

“The relationship between derivative instruments and systematic risk: a study on banks trading on BIST”

AUTHORS

Emre Esat Topaloglu  <https://orcid.org/0000-0001-8771-779X>
Turhan Korkmaz  <https://orcid.org/0000-0001-5468-2279>

ARTICLE INFO

Emre Esat Topaloglu and Turhan Korkmaz (2019). The relationship between derivative instruments and systematic risk: a study on banks trading on BIST. *Banks and Bank Systems*, 14(2), 152-163. doi:[10.21511/bbs.14\(2\).2019.13](https://doi.org/10.21511/bbs.14(2).2019.13)

DOI

[http://dx.doi.org/10.21511/bbs.14\(2\).2019.13](http://dx.doi.org/10.21511/bbs.14(2).2019.13)

RELEASED ON

Thursday, 27 June 2019

RECEIVED ON

Wednesday, 27 March 2019

ACCEPTED ON

Thursday, 20 June 2019

LICENSE



This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/)

JOURNAL

"Banks and Bank Systems"

ISSN PRINT

1816-7403

ISSN ONLINE

1991-7074

PUBLISHER

LLC “Consulting Publishing Company “Business Perspectives”

FOUNDER

LLC “Consulting Publishing Company “Business Perspectives”



NUMBER OF REFERENCES

32



NUMBER OF FIGURES

0



NUMBER OF TABLES

11

© The author(s) 2026. This publication is an open access article.



BUSINESS PERSPECTIVES



LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine

www.businessperspectives.org

Received on: 27th of March, 2019

Accepted on: 20th of June, 2019

© Emre Esat Topaloğlu, Turhan
Korkmaz, 2019

Emre Esat Topaloglu, Ph.D., Assistant
Professor, Faculty of Economics and
Administrative Sciences, Business
Administration Department, Şırnak
University, Turkey.

Turhan Korkmaz, Ph.D., Professor,
Faculty of Economics and
Administrative Sciences, Business
Administration Department, Mersin
University, Turkey.



This is an Open Access article,
distributed under the terms of the
[Creative Commons Attribution 4.0
International license](https://creativecommons.org/licenses/by/4.0/), which permits
unrestricted re-use, distribution,
and reproduction in any medium,
provided the original work is properly
cited.

Emre Esat Topaloğlu (Turkey), Turhan Korkmaz (Turkey)

THE RELATIONSHIP BETWEEN DERIVATIVE INSTRUMENTS AND SYSTEMATIC RISK: A STUDY ON BANKS TRADING ON BIST

Abstract

This study is aimed to analyze the relationship between the use of derivative financial instruments for speculative and hedging purposes and systematic risk. The effect of the use of derivatives by seven banks trading on Borsa Istanbul during the period of June 2007 – December 2017 on systematic risk was studied using panel cointegration, causality and regression analyses. Banking sector was examined within the scope of the study, since the level of use of derivatives is high in this sector. It was identified in the study that there is a long-run cointegration relationship between the use of derivatives and systematic risk. It was also identified that there is a significant and negative relationship between the use of derivatives for speculative purposes and systematic risk. Furthermore, it was determined that there is a one-way causality relationship from the use of derivatives for speculative purposes towards systematic risk. However, there was no relationship identified between the use of derivatives for hedging purposes and systematic risk. On the other hand, significant and negative relationship was identified between swap transactions that banks use for speculative purposes and systematic risk, while there was no significant relationship determined between forward and option contracts and systematic risk.

Keywords

derivatives, risk management, banks, panel data analysis

JEL Classification

C33, G10, G21, G32

INTRODUCTION

The activities of firms have reached an international level exceeding national boundaries owing to financial globalization. As a result of the activities firms carry out in financial markets, they encounter some risks. These risks can arise from within the firm as well as from external factors. Risk is described as the possibility of an unanticipated circumstance, while financial risk is the possibility of deviation between realized return and the expected return. The deviation in question can be negative or positive. Total risk is the sum of systematic and unsystematic risks. Unsystematic risks can be mitigated through diversification. Systematic risk is the variability of return on shares or portfolios associated with changes in return on the overall market. In other words, these are the risks that are caused by economic, political and other environmental conditions affecting all firms in business. Systematic risk types generally include inflation risk, currency risk, interest rate risk, market risk and political risk. Unsystematic risk is either a firm-specific threat or a risk that only affects a particular industry. This type of risks generally includes business or industry risk, financial risk and administrative risk. Since the total risk of firms include both systematic and unsystematic risks, it is not possible to reduce systematic risk through diversification in the same economy. Systematic risk that cannot be mitigated through diversification

in the same economy is an important factor for investors. With regard to systematic risk, CAPM was developed with the studies conducted by Sharpe (1964), Lintner (1965), and Mossion (1966). CAPM is a model generally based on a single variable. Market portfolio is considered as an independent variable in this model, and it is intended to explain returns on all risky securities with returns of market portfolio. Beta coefficient indicates the relationship between returns on a security and the market portfolio. Beta coefficient is the measure of systematic risk. If beta coefficient is 1, it is understood that the return on the security in question changes at the same rate as the return of market portfolio consisting of all securities. Beta coefficient is the coefficient demonstrating the relationship between changes in share's returns depending on the changes taking place in return rates of market portfolio. The factors affecting a firm's beta coefficient include the capital structure and level and field of activity of that firm.

Firms, especially banks as the financiers of the real economy, operate in futures market for hedging purposes in order to protect their capital within the scope of financial risk management. In this way, banks can make risk transfer by carrying out transactions in futures market by use of derivatives and minimize potential risks that they might come across in the future. Banks can use derivatives consisting of forward, futures, option and swap contracts for primarily hedging, arbitrage and speculative purposes. In this context, it is aimed to reveal the relationship between the use of derivatives by banks and systematic risk in the study. To this end, the data of seven banks trading on Istanbul Stock Exchange during the period of June 2007 – December 2017 were analyzed within the framework of the study.

Risk management is important for banks to be sustainable. Banks can minimize risks and make profit by using derivative instruments. Considering that banks cause systemic risk, it is also important for the economy of the country to perform risk management by using derivative instruments. In this context, researches on the relationship between derivatives and risks keep up to date (Haynes et al., 2019; Vuilleme, 2019). This study has a crucial importance in terms of investigating the short- and long-term relationship between the use of derivatives by banks for hedging and speculative purposes and systematic risk as well as the relationship between speculative forward, swap and option contracts and systematic risk.

1. LITERATURE REVIEW

Derivative financial instruments can be used in futures markets in order to measure and avoid market risk, i.e. systematic risk occurring in spot markets that cannot be eliminated through diversification and that investors are obliged to endure, or in order to take a speculative position. There are some studies with respect to this subject both in national and international literature. Descriptions on the findings obtained in these studies are given based on chronological order.

Selvi and Türel (2010), in their study, examined deposit banks in Turkey and the use of derivatives by non-financial corporations as part of financial risk management and the accounting for these usages. According to the results of this examination, it was demonstrated that firms used derivatives for hedging purposes, but they reported the costs and profits resulting from these procedures

as held for trading. Alaghi (2011) investigated the association between financial leverage and beta, accepted as the measure of systematic risk, in firms listed on Tehran Stock Exchange. As a result of the study, a significant and negative relationship between financial leverage and systematic risk was identified. In the study conducted by Bartram et al. (2011), the relationship between the use of derivatives by non-financial corporations from 47 countries and firm-specific risk and values was investigated. As a result of the study, it was determined that there was a negative relationship between the use of derivatives and total risk and systematic risk, while there was a positive relationship between firm value and systematic risk. In the study carried out by Coutinho et al. (2012), the effect of the use of derivatives as a risk management instrument by 47 non-financial corporations that were active in Brasil during the period of 2004–2010 on capital risk and cost was analyzed. The results of the analysis demonstrat-

ed that the use of derivatives affected capital cost in a negative way contrary to what was expected. Hon (2012) studied the use of derivatives by Hong Kong listed firms for financial risk management purposes. As a result of the study, it was identified that using derivatives was useful in avoiding interest rate risks. Keffala and Peretti (2013) investigated the relationship between the use of derivatives by banks in developed countries and borrowing risk along with credit risk and currency risk. The results of the study proved that there is a negative relationship between forward contracts and borrowing risk, while there is a negative relationship between swap contracts and credit risk, and a positive relationship between option contracts and currency risk. Li and Marinc (2014) studied the relationship between the use of derivatives by public banks operating in the USA during the period of 1997–2012 and systematic risk. The findings of the study showed that the use of derivatives by banks increased systematic risk.

Kornel (2014) investigated the relationship between the use of derivatives by public banks operating in Hungary during the period of 2003–2012 and riskiness of banks. As a result of the study, it was determined that there is a negative relationship between the use of derivatives and banking risks. In their study, Şirvan and Alp (2017) aimed to reveal the relationship between the use of derivatives by banks operating in Turkey during the period 2007–2015 and credit risk, and also between market risk and capital adequacy ratio. The results of the study did not suggest any relationship between the use of derivatives and risks. Živanović and Mina (2017) studied the use of derivatives within the context of corporate risk management of non-financial corporations that were active in Serbia. The results of the study revealed that derivatives were ascertained to be useful in avoiding interest and rate risks.

In the light of previous studies on the subject, the relationship between the use of derivatives and systematic risk was addressed in different manners in terms of scope and methodology in this study, and overall, it was examined in a more detailed way. In this context, the information regarding the research on the relationship between the use of derivatives and systematic risk is explained further on.

2. DATA SET, MODEL AND METHOD

The objective of the study is to investigate the relationship between the use of derivative financial instruments for speculative and hedging purposes and systematic risk. For that purpose, the data of seven banks trading on Istanbul Stock Exchange during a six-month period of June 2007 – December 2017 were analyzed within the scope of the study. Secondary data concerning the use of derivatives were obtained from balance sheets in the activity reports of banks, while the data regarding systematic risk were obtained from the database www.investing.com. Data on derivatives were available in the activity reports of banks. Systematic risk, on the other hand, was calculated by use of the data obtained from the market. As of 2018, there are 13 banks listed on BIST Bank Index, which was created on December 27, 1996. Seven banks, which were progressively listed on the index during the research period and whose full data could be obtained, were included in the analysis. These banks were Akbank, Denizbank, QNB Finansbank, Türkiye Garanti Bankası, Türkiye İş Bankası, Türkiye Sınai Kalkınma Bankası and Yapı Kredi Bankası.

As of 2017, there are 52 banks operating in the sector. 34 of them are deposit banks, while 13 of them are development and investment banks, and five of them are participation banks. Three of deposit banks are public-capital banks, while nine of them are private equity banks. There are 13 banks listed on BIST in Turkey. As of December 31, 2017, the amount of total assets in the banking sector has been USD 816.632 million, while the amount of total assets of seven banks examined in the study is USD 416.158 million (<https://www.tbb.org.tr>). The banks on BIST Bank Index subject to the study represent 51% of the banking sector in terms of active growth.

Banks use forward, futures, swap and option contracts for speculative and hedging purposes. The data regarding the use of derivatives by banks are specified in financial statements as footnotes. Accordingly, in the activity reports of the banks constituting the sample group of the study, it has been observed that derivatives were used mostly for speculative purposes. On the other hand,

it was observed during the analysis period that banks used forward, swap and option contracts for speculative purposes, and some banks did not prefer using futures contracts. Thus, futures contracts were not included in the analyses in order to be able to reach more accurate and reliable results in the research.

In the study, both the total uses of derivatives for speculative and hedging purposes were included in the analysis as independent variables as well as the uses of forward, swap and option, while Beta, the measure of systematic risk, was added to the analysis as a dependent variable. Systematic risk is one of the key factors that should be taken into consideration by investors. Capital Asset Pricing Model (CAPM) was suggested by Sharpe (1964) in regard to systematic risk, and it was developed by Linter (1965) and Mossin (1966). The model is based on the inclusion of the systematic risk premium to the risk-free interest rate for determining the expected return of the share. CAPM explains the relationship between systematic risk and share with linear regression model, and Beta coefficient is accepted as the measure of systematic risk that cannot be eliminated through diversification. Beta indicates the sensitivity of a share's return to the return on the market portfolio. Market return, CAPM and Beta are calculated by use of the following formulas.

$$R_t = \ln \frac{P_t}{P_{t-1}}, \quad (1)$$

$$R_i = R_f + \beta_i (R_m + R_f), \quad (2)$$

$$\beta = \frac{Cov_{i,m}}{\sigma_m^2}, \quad (3)$$

where R_i – expected return on a security, R_f = Risk-free rate, β – beta of the security, $Cov_{i,m}$ – covariance between market return and stock return, σ_m^2 – variance of the market.

The information regarding the variables used in the study within the scope of the relationship between the use of derivatives for speculative and hedging purposes and systematic risk is indicated in Table 1.

Table 1. Variables used in the model

Source: Keffala and Peretti (2013), Kornel (2014).

Notation	Variable	Specification
BETA	Beta coefficient	Covariance between market return and security return/market return variance
SPEC	Speculation	Derivative financial assets for marketable securities/total assets
HED	Hedging	Derivative financial assets held for cash flow hedges/total assets
FRW	Forward	Forward transactions/total assets
SWP	Swap	Swap transactions/total assets
OPT	Option	Option transactions/total assets

Panel cointegration, panel causality and panel regression analyses are carried out in order to determine the long-term and short-term relationship between derivatives and systematic risk. Four different models were created within the scope of panel data analyses. In the study, first of all, the long-term relationship between the use of derivatives for speculative and hedging purposes and systematic risk is tested with Kao (1999) and Westerlund (2005) CUSUM Panel Cointegration tests. The models created in regard to cointegration relationship was built as indicated below.

$$\Delta beta_{it} = \delta'_i d_t + \alpha_i y_{it-1} + \lambda'_i x_{it-1} + \sum_{j=1}^{market} \alpha_{1ij} \Delta y_{it-j}^{spec} + \sum_{j=1}^{market} \alpha_{2ij} \Delta y_{it-j}^{hed} + e_{it}, \quad (4)$$

$$Beta_{it} = \alpha_{it} + \beta_1 Spec_{it} + \beta_2 Opt_{it}. \quad (5)$$

Following the determination of presence of the long-term relationship, Panel DOLS was used to obtain estimates of cointegration coefficient. The model created for Panel DOLS test is as follows:

$$Beta_{it} = \alpha_{it} + \beta spec_{1it} + \beta hed_{2it} + u_{it}. \quad (6)$$

After the coefficients concerning the relationship between variables were estimated, Granger causality test based on Panel VECM was used to reveal if this relationship was a one-way or two-way relationship. The models built in accordance with speculation, hedging and beta variables are as follows:

$$\begin{aligned} \Delta Beta_{2it} = & b_{1i} + \sum_{p=1}^k b_{11ip} \Delta Beta_{2it-p} + \\ & + \sum_{p=1}^k b_{12ip} \Delta spec_{it-p} + \sum_{p=1}^k b_{13ip} \Delta hed_{it-p} + \\ & + \theta_{1i} ECM_{it-1} + u_{it}, \end{aligned} \quad (7)$$

$$\begin{aligned}\Delta spec_{it} = & b_{2i} + \sum_{p=1}^k b_{21ip} \Delta Beta_{2it-p} + \\ & + \sum_{p=1}^k b_{22ip} \Delta spec_{it-p} + \sum_{p=1}^k b_{23ip} \Delta hed_{it-p} + \\ & + \theta_{2i} ECM_{it-1} + u_{2it},\end{aligned}\quad (8)$$

$$\begin{aligned}\Delta hed_{it} = & b_{3i} + \sum_{p=1}^k b_{31ip} \Delta Beta_{2it-p} + \\ & + \sum_{p=1}^k b_{32ip} \Delta spec_{it-p} + \sum_{p=1}^k b_{33ip} \Delta hed_{it-p} + \\ & + \theta_{3i} ECM_{it-1} + u_{3it}.\end{aligned}\quad (9)$$

As a result of coefficient estimates and causality analyses regarding the cointegration relationship between the use of derivatives and systematic risk, findings implying the presence of statistically significant relationships between the use of derivatives for speculative purposes and systematic risk were obtained. The potential effects of forward, swap and options as derivatives used by banks for speculative purposes on systematic risk were investigated with Panel regression method. The model created within the framework of panel regression analysis is demonstrated in equation 9.

$$\begin{aligned}Beta_{it} = & \beta_{0it} + \beta_1 Frw1_{it} + \\ & + \beta_2 Swp2_{it} + \beta_3 Opt3_{it} + \varepsilon_{it}.\end{aligned}\quad (10)$$

Various assumptions should be tested in order to be able to reveal the relationship between variables within the scope of panel data analysis. Accordingly, the assumptions of multicollinearity, cross-sectional dependence, homogeneity and stationarity are tested in panel cointegration, causality and panel regression analyses, while the selection of estimation model and assumptions of autocorrelation and heteroscedasticity are also tested in panel regression analysis.

Whether there is a long-term relationship between the use of derivatives for speculative and hedging purposes and systematic risk is analyzed with Kao (1999) and Westerlund (2005) CUSUM panel cointegration tests. Kao panel cointegration test is based on DF and ADF tests (Baltagi et al., 2000, p. 13; Asteriou & Hall, 2007, p. 372). This test includes null hypothesis assumptions where there

is no cross-sectional hypothesis trend and cointegration. In the study, Kao test was employed using Newey-West estimators in order to reach Schwarz criterion and long-term variance when an individual constant exists. CUSUM test is used to make an assumption on cross-sectional dependence and hypothesis testing are reversed. Thus, it is implied that there is cointegration under the null hypothesis in a CUSUM test. After the determining a cointegration relationship, Pedroni's Dynamic Ordinary Least Squares (DOLS) method was used to detect the direction and the level of existing long-term relationship. In line with the long-term cointegration relationship, under the assumption that series are static, both long and short-term causality relationships between variables were analyzed. Granger causality test was based on the Panel Vector Error Correction Model (VECM).

3. RESEARCH RESULTS

In the study, the use of derivatives by banks was addressed generally in terms of speculative and hedging purposes, while derivatives used for speculative purposes were also addressed individually. In this context, long-term cointegration relationship between the total fund amounts attributed to derivatives was used for speculative and hedging purposes, and beta, the measure of systematic risk was tested, and it was investigated if the potential effect had a one-way and/or two-way causality relationship by making coefficient estimations. Later on, the relationship between forward, swap and option contracts used for speculative purposes and systematic risk was examined. When the activity reports of banks during the analysis period were reviewed, it was observed that banks did not prefer using futures contracts for speculative purposes. It was seen that Akbank, Denizbank, Türkiye İş Bankası, Türkiye Sınai Kalkınma Bankası and Yapı Kredi Bankası did not use futures during certain stages of the research period. Thus, futures contracts were not included in the analyses in order to be able to reach more accurate and reliable results in the research. For this reason, the study is composed of two parts where the long-term relationship between the use of derivatives for speculative and hedging purposes and systematic risk and the short-term relationship between the use of derivatives for speculative purposes and system-

Table 2. The results of multicollinearity analysis

Variance coefficient	Uncentered VIF	Centered VIF	Correlation	BETA	SPEC	HED
—	—	—	BETA	1.000	—	—
8.445	1.586	1.310	SPEC	−0.141	1.000	—
2.961	1.356	1.310	HED	0.071	0.205	1.000
0.004	1.212	NA	C	—	—	—

Table 3. The results of test examining multicollinearity among derivatives

Variance coefficient	Uncentered VIF	Centered VIF	Correlation	BETA	FRW	OPT	SWAP
—	—	—	Beta	1.000	—	—	—
139.687	1.073	1.055	Forward	−0.035	1.000	—	—
73.587	1.254	1.238	Option	−0.128	0.258	1.000	—
7.912	1.442	1.256	Swap	−0.107	0.333	0.237	1.000
0.005	1.236	NA	C	—	—	—	—

atic risk are analyzed separately. Accordingly, the analyses made and the findings obtained are specified below. The first assumption that should to be tested within the framework of panel data analyses is multicollinearity. The results of Spearman correlation analysis conducted for multicollinearity and variance inflation factor test are indicated in Tables 2 and 3.

OPT and *SWAP* variables was 0.333, and VIF value was smaller than 10, which is accepted as critical value. According to the correlation and VIF test results, no findings were found indicating the problem of multicollinearity between explanatory variables. Explanatory statistical data regarding the dependent and independent variables are indicated in Table 4.

The correlation coefficient between variables higher than 0.90 and *VIF* values greater than 10 indicate the presence of the problem of multicollinearity (Tabachnick & Fidell, 2001; Hair et al., 1998). According to the results of correlation and VIF analysis conducted to test the assumption of multicollinearity, it was identified that the level of relationship among the *BETA*, *SPEC* and *HED* variables was 0.20, while *VIF* values were 1.310. Hence, there is no question of multicollinearity between the explanatory variables and in the panel. The results of correlation analysis suggested that the highest level of relationship between *BETA*, *FRW*,

When the average values regarding explanatory and independent variables are analyzed, it is seen that the average value of the use of derivatives for speculation among total assets was 0.011, while the average value of the use of derivatives for hedging was 0.007. Therefore, it is possible to state that banks trading on BIST Bank Index use derivatives for speculative purposes more than for hedging purposes. Moreover, it can be said that banks used swap contracts the most, followed by options and forward contracts. The average value for beta, which indicates the sensitivity of a share's return to the return on the market portfolio and

Table 4. Descriptive statistics

	BETA	SPEC	HED	FORWARD	OPTION	SWAP
Mean	0.990171	0.011528	0.007961	0.000722	0.000939	0.009818
Median	1.065843	0.005874	8.72E−07	0.000423	0.000566	0.004434
Maximum	4.923800	0.133907	0.466540	0.053902	0.039253	0.197251
Minimum	−3.088771	−0.058047	−0.077743	−0.022851	−0.070518	−0.070892
Std. dev.	0.788595	0.025212	0.042579	0.005579	0.008325	0.025569
Skewness	−0.591150	1.673998	8.535916	4.897849	−3.457087	3.070718
Kurtosis	11.41738	8.805700	89.84102	57.71302	40.14997	23.00958
Jarque-Bera	463.6046	288.2061	50260.54	19824.10	9162.525	2811.145
J-B prob.	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	154	154	154	154	154	154

Table 5. The results of cross-sectional dependence test on the basis of panel and variable

Variable	LM (Breusch & Pagan, 1980)		CDLM (Pesaran, 2004)	
	Statistics	Prob.	Statistics	Prob.
PANEL A	21.433	0.433	0.067	0.473
BETA	30.161	0.089	1.414	0.079
SPEC	58.258	0.000	5.749	0.000
HED	56.174	0.000	5.427	0.000
PANEL B	32.990	0.046	1.850	0.032
BETA	30.610	0.080	1.483	0.069
FORWARD	68.091	0.000	7.266	0.000
OPTION	56.622	0.000	5.497	0.000
SWAP	57.428	0.000	5.621	0.000

which is the measure of systematic risk, is calculated as 0.99 in banks according to the results of descriptive statistics analysis. If there is cross-sectional dependence between series, analyses should be made taking this fact into consideration for the sake of accuracy and reliability of the findings to be obtained (Breusch & Pagan, 1980; Pesaran, 2004). Results of analyses where cross-sectional dependence is not taken into consideration can include deviation and become incoherent. Cross-sectional dependence between series was analyzed by use of Breusch-Pagan (1980) LM test and Pesaran (2004) CDLM tests due to the fact that time dimension of the study is greater than its cross-section dimension ($T > N$). The results of the CSD test are indicated in Table 5.

According to the CSD test results of Panel A, it was determined that probability values of beta as the dependent variable based on probability values of CSD test carried out on variable basis were above the critical value and that they did not include cross-sectional dependence. On the other hand, probability values for *SPEC* and *HED* variables were found to be below the critical value, and the null hypothesis was rejected. In this re-

gard, it is not possible to mention cross-sectional independence in terms of these two variables. The cross-sectional dependence test results of Panel B suggested that probability values for forward, option and swap variables were below the critical value, and the null hypothesis indicating nonexistence of cross-sectional dependence was rejected. Accordingly, it was revealed that there is no cross-sectional independence in the series.

Whether the stationarity assumption is investigated by use of first or second generation, unit root test within panel data analysis is decided by use of the assumption of homogeneity. The results of analysis made in accordance with homogeneity and heterogeneity of variables are indicated in Table 6.

The examination of the results of homogeneity test for Panel A and B suggested that probability values for all the variables were above the critical value, and the null hypothesis was not rejected. Accordingly, it was determined that slope coefficients of all three variables were homogeneous. In compliance with the presence of cross-sectional dependence and homogeneous structure identified in series, stationarity testing was carried out

Table 6. The results of the Pesaran and Yamagata (2008) homogeneity test

	Variable	$\bar{A}$	Prob.	$\bar{A}_{adj}$	Prob.
PANEL A	BETA	0.498	0.309	0.536	0.296
	SPEC	-1.760	0.961	-1.893	0.971
	HED	-1.042	0.851	-1.121	0.869
PANEL B	BETA	0.498	0.309	0.536	0.296
	FORWARD	-1.377	0.916	-1.482	0.931
	OPTION	-1.726	0.958	-1.857	0.968
	SWAP	-1.545	0.939	-1.662	0.952

by use of Bai and Ng (2004) PANIC unit root test, one of the second generation tests taking cross-sectional dependence and homogeneity into account. For *BETA* variable, which is homogeneous and includes CSD with a significance level of 0.10, PANIC second generation and Levin, Lin, and Chu (2002) (LLC) first generation unit root tests were used to investigate the stationarity assumption. The results of unit root test are indicated in Table 7.

The examination of the results of PANIC test used in the presence of cross-sectional dependence and homogeneity suggested that probability values for *BETA*, *SPEC*, *HED*, *FORWARD*, *OPTION* and *SWAP* variables were below the critical value, and the null hypothesis was rejected. Therefore, it was determined that all variables were stationary at level. The examination of the results of LLC test suggested that proba-

bility values for *BETA* variable were below the critical value, and the null hypothesis indicating nonexistence of stationarity was rejected. In this context, it was determined that series associated with *BETA* variable were stationary at level. This finding shows parallelism with the findings obtained from PANIC test.

It was revealed that series related to all variables were stationary at the same level according to the stationarity testing conducted on explanatory and dependent variables. The long-term relationship, namely cointegration relationship between variables having the same level of stationarity, can be analyzed. The long-term relationship between the use of derivatives and systematic risk was examined using Panel CUSUM and Kao Panel Cointegration tests. Test results are indicated in Table 8.

Table 7. The results of PANIC and LLC panel unit root tests

Level	Intercept		Intercept and trend	
	Statistics	Prob.	Statistics	Prob.
PANIC panel unit root tests				
BETA				
$Z_{\bar{e}}^c$	7.0153***	0.0000	6.1166***	0.0000
$P_{\bar{e}}^c$	51.1213***	0.0000	46.3659***	0.0000
SPEC				
$Z_{\bar{e}}^c$	3.9444***	0.0000	3.2200***	0.0006
$P_{\bar{e}}^c$	34.8717***	0.0015	31.0389***	0.0055
HED				
$Z_{\bar{e}}^c$	2.4760***	0.0066	3.0392***	0.0012
$P_{\bar{e}}^c$	27.1018**	0.0187	30.081***	0.0074
FORWARD				
$Z_{\bar{e}}^c$	6.2384	0.0000***	4.0618	0.0000***
$P_{\bar{e}}^c$	47.0103	0.0000***	35.4929	0.0012***
OPTION				
$Z_{\bar{e}}^c$	3.8739	0.0001***	2.4050	0.0081***
$P_{\bar{e}}^c$	34.4985	0.0017***	26.7258	0.0209**
SWAP				
$Z_{\bar{e}}^c$	3.1814	0.0007***	2.9702	0.0015***
$P_{\bar{e}}^c$	30.8343	0.0058***	29.7169	0.0083***
LLC panel unit root test				
BETA	-9.207	0.0000***	-8.024	0.0000***

Note: ***, ** and * denote the significance at the 1, 5 and 10 per cent levels, H_0 : Unit Root.

Table 8. The results of Kao and CUSUM cointegration tests

	t-statistics	Prob.
Kao cointegration tests		
ADF	-2.564***	0.0052
Residual variance	0.909	????
HAC variance	0.126	
DOLS-based CUSUM test		
CUSUM cointegration tests	1.583	0.057*

Note: ***, ** and * denote the significance at the 1, 5 and 10 per cent levels, H_0 : Cointegration.

According to the results of Panel CUSUM cointegration test, the null hypothesis indicating the presence of cointegration among series cannot be rejected. In other words, it was identified that series act together in the long term, and the problem of spurious regression cannot be encountered in model estimations to be conducted with the level values of these series. The presence of a long-term cointegration relationship between series was also investigated with Kao cointegration test, which has a null hypothesis according to CUSUM test. According to the results of Kao cointegration test, the null hypothesis indicating the nonexistence of cointegration among series was rejected. In this regard, it was put forward that there was a long-term cointegration relationship between series. The results obtained from Kao test support the Panel CUSUM test results.

After unveiling a long-term cointegration relationship between the use of derivatives for speculative and hedging purposes and systematic risk, Panel DOLS estimation method was used to detect the direction and coefficient of the relationship between variables. The results of Panel DOLS test are indicated in Table 9.

Table 9. The results of the Panel DOLS test

Variable	PANEL BETA
Period	June 2007 – December 2017
Method	Panel DOLS
Speculation	-20.775 (0.027)**
Hedging	2.0472 (0.657)
R ²	0.430
Regression S.E.	0.774
Long-run variance	0.373
Mean dep. var.	0.997
S.D. dep. var.	0.808
Akaike information criterion	49.195
Observations	154

Note: ***, ** and * denote the significance at the 1, 5 and 10 per cent levels.

The results of Panel DOLS tests suggested that there was a statistically significant and negative relationship between the use of derivatives for speculative purposes and systematic risk. An alteration of one-unit in derivatives used by banks for speculative purposes leads to a decrease of 20.775 units in systematic risk. However, there was no relationship identified between the use of derivatives for hedging purposes and systematic risk. Granger causality analysis based on Panel VECM was used to determine and analyze further if the relationship between the use of derivatives and systematic risk is a one-way and/or two-way relationship. Test results are indicated in Table 10.

Table 10. The results of the Granger causality test based on panel VECM

	Short-term causality			Long-term causality
	$\Delta(\text{BETA})$	$\Delta(\text{SPEC})$	$\Delta(\text{HED})$	ECT (-1)
$\Delta(\text{BETA})$	–	1.752 [0.6252]	0.823 [0.8438]	12.005 (0.0619)*
$\Delta(\text{SPEC})$	11.664 [0.0086]***	–	0.904 [0.8243]	1.859 (0.9322)
$\Delta(\text{HED})$	2.776 [0.4274]	0.139 [0.9867]	–	1.656 (0.9485)

Note: *** and * denote the significance at the 1 and 10 per cent levels. Maximum lag number is set to 2 and optimal lags for each country is determined by the means of the Akaike information criterion.

The results of the Granger causality analysis based on Panel VECM proved a one-way causality relationship between the use of derivatives for speculative purposes and systematic risk, while no causality relationship between the use of derivatives for hedging purposes and systematic risk was unveiled.

As a result of coefficient estimates and causality analyses regarding the cointegration relationship between the use of derivatives and systematic risk, findings implying the presence of statistically significant relationships between the use of derivatives for speculative purposes and systematic risk were obtained. The potential effects of forward, swap and option contracts used by banks for speculative purposes on systematic risk were explored with Panel EKK method and lengthier findings were obtained.

Table 11. The results of panel data analysis

Variable	PANEL BETA
Period	June 2007 – December 2017
Method	White Cross-Section
FORWARD	−7.205 (0.666)
OPTION	−8.126 (0.305)
SWAP	−6.771 (0.009)***
C	30.705 (0.000)***
F-gs	9.487 (0.000)
F-zs	0.971 (0.503)
F-gzs	2.812 (0.000)
LM-gr	96.318 (0.000)
LM-zr	1.763 (0.184)
LM-gzr	98.082 (0.000)
Honda-gr	9.814 (0.000)
Honda-zr	−1.328 (0.907)
Honda-gzr	6.000 (9.83E−1)
Hausman	0.627 (0.890)
BPG-LM	82.357 (0.000)
BL-LM	0.092 (0.760)
BB-LM	0.783 (0.376)
DW ($d_{PL} 1.9117$ - $d_{PU} 1.9206$)	1.975
R ²	0.385
F-statistics	2.577
Prob.	0.000***
Regression S.E.	0.689
Mean. dep. var.	0.990
S.D. dep. var.	0.788
Akaike info criterion	2.271
Hannan-Quinn info criterion	2.519
Observations	154

Note: *F-gs* – F-group_fixed, *F-zs* – F-period_fixed, *F-gzs* – F-two way_fixed, *LM-gr* – LM-group_random, *LM-zr* – LM-period_random, *LM-gzr* – LM-two way_random, *BPG LM* – Breusch-Pagan-Godfrey LMh_fixed, *BL-LM* – Baltagi and Li (1991) LMP, *BB-LM*, Born and Bretuing (2016) LMP, *DW* – Durbin-Watson, *R*² – R-squared. ***, ** and * denote the significance at the 1, 5 and 10 per cent levels.

When the results of panel data analysis are examined, it is anticipated that using fixed effects model to estimate the model created based on F, LM and

Honda test results would provide more accurate results. In the case that the data used in a study are created based on a specific group and a certain period, a one-way fixed effects model where group effects are taken into consideration should be used in the final estimation of models (Baltagi, 2005). In this context, it was ascertained that using fixed effects model for model estimation would provide more accurate, reliable and consistent results according to the fact that a sample group was incidentally not formed and that the data of a specific group from a certain period was used. Heteroscedasticity in model error terms was investigated by use of Breusch-Pagan-Godfrey Heteroscedasticity LM. The result of the analysis suggested that there was a heteroscedasticity problem (BPG-LM, 82.357-0.000) in the model. Autocorrelation, on the other hand, was analyzed by Baltagi and Li (1991), Born and Bretuing (2016) and Bhargava, Franzini, and Narendranathan (1982) in Durbin-Watson tests. The results of the test put forward that there was not autocorrelation between error terms in the model (BL-LM, 0.092-0.760; BB-LM, 0.783-0.376; DW, 1.975). Accordingly, model estimation was performed with White Cross-Section, resistant estimator correcting panel standard errors, which solves the problem of heteroscedasticity identified in the model. The results of the model prove that F-statistic probability value indicating the overall significance of the model was significant at the 99% confidence interval, and that independent variables explain 0.385 of changes in the dependent variable (*R*²). In the model, it was determined that there was a statistically significant and negative relationship between swap contracts used for speculative purposes and systematic risk. An alteration of one-unit in swap contracts leads to a decrease of 6.771 units in systematic risk. However, there was no significant relationship identified between forward and option contracts and systematic risk. Thus, banks should feature swap contracts instead of forward and option contracts in order to be able to minimize systematic risk. The fact that banks prefer swap contracts more in terms of the amount of use of derivatives supports the findings obtained.

CONCLUSION

This study was aimed to reveal the relationship between the use of derivatives during the period of June 2007 – December 2017 for speculative and hedging purposes and systematic risk. Significant and neg-

active relationship was identified in the long run between the use of derivatives by banks for speculative purposes and systematic risk, while there was no relationship determined between the use of derivatives by banks for hedging purposes and systematic risk. This finding obtained in the study shows similarity with the findings obtained by Bartram et al. (2011).

Causality analysis showed that it was determined that there was a one-way causality relationship between the use of derivatives for speculation and systematic risk, which supported previous findings. However, there was no causality relationship identified between the use of derivatives for hedging purposes and systematic risk. The findings obtained share similarities with the findings reached in the studies carried out by Keffala and Peretti (2013).

Banks should prefer using swap contracts rather than forward and option contracts in order to protect their capital, use their resources efficiently and maximize their profit by minimizing the market risk. The study can be improved by including non-public banks to the analysis, making comparisons with the banking sectors of other countries and applying different methodological approaches.

REFERENCES

1. Alaghi, K. (2011). Financial leverage and systematic risk. *African Journal of Business Management*, 5(15), 6648-6650. <https://doi.org/10.5897/AJBM11.335>
2. Asteriou, D., & Hall, S. G. (2007). *Applied econometrics: A modern approach using views and microfit*. New York: Palgrave Macmillan.
3. Bai, J., & Ng, S. (2004). A panic attack on unit roots and cointegration. *Econometrica*, 72(4), 1127-1177. Retrieved from <https://www.jstor.org/stable/3598781>
4. Baltagi, B. H. (2005). *Econometric analysis of panel data* (3rd ed.). West Sussex: Wiley.
5. Baltagi, B. H., & Kao, C. (2000). *Nonstationary panels, cointegration in panels: A survey* (Working Paper No. 16). Center for Policy Research. Retrieved from <https://surface.syr.edu/cgi/viewcontent.cgi?article=1135&context=cpr>
6. Baltagi, B. H., & Li, Q. (1991). A joint test for serial correlation and random individual effects. *Statistics and Probability Letters*, 11, 277-280.
7. Bartram, S. M., Brown, G. W., & Conrad, J. (2011). The effects of derivatives on firm risk and value. *Journal of Financial and Quantitative Analysis*, 46(4), 967-999. <https://doi.org/10.1017/S0022109011000275>
8. Bhargava, A., Franzini, L., & Narendranathan, W. (1982). Serial Correlation and the fixed effects model. *The Review of Economic Studies*, 49(4), 533-549. <https://doi.org/10.2307/2297285>
9. Born, B., & Breitung, J. (2016). Testing for serial correlation in fixed-effects panel data models. *Econometric Reviews*, 35(7), 1290-1316. <https://doi.org/10.1080/07474938.2014.976524>
10. Breusch, T., & Pagan, A. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *Review of Economic Studies*, 47(1), 239-253. <https://doi.org/10.2307/2297111>
11. Coutinho, J. R. R., Sheng, H. H., & Lora, M. I. (2012). The use of FX derivatives and the cost of capital: Evidence of Brazilian companies. *Emerging Markets Review*, 13(4), 411-423. <https://doi.org/10.1016/j.ememar.2012.07.001>
12. Granger, C. W. J. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica*, 37(3), 424-438. <https://doi.org/10.2307/1912791>
13. Hair, J., Erson, R. E., Tatham, R., & William, C. B. (1998). *Multivariate Data Analysis*. New Jersey: Prentice-Hall.
14. Haynes, R., McPhail, L., & Zhu, H. (2019). *When leverage ratio meets derivatives: Running out of options?* (SSRN paper). <http://dx.doi.org/10.2139/ssrn.3378619>
15. Hon, T. Y. (2012). Managing financial risk by using derivatives: A study of Hong Kong listed companies. *ELK Asia Pacific Journal of Finance and Risk Management*, 4(1), 1-16.
16. Honda, Y. (1985). Testing the error components model with non-normal disturbances. *The Review of Economic Studies*, 52(4), 681-690. <https://doi.org/10.2307/2297739>
17. Kao, C. (1999). Spurious regression and residual based tests for cointegration in panel data. *Journal of Econometrics*, 90(1), 1-44. [https://doi.org/10.1016/S0304-4076\(98\)00023-2](https://doi.org/10.1016/S0304-4076(98)00023-2)
18. Keffala, M. R., & Peretti, C. (2013). Effect of use derivative instruments on accounting risk: Evidence from banks in emerging and recently developed countries. *Annals of Economics and Finance*, 14(1), 149-178. <https://doi.org/10.13140/2.1.1548.9929>
19. Kornel, T. (2014). The effect of derivative financial instruments on bank risks, relevance and faithful representation: Evidence from banks in Hungary. *Annals*

- of *Faculty of Economics*, 1(1), 698-706. Retrieved from <https://ideas.repec.org/a/ora/journal/v1y2014i1p698-706.html>
20. Levin, A., Lin, C., & Chu, C. S. J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics*, 108(1), 1-24. [https://doi.org/10.1016/S0304-4076\(01\)00098-7](https://doi.org/10.1016/S0304-4076(01)00098-7)
 21. Li, S., & Marinc, M. (2014). The use of financial derivatives and risks of U.S. bank holding companies. *International Review of Financial Analysis*, 35, 46-71. <https://doi.org/10.1016/j.irfa.2014.07.007>
 22. Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *Review of Economics and Statistics*, 47(1), 13-37. <https://doi.org/10.2307/1924119>
 23. Mossin, J. (1966). Equilibrium in a capital asset market. *Econometrica*, 34(4), 768-783. <https://doi.org/10.2307/1910098>
 24. Pesaran, H. (2004). *General diagnostic tests for cross section dependence in panels* (IZA Discussion Paper No. 1240). Retrieved from <http://ftp.iza.org/dp1240.pdf>
 25. Pesaran, H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of Econometrics*, 142(1), 50-93. <https://doi.org/10.1016/j.jeconom.2007.05.010>
 26. Selvi, Y., & Türel, A. (2010). Derivatives usage in risk management by Turkish non-financial firms and banks: A comparative study. *Annales Universitatis Apulensis: Series Oeconomica*, 12(2), 663-671.
 27. Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The Journal of Finance*, 19(3), 425-442. <https://doi.org/10.1111/j.1540-6261.1964.tb02865.x>
 28. Şirvan, N., & Sezgin Alp, Ö. (2017). Türk bankacılık sektöründe Türev piyasa araçlarının riske etkileri. *Ticari Bilimler Fakültesi Dergisi*, 1, 130-157.
 29. Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics*. Boston: Allyn and Bacon.
 30. Vuilleme, G. (2019). Bank interest rate risk management. *Management Sciences*, 1-56. <https://doi.org/10.1287/mnsc.2018.3125>
 31. Westerlund, J. (2005). A panel CUSUM test of the null of cointegration. *Oxford Bulletin of Economics and Statistics*, 67(2), 305-339. <https://doi.org/10.1111/j.1468-0084.2004.00118.x>
 32. Živanović, B., & Mina, K. (2017). The usage of financial derivatives in financial risk management by non-financial companies in Serbia. *Industrija*, 45(3), 65-82. <https://doi.org/10.5937/industrija45-14079>