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Cross Hedging of Stock Returns and Gold Coin Futures Contracts with Approach BEKK-GARCH and CCC-GARCH

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ABSTRACT

This study has attempted to calculate the optimal hedge ratio for investment in the stock market by investing in the futures market, with CCC -GARCH and BEKK-GARCH approach. The purpose of this study is to cover the cross risk of stock returns and coin futures in Tehran Securities Exchange using daily data during 2013-2019. Therefore, the researcher has used the BEKK-GARCH model and the CCC GARCH model to determine the effectiveness of different GARCH models for cross-covering the risk of the stock market return using the coin futures contract. According to the estimation of symmetric GARCH models in the present research, it was found that there is a possibility of cross hedging the risk of the stock yield market, and symmetric GARCH models are effective for hedging the risk in the stock market using the coin futures contract. On the other hand, considering that the coefficient of determination in the VAR-BEKK model is larger than the coefficient of determination in the CCC-GARCH model, therefore the VAR-BEKK model is more efficient than the CCC-GARCH model. Also, based on the coefficients obtained in these two models, considering that in the second equation of the CCC-GARCH model and the non-significance of the coefficients of the stock market return in the previous period and the two previous periods and its lack of effect on the return of the coin futures contract, it can be concluded that the model VAR-BEKK is more efficient than CCC-GARCH model.

Keywords:

Cross Risk of Stock Returns, Futures Contract, Optimal Hedge Ratio

1. Introduction

The recent global financial crises have shown the importance of financial derivatives contracts, especially when used for hedging purposes. It is increasingly evident that high volatility in financial markets has harmful effects on different industries. Companies need to hedge their exposure with different derivatives contracts; the effectiveness of the hedge is the key to avoiding the effects of crises. A growing number of studies focus on the relationship between spot and futures market price fluctuation to measure the hedging effectiveness of different underlying assets using constant and dynamic hedging models. Kharbana and Singh (2020) study currency futures in India and compare three models for evaluating the effectiveness of hedges. Chiou-Wei et al. (2020) analyze US natural gas spot and futures prices in terms of hedging effectiveness. Kumar and Bose (2019) investigate the hedging effectiveness of Nifty index traded on the National Stock Exchange (NSE), India and cross-listed Nifty futures traded on the Singapore Stock Exchange (SGX) and compare the performance of constant and dynamic hedging strategies. All these studies find that a dynamic multivariate GARCH model outperforms other static models and improves hedging effectiveness. However, Kumar and Bose (2019) observe that constant hedging models have better hedging effectiveness than time-variant hedging models. In this respect, the main objective of this paper is to measure hedging effectiveness in the Iran derivatives market, using various futures contracts, and to compare different constant and dynamic hedging models. The Tehran Securities Exchange equity index and gold coin futures contracts are analyzed in this study. All the future contracts analyzed are settled in cash, such as no deliverable forward (NDF) contracts on the over the counter (OTC) market. Settlement price of future contracts have no physical delivery of the underlying asset for the buyer or seller; rather, the counterparties agree to accept a cash credit or debit resulting from their trading price relative to the settlement price of a futures contract. At the end of each day, the exchange declares the daily settlement prices, and profit/loss amounts are calculated for each account. If there is a profit, the investors might withdraw this excess cash over its required margin, and, if there is a loss, the amount is deducted from the account. All the required margin deposited to the clearinghouse also earns daily interest. This is another positive aspect of the futures market in Turkey, as the payment of interest is rare in other developed and developing countries. Investors also have the choice of not accepting the interest payment for religious reasons.

The remainder of this study is organized as follows. Section two reviews the literature. Section three describes the methodology, and Section four presents the data and preliminary analysis. Section five discusses the empirical results of the analysis.

With the approval of the Securities Market Law of the Islamic Republic of Iran in December 2005, the country's capital market started its movement towards development and transformation, and within the framework of the foundation and principles of the Islamic capital market, the goals of the 2025 Development Vision Document and the policies foreseen in the fourth plan of economic and social development and cultural, as well as the policies of the holy system of the Islamic Republic of Iran, have continued the path of development (Salehabadi, 2013). The risk caused by exchange rate fluctuations is one of the topics that have focused researchers' minds. One of the simplest tools used to reduce the risk caused by currency fluctuations is the futures contract. These contracts are bought and sold by individuals and institutions in organized markets such as stock exchanges. Individuals and entities that are adversely affected by the fluctuation of the underlying asset price can adopt different strategies using futures contracts. In recent years, in order to avoid reducing the liquidity of futures markets and the excessive variety of futures contracts, the use of cross risk hedging has been considered. Cross hedging refers to a situation where the cash asset is different from the base asset of the futures contract. Among the various methods that exist to reduce the risk caused by asset price fluctuations, the simplest and perhaps the most established risk hedging tool is the use of futures contracts. A futures contract is an agreement to buy or sell an asset at a certain time in the future with a definite duration (Bahrami and Mirzapour, 2011). For this reason, risk hedging is one of the most important methods of risk management, which is also more general. The existence of some problems in the commodity market (both in the supply, demand, and distribution sectors) and as a result the price fluctuations of goods and the advantages and benefits of creating and running commodity exchanges and their ability to solve the above problems are the most important motivations and factors that cause the emergence of future markets have become the economic scene of different countries. A future contract is an agreement based on the purchase or sale of an asset at a certain time in the future and for a certain amount. Usually, the goal is to reduce and neutralize the said risk as much as possible by adopting a trading position (selling trading position or buying trading position). (Pish Bahar et al., 2015).

2-Literature Review

2-1 Theoretical Foundations

2-1-1 Cross Risk of Stock Returns

Cross hedging refers to a situation where the cash asset is different from the base asset of the futures contract. The important issue in hedging the cross risk is choosing the future contract whose price has the highest correlation with the balance of the base asset. In other words, in the topic of risk hedging, when the cash asset is different from the base asset of the future contract, the risk hedging is called cross hedging (Mehrara et al., 2017). Stock return in a certain period is the change in the price of ordinary shares plus all the benefits that have been assigned to the share in the given period. Benefits belonging to shares include cash dividends paid, benefits resulting from pre-emptive rights to increase capital, benefits resulting from bonus shares or dividends belonging to each share (Bakhardi Nasab and Ghasemi, 2015). Also, one of the basic criteria for making decisions in the stock market is stock returns. Stock returns alone have informational content and are used by most actual and potential investors in financial analysis and forecasting. Currently, investors can predict stock returns to some extent by creating a bridge between stock returns and other financial and non-financial information (Asgar Nejad Nouri, 2017).

2-1-2 Future Contract

A futures contract is an agreement to buy or sell an asset at a certain time in the future and for a certain amount of time, in the sense that people buy and sell futures contracts with each other that these contracts are concluded based on a basic asset; If a person takes a buying position in the future contract, it means that a certain amount of the basic asset must be received from the seller on a certain date in the future, the balance determined at the beginning of the contract (when the contract is concluded). It is obvious that this person has taken a buying position in the future market because he is worried about the increase in the cash price of the basic asset over time; This is despite the fact that if a person considers the price reduction undesirable for any reason, he must take a sell position in the futures market, in which case he must deliver a certain amount of the asset specified at the time of the sale of the contract to the buyer in the future for the balance determined at the beginning of the contract. (Mehrara et al., 2017). Commodity futures have many fans in the world because this market secures the interests of the buyer and seller of goods and provides the opportunity to gain profit for swingers (Hosseini, 2017). Another point about these contracts is that in the futures market, contracts are traded with different maturities and usually there are 4 contracts with different delivery schedules at any point in time, which traders can buy by distinguishing which contract at what time and which contract to sell. When should they sell, do their transactions or even get a discount between due dates (Hosseini, 2017).

2-2 The Background of Conducted Research

2-2-1 The Background of Internal Research

Borzabadi, Farahani et al. (2019) evaluated the topic of time variable modeling of the optimal ratio of risk coverage using futures contracts: the combined approach of paired copula functions and wavelet decomposition. The results of investigating the time variable efficiency of the wavelet decomposition model, GARCH-Copula model and the combined model of even copula and wavelet decomposition show the better efficiency of the models based on even copula functions and wavelet decomposition in the medium- and long-term time horizon.

Shahabadi, Farahani et al. (2017) investigated the optimal exchange rate risk hedging ratio using the gold futures market in developing and developed financial markets: a case study of Tehran and Chicago stock exchanges. The results of this study showed that the coefficient related to the future price variable of gold coins for the zero regime was obtained as 0.0013, which indicates that for risk coverage, 0.0013 units of gold coin contracts should be purchased for each currency contract.

Nazarpour et al. (2015), in research entitled "Introduction of the optimal risk coverage model in the operational models of promissory notes, using the AHP and TOPSIS method, investigated the optimal risk coverage model using the analytical descriptive method. The findings of the article indicate the superiority of the model proposed by the exchange in covering the operational risk of Istrians bonds compared to other models.

Eskandari et al. (2015), in research entitled risk hedging using the composite index of future contracts (a case study of Iran's financial market), investigated the possibility of hedging risk using all maturities with weekly data, and for this purpose, they defined three scenarios. The results of their research showed that all three scenarios can reduce risk. In the in-sample tests of the first scenario with the vector autoregression model and in the out-of-sample tests of the second scenario with the GARCH model, they have the highest efficiency.

2-2-2 The Background of Foreign Research

Buyukkara et al. (2021) investigated the optimal risk hedging rate and hedging effectiveness: an analysis of the Turkish futures market. The results indicate that stock futures contracts of the Istanbul Stock Exchange

provide an efficient mechanism for hedging investors with the aim of protecting their stock securities.

Bae et al. (2018), in research titled exchange rate management through risk hedging: with a new approach to examine the effectiveness of companies' risk hedging activities, depending on the basic characteristics (for example, orientation) of the exchange rate and exchange rate risk before using hedging activities have paid. The results showed that two conditions in the product markets (for example, export, import and profit) and the direction of exchange rate exposure are considered to reveal the effectiveness of hedging activities.

Gilardo et al. (2017), in research on financial risk hedging with derivatives and its effect on the Colombian market value for listed companies, investigated and analyzed the Tobin Q method as an indicator of the effect of risk hedging on the exchange rate related to the stock market in the Colombian market. The results of the research showed that companies that are exposed to exchange rate risks use derivatives of 6.3% in market value, which is a significant statistical and financial advantage.

Wang et al. (2016), in research titled hedging exchange rate risk in the gold market, using panel data analysis to investigate whether the gold market can support the exchange rate against possible risks and that the main benefits of gold production, gold consumption and the currency is the key of the country. The results of the analysis of models based on the panel showed that at the peak of the exchange rate fluctuations, gold was able to show its effect and cover the exchange rate fluctuations.

3. Research Methodology

The method of conducting the present research is analytical-descriptive. In this order, first the theoretical discussions and experimental studies of the research were collected by the library method, and then, considering the considerations and conditions of the country, the appropriate analytical model was selected. Library and internet methods have been used to collect the necessary information regarding theoretical topics and the background of experimental studies. Estimation of the model is also done using econometric model and CCC-GARCH and BEKK-GARCH models, and the information related to the review of the theoretical foundations and literature of the subject has been collected through library studies and internet search, and the information related to the time series of stock market returns. It has also been collected through the official website of the Stock Exchange and Securities Company. Also, for analyzing the data of this research, EViews software is used. The efficiency results of the above models in cross hedging are examined. Many different research and studies have been done on direct risk hedging and it is usually used as a common tool for risk hedging. For example, after buying the Bahar Azadi gold coin in the cash market, we can take a sell position in the futures market of the Iran Commodity Exchange so that we can cover our risk if the price falls in the market. In the crossover method, we use the future contract of another asset to cover the risk of one asset. The statistical model of the research is as follows:

$$RF = C(1) \times FR(-1) + C(2) \times RS(-1) + C(3)$$ (Eq.1)

$$RS = C(4) \times RF(-1) + C(5) \times RS(-1) + C(6)$$ (Eq.2)

RF stock market return (Dependent Variable), coin future contract returns (Dependent Variable). Also, the statistical population of this research is the country's capital market, and the statistical population of this research is Tehran securities Exchange.

4. Data Analysis

4.1 Estimation of the Model

The generalized Dickey-Fuller unit root test is one of the most common tests used today to detect the mean of a time series process. Therefore, in this part, the generalized Dickey-Fuller test has been performed for the variables, the results are reported in a summary form as described in Table No. 1, and the software outputs are given in the appendices.

As can be seen from the table, the generalized Dickey-Fuller statistic is greater than McKinnon's critical values, so the variables of stock return and coin future contract return are at a static level.

Table 1) Results of the Generalized Dickey-Fuller Unit Root Test for Model Time Series Data

Time Series Name	Generalized Dickey-Fuller Statistic at Level	Mckinnon Critical Values			Prob.	Result
		1%	5%	10%		
RF	-19/24	-3/43	-2/86	-2/56	0/000	Stationary
RS	-25/24	-3/43	-2/86	-2/56	0/000	Stationary

Now, in the following, firstly, the variables of stock return and coin futures contract are modeled using ARIMA estimation, and then to check the existence of heteroscedasticity variance, ARCH and WHITE

heteroscedasticity variance tests are used, and after ARCH and GARCH estimation, the conditional variance of each variable is extracted.

4.2 ARMA Model of Stock Returns

Now, we will check the existence of heterogeneity variance in the above model using the white test:

Table 2) ARMA model estimation for the Dependent Variable of Stock Returns

Independent Variables	Coefficient	T Statistic	Prob.
C	0/031	0/109	0/913
AR (1)	0/933	5/745	0/000
MA (1)	-0/911	-5/210	0/000

Table 3) The Result of White's Heteroskedasticity Variance Test

F-statistic	٥,٥٩E+24	Prob. F(14,1585)	٠,٠٠٠٠
Obs*R-squared	١٦٠٠,٠٠٠	Prob. Chi-Square (14)	٠,٠٠٠٠

4.3 ARMA Model of Coin Future Contract Returns

Now, we will check the existence of heterogeneity variance in the above model using ARCH test:

After selecting the variables used in the model, the most important issue in the vector regression model is to determine the optimal interval length.

After estimating the vector autoregression model and determining the length of the interval, the mean and variance equation system is built and estimated using the VAR (2)-BEKK method. Because the optimal lag length is two, the variables of stock return and coin future contract return are entered into the model with a lag of two.

Table 4) ARMA Model Estimation for Dependent Variable of the Coin Future Contract Yield

Independent Variables	Coefficient	t statistic	Possibility
C	0/0946	1/8283	0/0677
AR (1)	-0/7509	-26/6885	0/000
MA (1)	0/8550	34/0019	0/000

Table 5) The Result of ARCH Heteroscedastic Variance Test

F-statistic	175/91	Prob. F (1,1596)	0/000
Obs×R-squared	158/64	Prob. Chi-Square (1)	0/000

Table 6) Determining the Optimal Interval Length

The Length of the Break	Log L.	LR	FPE	AIC	S.C.	H.Q.
0	-7082/28	NA	26/59	8/96	8/96	8/96
1	-7064/44	35/61	26/12	8/94	8/96	8/95
2	-7044/80	39/15*	25/61	8/92	8/95*	8/93*
3	-7039/20	11/17	25/56	8/92	8/96	8/93

The Results of Estimation of Conditional Mean Parameters of VAR-BEKK Model				
$RF = C(1) \times RF(-1) + C(2) \times Rs(-1) + C(3) \times RF(-2) + C(4) \times RS(-2) + C(5)$				
$RS = C(6) \times RF(-1) + C(7) \times Rs(-1) + C(8) \times RF(-2) + C(9) \times RS(-2) + C(10)$				
	Coefficient	**Standard Deviation**	**Z statistic**	**Significance level**
RF (-1)	0/177	0/016	11/171	0/000
RS (-1)	-0/024	0/011	-2/093	0/036
RF (-2)	0/141	0/011	12/351	0/000
RS (-2)	-0/221	0/012	-18/649	0/000
C (5)	0/812	0/021	37/865	0/000
RF (-1)	0/009	0/001	7/192	0/000

RS (-1)	0/017	0/001	15/108	0/000
RF (-2)	0/012	0/001	9/817	0/000
RS (-2)	-0/239	0/001	-219/083	0/000
C (10)	0/314	0/001	242/242	0/000
The Results of Estimation of Fluctuation Parameters of VAR-BEKK Model) Variance Equation Coefficients)				
	Coefficient	**Standard Deviation**	**Z statistic**	**Significance level**
C (11)	6/429	0/069	92/681	0/000
C (12)	0/284	0/011	26/282	0/000
C (13)	6/402	0/077	83/557	0/000
C (14)	0/609	0/023	26/135	0/000
C (15)	-0/764	0/361	-2/113	0/035

The Results of Estimation of Conditional Mean Parameters of CCC-GARCH Model				
$RF = C(1) \times RF(-1) + C(2) \times Rs(-1) + C(3) \times RF(-2) + C(4) \times RS(-2) + C(5)$				
$RS = C(6) \times RF(-1) + C(7) \times Rs(-1) + C(8) \times RF(-2) + C(9) \times RS(-2) + C(10)$				
	Coefficient	**Standard Deviation**	**Z statistic**	**Significance level**
RF (-1)	0/177	0/016	11/171	0/000
RS (-1)	-0/024	0/011	-2/093	0/036
RF (-2)	0/141	0/011	12/351	0/000
RS (-2)	-0/221	0/012	-18/649	0/000
C (5)	0/812	0/021	37/865	0/000
RF (-1)	0/009	0/001	7/192	0/000
RS (-1)	0/017	0/001	15/108	0/000
RF (-2)	0/012	0/001	9/817	0/000
RS (-2)	-0/239	0/001	-219/083	0/000
C (10)	0/314	0/001	242/242	0/000
The Results of Estimation of Fluctuation Parameters of VAR-BEKK Model) Variance Equation Coefficients)				
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C (13)	6/402	0/077	83/557	0/000
C (14)	0/609	0/023	26/135	0/000
C (15)	-0/764	0/361	-2/113	0/035

5.Conclusion

The purpose of this study is to investigate the effectiveness of dynamic econometric models (BEKK GARCH, CCC-GARCH) to hedge the cross risk of stock returns and coin futures contracts in Tehran Stock Exchange using daily data during 2013-2019. Therefore, in this section, we examine the hypotheses:

The first hypothesis:

There is cross hedging of stock market return risk using coin futures contract with BEKK-GARCH model. The significance of the Rs (-1) coefficient indicates the correlation between coin futures and stock returns, and as a result, the possibility of hedging the risk of stock market returns using coin futures. Also, the significance of the Rs (-2) coefficient indicates the correlation between coin futures and stock returns, and as a result, the possibility of hedging the risk of stock market returns using coin futures. In the second equation, the significance of the Rf (-1) coefficient indicates the correlation between coin futures and stock returns, and as a result, it is possible to cover the risk of coin futures using stock market returns. The significance of the Rf (-2) coefficient indicates the correlation between coin futures and stock returns, and as a result, it is possible to cover the risk of coin futures using stock market returns. The

effect of coin futures yield fluctuations on the stock market yield and vice versa is shown in the coefficients of the variance equation. The reason for this positive effect can be that company shares and coins can be considered as alternative investments, and with the increase in volatility and the risk of investment in one of them, the demand is drawn to the other side, and with the increase in demand, its value increases. Therefore, the hypothesis of a research will not be rejected, and it is possible to cross hedge the risk of stock market returns using the coin future contract with the BEKK-GARCH model.

The second hypothesis:

There is cross hedging of stock market return risk using coin futures with CCC-GARCH model. Considering the negative Ness of the RF (-1) coefficient, it can be concluded that eleven stocks in the previous period have a negative effect on eleven stocks in the current period. The significance of the RS (-1) coefficient indicates the correlation between coin futures and stock returns, and as a result, the possibility of hedging the risk of stock market returns using coin futures. The significance of the Rs (-2) coefficient indicates the correlation between coin futures and stock returns, and as a result, the possibility of hedging the risk of stock market returns using coin futures. In the second equation, due to the positiveness of the Rf (-1) coefficient, it can be concluded that the return of the stock market in the previous period has a positive effect on the return of the coin futures contract. Considering the positiveness of the RS (-2) coefficient, it can be concluded that the return of the stock market of the previous two periods has a positive effect on the return of the coin futures contract. The effect of coin futures yield fluctuations on stock market returns is shown in the coefficients of the variance equation. Based on the coefficients of ARCH and GARCH obtained in the above model, which are the coefficients of C (11) to C (19) and their significance and considering that most of the coefficients are positive. The reason for this positive effect can be that company shares and coins can be considered as alternative investments, and with the increase in volatility and the risk of investment in one of them, the demand is drawn to the other side, and with the increase in demand, its value increases. As a result, it is possible to hedge the risk of stock market returns using the coin futures contract with the CCC-GARCH model. Therefore, the hypothesis of two research will not be rejected.

The main hypothesis: Different GARCH models are effective for risk hedging in the Tehran Stock Exchange using the future contract. Based on the explanation of the results of two sub-hypotheses, it was determined that there is a possibility of cross hedging the risk of the stock yield market, and GARCH's symmetric models are effective for hedging the risk in the stock market by using the coin futures contract. Therefore, the main hypothesis of the current research will not be rejected. Also, based on the results of symmetric GARCH models, considering that the coefficient of determination in the VAR-BEKK model is larger than the coefficient of determination in the CCC-GARCH model, therefore the VAR-BEKK model is more efficient than the CCC-GARCH model. Also, based on the coefficients obtained in these two models, considering that in the second equation of the CCC-GARCH model and the non-significance of the stock market return coefficients in the previous and two previous periods and its lack of effect on the return of the coin futures contract, we can conclude that the VAR-BEKK model It is more efficient than the CCC-GARCH model. Among the various methods that exist to reduce the risk caused by asset price fluctuations, the simplest and perhaps the most established risk hedging tool is the use of futures contracts. Therefore, according to the estimation of symmetric GARCH models in the present research, it was found that there is a possibility of cross hedging the risk of the stock return market, and symmetric GARCH models are effective for hedging the risk in the stock market using the coin futures contract. On the other hand, considering that the coefficient of determination in the VAR-BEKK model is larger than the coefficient of determination in the CCC-GARCH model. Therefore, the VAR-BEKK model is more efficient than the CCC-GARCH model. Also, based on the coefficients obtained in these two models, considering that in the second equation of the CCC-GARCH model and the non-significance of the stock market return coefficients in the previous and two previous periods and its lack of effect on the return of the coin futures contract, we can conclude that the VAR-BEKK model It is more efficient than the CCC GARCH model. According to the results of the current research, it is suggested to act in a way by providing a positive, attractive, and realistic atmosphere, so that the risk of not collecting enough cash is covered, with the tendency of investors to invest as much as possible. It is suggested to use credit rating and unconditional bank guarantees to increase willingness to invest and cover risk in the primary market. It is also suggested that by anticipating things such as redemption, the existence of options and the creation of an efficient secondary market, the risk of liquidation will be eliminated and thus the willingness to invest will increase. In line with risk coverage in the capital market, it is suggested that an arrangement be adopted so that the law-making officials, while considering the needs of the society, avoid continuous and unnecessary changes in laws and regulations that reduce the stability of the investment environment. Considering

that the increase in inflation reduces the real return of investors and the amount of profit or loss of investors will depend on their expectation and forecast of the level of inflation in the future. Therefore, it is recommended to use effective mechanisms to reduce the level of inflation, rationalize the real return of investors and increase the willingness to invest. To cover operational risks, it is recommended to design a suitable internal control system, train employees, use the necessary expertise according to the complexity of the administration, this type of risk is controlled and the willingness to invest is increased; Some of the effective factors in this function are using appropriate and efficient technology, applying precautionary principles of contracts and predicting some possible risks and implementing methods to manage them.

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