Vol. 02, No. (1-2) 2020, Pg. 89-101

Journal of Business Strategy Finance and Management

Journal Website: jbsfm.org

Do Derivatives hinder the Financial Contagion? A case Study of Developed Countries' Stock Markets

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Abstract

The main purpose of this study is to test the effect of the derivative instruments on financial contagion in developed countries including France, Germany, South Korea, Spain, the Netherlands and the United Kingdom, considering the United States as the source of the crisis. Therefore, at first, existence of the contagion in the markets was investigated using the ARMA-GARCH-COPULA method, and then, the effect of the derivative instruments on the contagion for the selected countries was examined during the time period 01: 2007: to 08:2018. The results confirm the negative effect of the derivatives on the contagion.

Article History

Received: 17 February 2021

Accepted: 02 May 2021

Keywords

Copula Function;

Derivatives;

Developed Countries;

Financial Contagion;

Stock Market.

Introduction

The 2008 financial crisis in the United States went bankrupt the Lehman Brothers Company, one of the largest commercial banks in the country. The effects of the crisis was quickly shifted to Europe, Asia and Latin America, and in a short time, global financial markets were faced with a sharp decline in exchange rate, commodities and stock value. The expansion of the negative effects of the event to the financial markets of a number of countries was named as the financial contagion of Lehman brother's company bankruptcy at the same time (Wiggins, *et al.*[41]

Although extensive research has been carried out on the complex phenomenon of contagion, but this conception has not defined precisely and comprehensively. Generally, contagion referring to the transfer of devastating effects of the crisis, from one country to another or a group of countries, is accompanied by an co-movement in stock value, exchange rate and capital flow. The contagion can occur for two reasons and has two distinct concepts (Masson,[19] Wolf [39] and Pritsker[25]). First, contagion is the spillover due to the usual interdependence among countries. Such interdependence means that the transfer of shocks is due to the real and financial relations among countries. This co-movement does not mean pure contagion. Because it reflects a normal dependency that may intensify during a crisis period in a country (Pritsker,[25]). Second, contagion is not only an increase in co-movement based on economic principles. This pure contagion involves a purely financial crisis that is not related to changes observed in macroeconomic conditions and is merely a result of the behavior of investors or other financial agents.

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Doi: http://dx.doi.org/10.12944/JBSFM.02.01-02.10

According to this definition, the crisis in a country and the price volatility in financial markets may lead investors to with draw their capital from many markets because of risk and uncertainty (Masson,[19]).

Hence, the financial instruments of risk management to reduce volatility and contagion are important. In this regard, derivative instrument is important as a method to hedge and reduce volatility in financial markets, especially stock markets. Derivative instrument is a kind of financial oneand its value is derived from a stock or a portfolio (Mallikarjunappa and Afsal,[20]). These instruments are the most important tools for price discovery, portfolio diversification, and hedge in financial markets around the world (Pilarand Rafael,[23]).

There are two different views on the effectiveness of a derivative instrument on the volatility of financial markets. In the first one, derivative instrument increases the volatility of financial markets (Stein and Stein,[36]) and based on the second view which is more dominant, these types of transaction screate less volatilities and, consequently, the more stability of markets (Powers,[22] Schwarz[33]).

The main purpose of this paper is to examine the effect of derivatives on the contagion and in this framework we show that the contagion may be mitigated by using the derivatives. Besides, the review of historical financial crises especially in the United States with long-run effects on other countries has some lessons for the future since they have similar global causes, effects and solutions. As a solution, the spread of derivatives in financial markets may have an insulating effect which is the present research hypothesis.

Based on the hypothesis, this study examines the effect of a derivatives on the stock market contagion of France, Germany, South Korea, Spain, the Netherlands and the United Kingdom during the period of 01:2007 to 08:2018 using monthly stock index and futures contract of the stock index. For this purpose, the United State was considered as the source of the financial crisis in 2008. To test the hypothesis of the negative effect of the derivative instrument on the stock market contagion, at first, the dependency parameter for each pair of series (United States/ France, United States/ Germany, etc.) was estimated using the Copula function, and then, the hypothesis was examined with the null one of the non-negative effect of the derivative instrument on stock market contagion.

Theoretical and Emprical Background

Although most researchers agree on the phenomenon of post-crisis contagion, there is still no precise definition of financial contagion. Seth and Panda[43] has classified the contagion and given several definitions and methods for capturing it and in this case, it has clarified that the contagion is a wide conception. Specifically, the paper has mentioned the categories of contagion definitions of the World Bank group which are broad, restrictive and very restrictive definitions (figure 3 of this paper). There is also no agreement to choose the best method for measuring contagion (Echen green and Mody[6]). The World Bank[40] has proposed three definitions of contagion; broad, restrictive and very Restrictive ones.In a broad definition, Contagion is the cross-country transmission of shocks or the general cross-country spillover effects. Of course, Contagion can occur both during good and bad times and in this framework, it is different from a crisis.In a restrictive definition, Contagion is the transmission of shocks to other countries and it means the cross-country correlations, beyond any fundamental link among the countries and beyond common shocks. This definition is usually referred as excessco-movements, commonly explained by herding behavior and in a very restrictive definition, Contagion occurs when cross-country correlations increase during crisis times relative to correlations during tranquil times (Gandolfo[8]).

It is very difficult to determine a proper mix of financial and real, and even political principles in order to measure the contagion. One of the methods of measuring the contagion is to measure the correlation of markets in the pre-crisis and the crisis period and then test them statisticallly. Specifically, there will be a sign of financial contagion, if the correlation coefficient between markets is increased. A wide range of studies has tested the existence of contagion in financial markets by a simple correlation coefficient between these markets. The ARCH and GARCH models are very useful in this regard. Sunsequent studies have observed the contagion as a nonlinear phenomenon and employed Copula functions to study its effects (Rodriguez[26]).

Derivative instruments play a very important role in the risk management for investors and managers of investment funds.There are two different views on the effect of these financial instruments on volatilities in the literature. In the first view, these types of transactions are one of the reasons for the volatilities of spot markets and, as a result, market instability (Cox;[5] Figlewski;[7] Steinand Stein[36]). According to the first view, the activity of traders with a little money or stock in a market with a high level of leverage effect can reduce the quality of information in the market (Figlewski[7]). Against this view, some studies have proved that derivative instruments did not increase the risk and market volatility (McLear and Chang;[18] Rossi and Daigler[28]). Based on the second view, the financial instruments are the reasons for falling volatilities and, consequently, the stability of markets (Powers;[22] Schwarz[33]). The empirical results are also different and ambiguous. But, most results show that derivative trading did not increase the price fluctuations in spot markets in the long run.

Shembagaraman[32] by examining the Indian stock market concluded that by introducing the derivatives (futures), the volatilities changed qualitatively and quantitatively. Boyer and Loretan[1] used a market model to find fluctuations before and after the introduction of futures, and they did not find any evidence to increase volatility after the introduction of derivative instruments. Also, Mallikarjunappa and Afsal[20] did not find any evidence of stability or instability after the introduction of futures and option contracts on the Indian stock index. Pilar and Rafael[23] investigated the effect of derivative instruments on the instability of the return on the assets in the Spanish stock market and using the GARCH model and the Exponential GARCH (EGARCH) model. They showed that the conditional variance of the return reduced after using the derivatives. In addition, the use of derivative instruments in Spain reduced the uncertainty and increased the liquidity as well as market efficiency. Shenbagaraman[34] tested the effect of the futures and option son stock market volatilities. The results showed that the existence of derivatives did not have a significant effect on the market volatility during the whole period. Jacobsen [14] by using the ARMA and the GARCH models showed that there is astrong and positive relationship between unexpected speculative shock and stock price volatility for the whole period. Also, the results indicated thatthe derivatives affected volatilities and speculators as market players. Rayand Panda[27] examined the effect of financial derivatives on stock market volatilities in India. The results showed that the volatilities in the period of introduction of the derivatives increased as compared with the previous periods, with more continuity, and therefore the stock market has less coherence than the periods before using of the derivatives. Singh and Tripathi[32] by examining the effect of derivative instruments on the Indian currency market fluctuations, by using the GARCH model, showed that the existence of derivatives led to a decrease in foreign exchange market volatility in India. The results also indicated the more importance of recent news in the market volatilities, and decreasing the effect of the continuation of the old news, with the introduction of futures.

Bae *et al.*[3] showed that the contagion of Latin America to other parts of the world was higher than that from Asia to other parts of the world. Kuusk and Tripathi[15] with the review of the financial contagion in US crisis in 2008 between the United States and the Baltic states, indicated that there was a finantioal contagion from the United States to the Baltic states. Imen and Abidi[11] tested the contagion and showeda significant increase in the dynamic correlation between developed and developing stock market returns by using the GARCH model. The results indicated a high degree of financial integration among the studied countries, especially during the financial crisis. Mollah and Zafirov[17] investigated the global financial crisis contagion and revealed that there were the contagion in 46 countries of 63 countries. In these countries, there was a significant increase in the correlation coefficient of stock market returns during the financial crisis as compared with the pre-crisis period. Based on this reseach, although the crisis originated from the United States, it immediately spread to other global markets. Shastri[37] investigated the correlation between the bond and the stock markets in developing and developed countries with the Copula function. The results showed that these markets in the studied countries have co-movements.

According to the literature, the derivatives have a negative effect on the volatility, but there are few studies over the effect of derivatives on the contagion. Based on this narrow literature, on one hand, the derivatives have a positive effect on the contagion since speculators use the derivatives for their benefits and in this case, the market may be volatile and contagious. On the other hand, the derivatives as hedging instruments immune the dealers against the volatilities and based on this feature as well as the nature of these types of transactions which are effective on the value date based on the present-determined forward rate, the volatility and the contagious phenomenon may be alleviated by using and strengthening of the derivatives. Furthermore, through wake up calls mechanism, the crisis has spread to other countries without significant relations with the origin of the crisis since bad news from the crisis has negative effect on the investors' attitudes and actions. By expanding the use of derivatives, investors are investing more confidently, therefore effect of bad news and financial contagion is reducing.

Methodology

Every econometric methodology depends on some statistical characteristics especially regarding to the statistical distribution of variables as well as the purpose of the research. In the study of contagion, the Copula function with different distributions is more suitable than other methods. This method is not limited toa specific distribution such as normal one which is not correct for skewed distributions. As shown in the litrature, Copula is suitable for modeling the dependence and co-movement of several stochastic variables and this helps researchers to build the joint distribution of these variables with specified statistical features. Using some proxies such as simple correlations for the dependency may create biased results especially with variable variance and mean.

The GARCH model was proposed by Bollersley.[2] Many researchers developed this model and presented a variety of GARCH models in the following years. In this framework, the model ARMA (p,q)-GARCH (r,s) is presented as follows:

$$y_t = x_t'\gamma + u_t, (t = 1, 2, ..., T)$$
$$u_t = \sum_{j=1}^{p} \phi_j u_{t-j} + \varepsilon_t + \sum_{j=1}^{q} \theta_j \varepsilon_{t-j}$$
$$\sigma_t^2 = \omega + \sum_{j=1}^{r} \alpha_j \varepsilon_{t-j}^2 + \sum_{j=1}^{r} \beta_j \sigma_{t-j}^2 \qquad ...(1)$$

Where γ is the regression coefficient; σ_t^2 is the conditional variance of ε_t; θ_j and ϕ_j are ARMA (p,q) model parameters; β_j and α_j are GARCH (r,s) model parameters.

The Copula[2] function is a method for modeling the dependencies of several random variables. According to Sklar[29] theory, Copulas are the mechanism which allows to isolate the dependency structure in a multivariate distribution (Schmidt[35]). An important tool for the Sklar theorem is related to the main result of Fisher's random number generation theory, which states that if X is a random continuous variable with a distribution function F, then U = F (X) has a uniform distribution in the interval [1, 0] (Patton[24]). According to Sklar theory, F is a d-dimensional distribution function with margins $F_1.F_2,\ldots,F_d$ and C, d-dimensional copula for all x in $\overline{R}^n$ (Nelsen[21]).

$$F(x_1, x_2, ..., x_d) = C(F_1(x_1), ..., F_d(x_d)) \qquad ...(2)$$

copula function is:

$$C(u_1,...,u_d) = F(F_1^{-1}(u_1),...,F_d^{-1}(u_d)) \qquad ...(3)$$

Where F_i^{-1} is an inverse function of the marginal distribution and $U \sim Unif\,(0,1)$ (Nelsen[21]). $C(u_1,\ldots,u_d)$ is non-decreasing in each component, u_i and the ith marginal distribution is obtained by setting $u_j = 1$ for $j \neq i$ and since it is uniformly distributed $C(1,\ldots,1, u_i,1,\ldots1) = u_i$ (Haugh[9]).

Rank correlations (Kendall'sτ and Spearman'sρ) are also useful in measuring the dependence structure between the copulas (Siedlecki and Papla[30]). Kendall'sτ is defined as follows, and the parameters are directly obtained from the copula function (Hortaand Vieira[10])

$$\tau_{\text{Kendall}}(X_1, X_2) = 1 - 4\int_0^1\int_0^1 \frac{\partial C(u_1,u_2)}{\partial u_1}\frac{\partial C(u_1,u_2)}{\partial u_2} du_1 du_2 \qquad ...(4)$$

Different types of copula in literature, and in the studies of Nelsen[21] and Joe[13] were used to model dependence. But Gumbel, Frank, Clayton and t-Student Copulas havebeen mostly used in financial and insurance market studies (Trivedi and Zimmer[38]). Gumbel Copula has a low tail dependence and high tail independence.

$$C_G(u,v;\delta) = \exp\left\{-\left[(-\ln u)^{\delta} + (-\ln v)^{\delta}\right]^{\frac{1}{\delta}}\right\} \quad , \qquad \delta \in [1,\infty) \qquad ...(5)$$

Clayton Copula has a low tail dependence and high tail independence.

$$C_{cl}(u,v;\theta)=\left\{u^{-\theta}+v^{-\theta}-1\right\}^{\frac{-1}{\theta}},\theta\geq 0 \quad ...(6)$$

Frank Copula is indicated by a high and low tail dependence.

$$C_f(u,v;\alpha)=-\frac{1}{\alpha}\ln\left[1+\frac{(e^{-\alpha u}-1)(e^{-\alpha v}-1)}{e^{-\alpha}-1}\right] \quad , \quad \alpha\epsilon[0,\infty) \quad ...(7)$$

t-Student CopulaCopula is symmetric and shows the tail dependence

$$C(u,v;\nu,\rho)=\int_{\infty}^{t_\nu^{-1}(u)}\int_{\infty}^{t_\nu^{-1}(v)}\frac{1}{2\pi\sqrt{(1-\rho^2)}}\left\{1+\frac{s^2-2\rho st+t^2}{\nu(1-\rho^2)}\right\}^{\frac{-\nu-1}{2}}dsdt \quad ...(8)$$

The coefficient of tail dependence is equal to:

$$\lambda_l=\lambda_u=2\left[1-t_{\nu+1}\left(\sqrt{(\nu+1)(1-\rho)/(1+\rho)}\right)\right] \quad ...(9)$$

Clayton and Gumbel Copulas cannot be used to model negative dependencies. But the use of the above copulas helps solve the problem, since there usually is a positive dependence between the returns on the stock indices. Frank Copula is symmetric, and has advantages as compared with the Gumbel, Clayton, and t-Student Copulas, because it offers a simpler estimate of the dependence structure due to its simple analytical form. It is also suitable for variables with poorly dependence structure (Trivedi and Zimmer[38]).

The data of this research, stock and futures indices are as follows: FTSE100 stock market index ofthe 100 listed companies in London Stock Exchange, DAX German Stock Index, AEX Netherlands Stock Index, KOSPI200 Index of all traded stock on the South Korean Stock Exchange, IBEX35 index of the 35 largest companies on the Spanish Stock Exchange, and the S & P500 index of the 500 largest companies on the United States Stock exchange.

It is necessary to determine the crisis period to investigate the effect of a derivative instrument on the contagion of stock markets in developed countries. Also, the stock returns must be calculated using the data before software computations. Stock returns are equal to the natural logarithmic difference of two successive stock indexes:

$$R_c = 1n\ (P_{it} / P_{it}\text{-}1) \quad ...(10)$$

P_{it} showsthe stock index and R_{it} the return on stock index.

Estimation Results

Descriptive statistics of the data used in the research are presented in tables (1) and (2). Based on these tables, distributions of the return of French stock index (RCAC40) and the UK futures (FFTSE100) are closer to the normal distribution.

Stationarity and non-stationarity can have a serious effect on the properties of a given time series (souri[31]). For this reason, the unit root test of the Dickey-Fuller was performed for each time series. The results are presented in tables 3 and 4. The results of tables 3 and 4 show that all studied variables) Stock Returnsand futures) are stationary.

Given that H_0 in the ARCH effect test is homoscedasticity of the residuals, based on the results of table 5, the statistics are large and in the critical area. Also, the probabilities for the statistics are less than 0.05. Consequently, the H_0 is rejected and the hypothesis of the existence of the ARCH effect is not rejected. Therefore, considering the

Table 1: Descriptive statistics of return on stock indices

RSP500	RIBEX35	RFTSE100	RDAX	RKOSPI200	RCAC40	RAEX	
0.0058930	-0.001276	0.002222	0.005843	0.005007	0.001035	0.002195	Mean
0.0102360	0.001468	0.005319	0.009852	0.006687	0.001953	0.009783	Median
0.1077230	0.166245	0.084522	0.167621	0.137171	0.125567	0.111735	Maximum
-0.169425	-0.170330	-0.130248	-0.191921	-0.209620	-0.135173	-0.197147	Minimum
-0.778020	-0.067773	-0.437617	-0.503357	-0.542259	-0.352362	-0.978079	Skewness
4.9234020	3.684409	3.469477	4.538322	5.404606	3.131940	5.666992	Kurtosis

Source: Present Research Findings based on Investing Statistical Database[42]

Table 2: Descriptive statistics of futures

FAEX	FKOSPI200	FCAC40	FDAX	FFTSE100	FIBEX35	FSP500
406.3534	247.0129	4323.904	8462.682	6139.005	10234	16
405.45	250.8	4340.25	7892.5	6218.25		
571.1	334.95	6090	13222			
215.9	137	2701				
0.02715	-0.388254					
1.92584						

Source: Present Research Findings based on Investing Statistical Database[42]

Table 3: Dickey-Fuller Unit Root Test Results for Returns of Stock Indices

Symbol	Dickey-Fuller (DF)	P-Value	Null Hypothesis	Country
RKOSPI200	-11.12261	0.00000	Lack of unit root	South Korea
RSP500	-9.99774	0.00000	Lack of unit root	United states
RFTSE100	-12.05112	0.00000	Lack of unit root	England
RDAX	-9.486566	0.00000	Lack of unit root	Germany
RAEX	-10.50653	0.00000	Lack of unit root	Netherlands
RCAC40	-10.44505	0.00000	Lack of unit root	France
RIBEX35	-11.13608	0.00000	Lack of unit root	Spain

Source: Present Research Findings based on the Output of Eviews Software

Table 4: Dickey-Fuller unit root test results for futures

Symbol	Dickey-Fuller (DF)	P-Value	Null Hypothesis	Country
FKOSPI200	11.72244-	0.00000	Lack of unit root	South Korea
FSP500	10.6181-	0.00000	Lack of unit root	United States
FFTSE100	12.6287-	0.00000	Lack of unit root	England
FDAX	9.39485-	0.00000	Lack of unit root	Germany
FAEX	-11.00865	0.00000	Lack of unit root	Netherlands
FCAC40	10.46078-	0.00000	Lack of unit root	France
FIBEX35	10.64336-	0.00000	Lack of unit root	Spain

Source: Present Research Findings based on the Output of Eviews Software

existence of heteroscedasticity in the model, the GARCH model is used for modeling dependence.

The ARMA-GARCH model was estimated for each country and the filtered returns extracted before estimating the model and testing the hypothesis of the research. Then, the proper distribution of filtered returns was identified by Akaike criteria. In the folowing, the Copula function was estimated and the Kandell rank correlation coefficient was calculated for each pair of series. In the end, the presence of contagion was examinedfor selected countries. The null hypothesis is the absence of financial contagion:

$$\begin{cases} H_0 = \Delta\tau = \tau_{crisis} - \tau_{pre-crisis} \leq 0 \\ H_1 = \Delta\tau = \tau_{crisis} - \tau_{pre-crisis} > 0 \end{cases} \quad ...(11)$$

It should be noted that the starting point of the crisis is October 2008, but we assumed that the crisis period has begun since September 2008 for more confidence in modeling. Therefore, the pre-crisis period is from January 2007 to August 2008 (Hortaand Vieira[10]). The hypothesis test results are presented in table 6.

Table 5: ARCH-LM test results

P- value	Calculated statistics	statistic	Countries
0.000	452.8428	F	
0.000	97.68324	Obs*R-Squared S	
0.000	1047.749	F	
0.000	111.0673	Obs*R-	
0.000	9.348262	F	
0.000	101.8062		
0.000	497.7478		
0.000	99.59007		
0.000	466.1		
0.000			
0.000			
0.0			

Source: Present Research Findings based on the Output of Eviews Software

Table 6: Results of the existence of financial contagion

$\Delta\tau$	p- value	Country
0.07156	0.015	South Korea/ United States
0.02324	0.021	England/ United States
0.1848	0.031	Germany / United States
0.1397	0.055	Netherlands / United States
0.0073	0.019	France / United States
0.15625	0.021	Spain / United States

Source: Present Research Findings based on the Output of Model Risk Software

$\Delta\tau$ indicates the difference between the Kendall rank correlation coefficient of crisis and non-crisis periods. According to table 6, the null hypothesis is rejected with a probability of 95% and the hypothesis of the existence of contagion between the pairs of countries is accepted. Consequently, the hypothesis of the negative effect of the futures on stock market contagion is tested. For this, the futures is introduced in the ARMA-GARCH model only considering the crisis period. In the end, the Copula parameter and the Kendell rank correlation coefficient after introducing the futures are compared with the Copula parameter and the Kendell correlation coefficient before using the derivatives. Table 7 presents the results of correlation and partial correlation coefficients.

Based on the results, the model of all countries except South Korea is ARMA (0,0) - GARCH (1,1). The futures was entered as an independent variable in the ARMA-GARCH model to estimate the ARMA-GARCH model.Then, the filtered returns were extracted like the process of estimating financial contagion, before the introduction of the derivative instrument, which is the residual of the estimated model above. The distribution functions were determined for each series (filtered returns). The type of distribution function of the filtered returns as input was used to estimate the copula and calculate the Kendell rank correlation coefficient.

As shown in table 9, the filtered returns distribution for the United States, Germany, South Korea, England and Spain is logistic one. Furthermore, the distribution of the filtered returns for the Netherlands and France is normal. Consequently, Copula is estimated to examine the dependence structure of each pair of series according to the specified distributions for each series, and the Akaike criterion is also used to select the appropriate copula. Estimated copulas parameters with Akaike statistics are presented in tables 10 and 11.

Comparison of Copula parameters before introducing the future contract during the crisis period with Copula parameters after introducing the future contract during the crisis period showed that the Copula parameter reduced after the introduction of the futures in all studied countries. The selection of the appropriate copula for each pair of series is based on the Akaike criterion and the results are presented in table 12.

As stated, in addition to the copula parameters, Kendall's correlation coefficient is the other method to examine the dependence. If Kendall's rank correlation coefficient in the crisis period after introducing the futures than before introducing the future contracts reduced, it can be claimed that the future contracts reduces the co-movements between stock markets and the effects of contagion. Table 13 shows the rank correlation coefficients for the pair of series that the presence of the contagion is not rejected in them after introducing of the futures. Comparison of table 13 and 14 shows that the rank correlation coefficient between pair of series has been reduced despite the futures, which is indicative of the negative effect of the futures on the co-movement and the contagion between the stock markets of countries with the US stock market.

Table 7: Results of correlation coefficients

stock return index	Model ARMA(p,q)- GARCH(r,s)	country
RKOSPI200	ARMA(3,3)- GARCH(1,1)	South Korea
RSP500	ARMA(0,0)- GARCH(1,1)	United States of America
RFTSE100	ARMA(0,0)- GARCH(1,1)	England
RDAX	ARMA(0,0)- GARCH(1,1)	Germany
RAEX	ARMA(0,0)- GARCH(1,1)	Netherlands
RCAC40	ARMA(0,0)- GARCH(1,1)	France
RIBEX35	ARMA(0,0)- GARCH(1,1)	Spain

Source: Present Research Findings based on the Output of Model Risk Software

Table 8: Distribution of Filtered Returns during Crisis, after Introducing the futures

Logistic	Normal	Student	Ext-value min	Ext-.value max	index
-425.388	-421.422	-228.79	-343.84	-166.31	RKOSPI200
-432.422	-428.35	-228.77	-405.656	-148.535	RSP500
-435.94	-435.92	-228.76	-406.81	-172.17	RFTSE100
-373.44	-370.018	-228. 911	-353.058	-65.153	RDAX
-356.71	-394.045	-228.85	-361.62	-94.558	RAEX
-299.5	-383.401	-228.87	-363.388	-151.41	RCAC40
-342.688	-339.811	-229.009	-252.928	-105.378	RIBEX35

Source: Present Research Findings based on the Output of Model Risk Software

Table 9: distribution of filtered returns after introducing the futures

Index	Proper distribution
RKOSPI200	Logistic
RSP500	Logistic
RFTSE100	Logistic
RDAX	Logistic
RAEX	Normal
RCAC40	Normal
RIBEX35	Logistic

Source: Present Research Findings based on the Output of Model Risk Software

Table 10: Copula Estimation Result after the Crisis and before introducing of futures

Index	Criterion	Clayton	Frank	Gumbel	Normal	t- student	Country
C-RSP500/C-RKOSPI200	MLE fit	1.05	3.46	1.52	0.65	6, 0.65	USA / Sout
	AIC	42.139	30.48	46.63	44.003	44.52	
	LL	23.12	17.29	25.36	23.01	24.31	
C-RSP500/C-RFTSE100	MLE fit	2.23	6.45	2.16	0.81	5, 0.8	
	AIC	-98.06	-83.27	-106.29	-100.21		
	LL	51.082	43.68	55.19	51.1		
C-RSP500/C-RDAX	MLE fit	2.27	6.36	2.13			
	AIC	-92.76	-80.74 -99				
	LL	48.43	42.42				
C-RSP500PC-RAEX	MLE fit	1.799	5				
	AIC	72.3					
	LL						
C-RSP500/C-RCAC40	ML						
C-RSP500/C-							

Source: Present Research Findings based on the Output of Model Risk Software

Table 11: Copula Estimates Result in the crisis period and after the introducing futures

Index	criterion	Clayton	Frank	Gumbel	Normal	t- Student	Country
RSP500/ RKOSPI200	MLE fit	0.89	3.03	1.44	0.55	5, 0.55	USA/ South Korea
	AIC	21.67	23.02	29.74	35.13	34.84	
	LL	12.89	13.56	16.92	18.58	19.47	
RSP500/ RFTSE100	MLE fit	2.23	6.27	2.11	0.79	7, 0.79	USA/ England
	AIC	84.37	81.05	98.47	98.43	98.87	
	LL	44.23	42.57	51.29	50.23	51.49	
RSP500/ RDAX	MLE fit	2.26	6.35	2.08	0.57	6, 0.57	USA/ Germany
	AIC	90.72	83.58	100.58	93.42	96.07	
	LL	47.41	43.84	52.34	47.72	50.08	
RSP500/RAEX	MLE fit	1.77	5.23	1.88	0.73	4, 0.73	USA/ Netherlands
	AIC	72.731	63.03	79.85	73.34	79.52	
	LL	38.41	33.57	41.98	37.69	41.81	
RSP500/ RCAC40	MLE fit	2.38	6.6	2.19	0.79	6, 0.79	USA/ France
	AIC	100.2	86.45	108.01	99.44	103.8	
	LL	52.19	45.27	56.05	50.73	53.99	
RSP500/ RIBEX35	MLE fit	1.58	4.78	1.79	0.66	40, 0.66	USA/ Spain
	AIC	55.98	52.83	62.23	62.87	60.535	
	LL	30.04	28.47	33.16	32.45	32.31	

Source: Present Research Findings based on the Output of Model Risk Software

Table 12: Proper copula

Capula	Country
Normal	USA/ South Korea
t- Student	USA/ England
Gumbel	USA/ Germany
Gumbel	USA/ Netherlands
Gumbel	USA/ France
Normal	USA/ Spain

Source: Present Research Findings based on the Output of Model Risk Software

Table 13: Rank correlation coefficient before introducing futures

Clayton	Frank	Gumbel	Normal	t-student	Country
0.34	0.35	0.34	0.44	0.44	USA/ South Korea
0.53	0.55	0.53	0.56	0.58	USA/ England
0.57	0.52	0.53	0.54	0.55	USA/ Germany
0.49	0.46	0.45	0.52	0.51	USA/ Netherlands
0.55	0.52	0.53	0.57	0.59	USA/ France
0.45	0.46	0.51	0.47	0.48	USA/ Spain

Source: Present Research Findings based on the Output of Model Risk Software

Table 14: Rank correlation coefficient after introducing futures

Clayton	Frank	Gumbel	Normal	t-student	Country
0.32	0.31	0.3	0.34	0.36	USA/ South Korea
0.52	0.53	0.51	0.5	0.56	USA/ England
0.55	0.51	0.5	0.56	0.56	USA/ Germany
0.44	0.45	0.41	0.51	0.49	USA/ Netherlands
0.52	0.51	0.5	0.57	0.56	USA/ France
0.4	0.42	0.43	0.42	0.45	USA/ Spain

Source: Present Research Findings based on the Output of Model Risk Software

Table 15: Results of the research hypothesis test

p- value	Country
0.004	United States of America/ South Korea
0.008	United States of America/ England
0.003	United States of America/ Germany
0.043	United States of America/ Netherlands
0.032	United States of America/ France
0.004	United States of America/ Spain

Source: Present Research Findings based on the Output of Model Risk Software

In the research hypothesis, H_0 indicates that the futures haven't the negative effect on financial contagion. The test results are presented in table 15. The value of p-value in all pair of series based on the results of the hypothesis test in this table is less than 0.05. As a result, the null hypothesis based on the ineffectiveness of the futures on financial contagion is not accepted, and therefore the H_1, namely, the peresence of financial contagion with a probability of 95% is approved.

Conclusion

The main purpose of this study is to test the effect of the derivatives on financial contagion in the developed countries of France, Germany, South Korea, Spain, the Netherlands and the United Kingdom, considering the United States as the source of the crisis. The starting point for the crisis is October 2008, but we assumed that the crisis period has begun since September 2008 for more confidence in modeling, and therefore the pre-crisis period is January 2007 to August 2008. The hypothesis of the present study is that the future contracts reduce the financial contagion in developed countries. To test the effect of the futures on the financial contagion, the filtered returns were extracted only for the crisis period with the ARMA-GARCH model, and then the Copula dependence parameters for the crisis period were estimated.

The results of this research showed that the copula dependence parameter as well as the Kendall rank correlation coefficient decreased with the introducingfutures. This means a negative effect of the future contractson the stock market in developed countries.

According to the results, the difference between the rank correlation coefficient before introducing the derivatives with the rank correlation coefficient after introducing the derivative instrument ($\Delta\tau$) is very little in the United States/Germany. This means that the rank correlation coefficient did not change much and fell less than other countries after introducing the derivatives. Therefore, the derivatives did not have a significant impact on the financial contagion in Germany than other countries. is more in the United States /United Kingdom than the others. Therefore, derivatives had a significant impact on the financial contagion of England than other countries. It can be said that the effectiveness of the derivatives on the contagion in the selected countries depends on the geographical location, pure and financial channels, the economic infrastructures, the behavior of investors, the relationship with global financial markets, and so on.

Acknowledgement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest

There is no conflict of interest

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