supports the findings of Glick and Moreno (1999), Cartapanis (2002), Frankel and Saravelos (2010), Mendoza and Terrones (2008), Jakubík and Slačik (2013).

5. Conclusion

In this study, it is analyzed whether central bank independence or real effective exchange rate, international reserves, credits, and current account deficit are effective on financial stability in 9 developed countries. The analysis contains the period of 1996-2017 and the Fourier methodology is used for analysis. According to the empirical findings of the study, it is concluded that central bank independence is not effective on financial stability in developed countries. Besides, it is concluded that credit volume negatively affects financial stability while international reserves positively affect it in developed countries. However, it is determined that real effective exchange rate and current account deficit do not have any effect on financial stability.

Due to the fact that central banks focus on the stability of the financial system as a whole during the decision-making process of monetary policies, the existence of a powerful and effective financial system can only be possible by the existence of independent central banks.

The fact that central banks are independent from external political pressure and politicians in their decisions comes to mean that they have an increased capacity to get signals against threats in the financial system, to send signals to the markets through monetary policies, and to take precautions against crises. Moreover, the existence of an independent central bank can signal to the markets by contributing (Cihák, 2007) to the solution of time inconsistency and reliability problem in financial stability. Thus, a strong CBI can support financial stability. Although there is such a relationship between central bank independence and financial stability, in this study, it was determined that CBI is not effective on financial stability.

This result can be best explained by sharing the control authority of central banks on the financial stability field with various organizations and institutions such as the ministry of finance and capital markets and by the weakening of financial stability due to this authority share (Klomp and Haan, 2009; Cihák, 2007).

Moreover, this situation can be explained by the fact that central banks are more institutionalized, since central bank independence implementations began earlier compared to developing countries, as discussed in the empirical findings section of the study. Central banks being more institutionalized makes it possible to be less exposed to direct or indirect interference by the political authorities. The independence of central banks from the political authority in their policy implementations allows decreasing the unexpected policy implementations that will create shock effects in the markets. For this reason, central banks in developed countries mainly make decisions based on scientific methods in their policy implementations and these implementations become more systematic. Therefore, implementations of central banks cannot be expected to go beyond this routine. The routinization of central bank policy implementations reduces the importance of central bank independence in terms of affecting markets. Also, the global economic crisis that started in the US in 2007 and spread to the whole world affected the developed countries the most, even though CBI and price stability were ensured in developed countries. This case supports the result that was obtained for the relationship between CBI and financial stability in developed countries in this study. These results also show that central bank independence is required in developed countries for ensuring financial stability but it is not adequate alone.

Other findings obtained are that the amount of credit and international reserves are effective on financial stability. For this reason, to obtain financial stability, policy authorities should prefer policies that limit credit growth and increase reserves. Although credit growth is an important variable for economic growth, the fact that credit volume increases too much

may lead to an increase in asymmetrical information. Thereby, adverse selection and moral hazard problems may increase in bank loans. This case may lead the banking sector – having a large share within the financial markets – to be damaged and financial markets to be negatively affected. Thus, the lending conditions of banks in developed countries and the standards regarding these conditions should be further improved. For this, regulations and supervision related to the banking sector should be developed. In this context, Basel I, II, and III regulations regarding the capital structure of banks and independent institutions that will audit the bank loans should be improved. In addition to credit volume, international reserves also play an important role in ensuring financial stability in developed countries. The currency of some developed countries is reserve money. That is, the currencies of some developed countries can be used in trade all around the world. Foreign trade volumes of developed countries are also much higher than those of developing countries. For this reason, when firms experience problems in foreign trade, banks of the firms that will make payment will not be negatively affected when international reserves are used and parallel to this financial sector will not be affected deeply. This result shows that international reserves have great importance for the banking sector and accordingly the financial sector. In this context, policy authorities should also apply policies that will increase international reserves to ensure financial stability in developed countries. In this regard, central banks have a great responsibility. Applications such as repo and reverse repo made by central banks in financial markets to increase reserves should be done according to the needs of the market. Otherwise, the use of policy instruments by central banks only to increase reserves may adversely affect all financial markets, especially the foreign exchange market, and may destabilize financial stability.

Notes

- (1) This study is supported by The Scientific and Technological Research Council of Turkey (TÜBİTAK) with project number 221K290.
- (2) Detailed information about the studies analyze the effect of CBI on financial stability, see the literature part of this study.
- (3) Detailed information about using the some variable based on factor analysis for representing the Z-score, see the literature part of this study.
- (4) There are a lot of studies using the Z-score for representing the financial stability. These studies are as follows: Andries and Capraru, 2011; Aasen, 2011; Anjum, 2012; Rama, 2012; Hauschild, 2013; Fiordelisi and Mare, 2013; El Khoury and Al Beaino, 2014; Diaconu and Oanea, 2015; Badea, 2016; Dudchenko, 2020.
- (5) There is two study use the CWN index and Z-score for representing the CBI and financial stability, respectively. Detailed information about these two studies, see the literature part of this study.
- (6) See the study of Cukierman et al. (1992) for detailed information about the CWN index. For the calculation of the CWN index, the Table 1, which is in the study of Cukierman et al. (1992), is

taken into account. In the study of Cukierman et al. (1992), four different independence orderings were made for central banks. The turnover rate of central bank governors (rate of change) is used to measure the de jure independence in the first ordering and the de facto independence in the second ordering. In the third ordering, the answers of the experts to a questionnaire were used. This independence index was created by using survey questions. The survey questions were gathered under the four categories of board of directors, making the policy, aims of central banks, and limitations in lending money to governments. These four categories are also divided into fifteen sub groups, such as term of the central bank governor, the institution that appoints the governor, whether the governor is discharged from office by the government, who created the monetary policy, how disputes are resolved, whether the central bank plays a role in creating the budget, whether the central bank gives advances to the government, terms of borrowing, whether there are limits on lending, debt maturity, interest rates, whether the central bank buys securities in the primary market and what the objectives of the central bank are. The fourth ordering is the sum of the first two orderings.

- (7) Central bank independence is more functional in liberal markets. Therefore, the countries analyzed in the study were preferred by taking into account the economic freedom index. This index is published by Heritage Foundation and indicates the level of independence and liberal of countries in terms of economics. The Economic Freedom Index covers 12 freedoms – from property rights to financial freedom – in 184 countries. Each of the twelve economic freedoms within these categories is graded on a scale of 0 to 100. A country's overall score is derived by averaging these twelve economic freedoms, with equal weight being given to each (<https://tcdata360.worldbank.org/>). According to this, the first hundred countries among the developed countries in the economic freedom index were chosen.
- (8) The first difference result of the unit root test can be requested from the authors.
- (9) For detailed information about credit volume/GDP see the following website of WDI: <https://databank.worldbank.org/source/world-development-indicators>
- (10) For detailed information about International Reserves of countries see the following website of IFS: <https://data.imf.org/?sk=4c514d48-b6ba-49ed-8ab9-52b0c1a0179b&sl=1409151240976>

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