Short Term Hedging Using Futures Contracts

Maria CARACOTA DIMITRIU [1]
Ioana – Diana PAUN [2]

ABSTRACT
The objective of this paper is to demonstrate the effectiveness of risk management portfolio using futures contracts to achieve hedging. The risk can be minimized once measured, and the traditional tool of market risk management is hedging. The objective is to identify the optimum position to minimize the variation in a contract concluded now. Clearly hedging portfolio will reduce not only risk but also profitability. In conclusion hedging aims risk management, no additional gain. Portfolio manager will have the opportunity to carefully consider the relationship between risk and return in order to act according to his profile and targeted results.

KEYWORDS: *Futures contracts, derivatives, hedging, OLS*

JEL CLASSIFICATION*: C12, G11*

1. INTRODUCTION

This study aims to analyze the efficiency of hedging on futures market on securities and to identify the relationship between spot and futures markets in Romania. Derivatives can provide risk management. To reduce the imminent risk of holding a security, the investor can hedge the portfolio by selling a futures contract on an underlying asset. If spot and futures price developments will be successfully compensated then hedging will be successfully achieved. However, due to the existence of basis risk, futures contracts can not completely eliminate the risk associated with spot position (Figlewski, 1984, Holmes, 1996). For this reason it is important for market participants to understand the effectiveness of futures hedging. The consequence was a very effective hedging analysis has been developed in recent years.

The reason behind the decision to hedge consists in the desire to eliminate or reduce the variability of profits and firm value resulting from changes in market prices. Hedge effectiveness becomes relevant only when there is a significant change in the value of the subject for which hedging was done .Hedging is effective if the price evolution of the subject for which hedging was done and the derivative used for this purpose shall be compensated. According to Pennings and Meulenberg (1997), a factor that explains the success of the futures contracts is how effectively they can be used in hedging. Ederington (1979) defines the efficiency of hedging as variance reduction as the goal is to reduce risk. Howard and D'Antonio (1984) define hedging effectiveness as the ratio of excess return per unit risk portfolio containing the spot position. Hsin et al. (1994) measures the effectiveness of hedging by taking into accounts both risk and profitability. But all these studies assume that the futures contract involves no risk, which is a false hypothesis.

[1] The Bucharest University of Economic Studies, Romania, maria.caracota@gmail.com
[2] The Bucharest Academy of Economic Studies, diana_paun@yahoo.com

Numerous studies investigating the effectiveness of hedging have tried to determine which method can reduce cash price risk using futures contracts. First Markowitz (1959) measures the effectiveness of hedging as reduction of the standard deviation of the associated portfolio return. Then Ederington (1979) measures the effectiveness of hedging as a percentage reduction of variability. He explains that a process is effective hedge if the regression R2 of the explanatory regression model is high, say 90%. But a high R2 is not necessarily an indicator of an effective hedge. Howard and D'Antonio (1984) define hedging effectiveness in terms of risk and return. In particular, Chang and Shanker (1987) shows that the model of Howard and D'Antonio (1984) produces inconsistent results. Lindahl (1991) discuss the measures used by Howard and D'Antonio (1984, 1987) and argues that both measures are not appropriate for that lower risk near zero bases. Moreover, hedge effectiveness was measured by a simple risk minimization. According to Lypny and Powalla (1998), effectiveness depends on whether the average return on futures is zero; otherwise it may be too expensive hedging. Finally, the most recent studies are using most advanced econometric methods (model ECM, VECM, BGARCH) with or without error correction.

2. LITERATURE REVIEW

Hedging effectiveness has been extensively analyzed. Most research focuses on post-hedging effectiveness of futures contracts on stock indices (Figlewski, 1984). Research also gave attention to efficiency of hedging both ex and ante action (Malliaris and Urrutia, 1991; Benet, 1990; Holmes, 1995).

Figlewski (1984) is studying the effectiveness of hedging with futures contracts on American stocks as underlying assets and notes that the basis risk increases as hedge horizon decreases. Marmer (1986) is studying the effectiveness of hedging with futures contracts having as underlying assets the Canadian dollar between July 1981 and September 1984. Marmer (1986) studying the effectiveness of the minimum variance hedge ratio (MVHR) and demonstrates the usefulness MVHR as rather limited. Lasser (1987) considers the effectiveness of hedging with futures contracts having the treasury bonds as underlying assets. His conclusion is that generating hedging for a greater period of estimation is more efficient. Further, Benet (1990) investigates and analyzes how can reduce the potential risk on an ex ante foreign exchange futures contracts. He argues that there is a discrepancy between measured and ex ante hedge ratio. The same arguments are supported by Butterworth and Holmes (2000). Holmes (1995) examines the hedging effectiveness of futures contracts having UK stock index (FTSE 100) as underlying assets using data between 1984 and 1992. The results show that futures contracts give managers a valuable tool to avoid risk (Holmes, p.59). In addition, Law and Thompson (2002) analyzes the effectiveness of hedging with stock index futures, while Butterworth and Holmes (2000) further investigate the effectiveness of hedging using futures contracts on indices FTSE 100 and FTSE Mid 250 for a wide range of portfolios. According to their study, the FTSE 100 contract offered the most effective hedge for portfolios dominated by well-capitalized shares and Mid 250 was efficient for less capitalized securities (Butterworth and Holmes, 2000, p 15).

Further, Chang and Shanker (1987) provide a new definition of hedging effectiveness using the model proposed by Howard and D'Antonio (1984, 1987). According to their analysis, the model provided by Howard and D'Antonio provides inconsistent results. Also, Jong et al. (1997) applied three models to test the effectiveness of hedging with futures contracts: minimum variance model of Ederington's (1979), Fishburne's α -t model (1977) and model using the Sharpe ratio (1979). Their results indicate that hedging is efficient only when using the last two models. Brailsford, Corrigan and Heaney (2000) call into question several techniques for measuring the effectiveness of hedging using futures contracts having Australian All ordinaries share price index futures contracts as underlying assets. In addition, Chou, Denis and Lee (1996) compare the performance of hedging process using futures indices released on the Japanese market at different times as underlying assets. They have shown that conventional hedging performance is not as good as that achieved in the sampling period of time. Park and Switzer (1995) analyze hedging effectiveness for three types of stock index futures: S & P 500, MMI and Toronto 35. Their results illustrate that the bivariate GARCH estimation improves the hedging performance compared to the use of conventional hedging strategy (OLS). Further, Bera, Garcia and Roh (1997) uses a bivariate GARCH model and a random coefficient autoregressive (RCAR) to test the hedging performance of spot and futures prices. Lypny and Powalla (1998) analyze the effectiveness of hedging applied on German index DAX and using a bivariate GARCH model (1.1) and the error correction on average return. The empirical results confirmed that in this case dynamic model is superior to models using a constant hedge or media without error correction. This result is consistent with results obtained by Kroner and Sultan (1993). They argue that GARCH model leads to a much more efficient hedge than the conventional OLS.

3. DATA AND METHODOLOGY

3.1 Data

The data used in this study consist of 1,243 daily observations, concerning the evolution of stocks SIF5 and Futures SIF5 between 02.04.2007 - 30.03.2012.

We used daily closing prices and holidays were eliminated. For SIF5 stocks the data were provided by the www.ktd.ro (SIF5 shares are traded on the BSE). For futures the information was collected on www.sibex.ro (DESIF5 began to be traded on Sibiu Stock Exchange since 2004 and from 2008 Futures contracts having SIF5 as underlying shares are traded at Bucharest Stock Exchange).

Why chose SIF5 actions? Following examination of the last trading session, both the BSE and the SIBEX, SIF5 stocks proved to be among the most liquid (Table 1).

Table 1: BVB Trading Sessions Results

BSE **Last 20 trading sessions (23.03.2012-20.04.2012)**

Symbol	Name	Volume	Value
FP	SC FONDUL PROPRIETATEA SA - BUCURESTI	247.200.816	143.302.311,46
SIF3	SIF TRANSILVANIA S.A.	46.119.777	32.155.079,39
SIF1	SIF BANAT CRISANA S.A.	44.723.637	47.767.998,87
SNP	OMV PETROM S.A.	39.405.214	15.833.711,99
SIF5	SIF OLTENIA S.A.	21.916.226	29.528.731,51
AMO	AMONIL S.A.	21.405.058	248.886,78
TLV	BANCA TRANSILVANIA S.A.	19.005.637	21.560.838,58
SIF2	SIF MOLDOVA S.A.	16.435.205	21.421.290,25
SIF4	SIF MUNTENIA S.A.	15.721.994	11.436.368,85
TEL_SV	C.N.T.E.E. TRANSELECTRICA	10.995.472	164.723.165,87

Source: www.bvb.ro

Table 2: SIBEX to Top of liquidity and share of contracts / total turnover during

No	Contract	Total	% of total
1	DESIF5	1.177.583	72.69
2	DEDJIA_RON	345.62	21.33
3	EUR/RON	80.698	4.98
4	SIBGOLD_RON	10.792	0.67
5	DESIF2	2.937	0.18
6	DESNP	1.217	0.08
7	DETLV	600	0.04
8	BRK	169	0.01
9	DEBRD	168	0.01
10	DESIF3	138	0.01
11	CO2_RON	54	0.00
12	DERRC	34	0.00
13	*DEBRK*	*30*	*0.00*
14	DEBVB	16	0.00
15	DESBX	10	0.00
16	DESIF4	6	0.00
17	SIF1	3	0.00
18	TLV	3	0.00
	TOTAL	**1.620.078**	**100.00**

Source: www.sibex.ro

3.2. Methodology

To determine the effectiveness of hedging strategy in this study we used Markowitz's measure which measures the efficiency in relation to reducing the standard deviation of portfolio return. In this case, since the risk is reduced further, the efficiency is higher. Ederington (1979) argues that hedging effectiveness is equal to R2 of OLS regression: $\Delta S_t = c + b\Delta F_t + u_t$, where S_t and F_t is the logarithm of spot and futures prices in period t, and u_t the error of OLS estimation. ΔS_t and ΔF_t represents the evolution of spot and futures prices.

Ederington (1979) shows that if R^2 of simple linear regression is high a hedge is effective. In other words, the higher R^2 the higher efficiency and lower variance.

Following the model of Ederington (1979), to highlight the relationship between spot market and futures market we used a simple regression model with the following parameters:

$$Yt = \beta0 + \beta1Xt + \varepsilon t, t = 1, 2, ..., 208$$

Where:

X = FUTURES variable

Y= SPOT variable

t = time in days

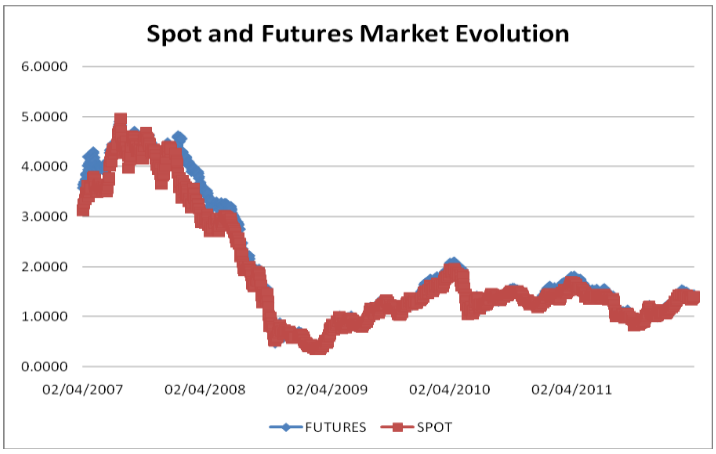

Figure 1. Romanian Spot and Futures Market Evolution
Source: authors

With FUTURES have been noted the market developments of Futures contracts having as underlying shares SIF5 and with SPOT ,the spot market trends represented by the evolution of stock prices SIF5.The analysis of variables linear graph shows that the indices are not stationary series.

This series were log, given the following model:

$Y_t = \beta_0 X_t^{\beta 1} \varepsilon_t$

That is $logY_t = log\beta_0 + \beta_1 logX_t + log\varepsilon$

From the analysis of linear graph of l_spot and l_futures where l_spot = log (spot) and l_futures = log (futures) is observed that the series still are not stationary. For this is done the first difference: Genrdl_spot=l_spot-l_spot(-1)

Genr dl_futures = l_futures - l_futures (-1),

Where dl_spot and dl_futures represent daily variation of the index and stationary according to the linear graph.

Thus, the regression model becomes:

$dl\_spot = \beta_0 + \beta_1 * dl\_futures + \varepsilon_0$

Descriptive analysis of data series provides us the following information:

Table 3: Descriptive statistics

Indicators	Futures	Spot
Nr Observations	1243	1243
Average	-0.000728	-0.000645
Maxim	0.173663	0.139420
Minimum	-0.198891	-0.161268
Standard deviation	0.034638	0.032682
Skewness	-0.125388	-0.109792
Kurtosis	8.404388	6.670145
Jarque-Bera	1514.738	699.5658
Probabilitaty	0.000000	0.000000
Augmented Dickey Fuller	-32.55517	-30.97862

Source: authors

From the diagram "cloud point" is observed that the model is well specified and between the two variables there is a significant positive linear dependency. The high density of points recommends the estimate of model parameters using all the 1,243 values of the data series.

Linear graph demonstrates a close evolution of the two markets, significant decreases in both.

Stationarity series has been confirmed by ADF test. For both series test value is less than the critical value, leading to rejection of the null hypothesis, i.e. the series is stationary. Series integration order is 1, or series are 1(1).

Both series have the average value close to zero and k> 3 i.e. a leptokurtosis distribution (most financial assets have such distribution), which means that the likelihood of an extreme event is superior to the probability of occurrence of an event normally distributed. As a result, the valuation models of prices, risk equity and futures contracts can lead to errors if we assume normal distribution. JB test also demonstrates there is no normal distribution.

According to the time series corelogram, the series are stationary. Series are nonzero probability, so there is no significant autocorrelation of the series terms. AC function has the 36 values close to zero and decreases continuously, resulting that the series contain a component type MA.

4. EMPIRICAL RESULTS

According to the results of the parameter estimated by OLS, the regression model used is valid as t test probability is less than the chosen level of relevance (0.5%) resulting that 0 hypothesis is false and so the coefficient is considered statistically significant.

DW = 2.3818, which means that there is a negative serial correlation of errors.

It is noted that we obtained an R^2 of 0.66 (66%), indicating an effective hedge. According to theory, hedging is effective if it significantly reduces the risk of price developments. The hedge ratio of 0.763936 was estimated according to parameters:

Dependent Variable: DL_SPOT

Method: Least Squares

Date: 04/22/12 Time: 18:56

Sample (adjusted): 2 1243
Included observations: 1242 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DL_FUTURES	0.763936	0.015725	48.57973	0.0000
C	-8.93E-05	0.000545	-0.163981	0.8698

R-squared	0.655555	Mean dependent var	-0.000645
Adjusted R-squared	0.655277	S.D. dependent var	0.032682
S.E. of regression	0.019189	Akaike info criterion	-5.067395
Sum squared resid	0.456569	Schwarz criterion	-5.059143
Log likelihood	3148.853	F-statistic	2359.990
Durbin-Watson stat	2.381880	Prob(F-statistic)	0.000000

Figure 2: OLS estimation parameters
Source: authors

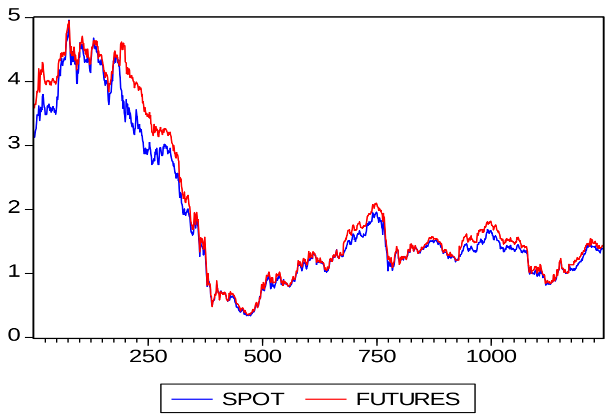

Figure 3: Linear graph of Spot and Futures Markets evolution
Source: authors

Optimal hedge ratio is the ratio between the positions taken on futures market and spot market for which the total portfolio risk is minimal. The no hedged and hedged return of a portfolio can be written as:

$$R_U = S_{t+1} - S_t$$

$$R_H = (S_{t+1} - S_t) - H(F_{t+1} - F_t)$$

Where S is the spot and F is the futures.
Hedging effectiveness is determined by: $Hedging\ efficiency = \frac{Var(U) - Var(H)}{Var(U)}$

The equation obtained from the estimate by the method of least squares (OLS) is:
$R_{st} = \propto + HR_{ft} + \varepsilon_t$

Where R_{st} and R_{ft} is the spot return, respectively futures return, and H is the optimal hedge ratio. The results:
$R_{st} = -8.93E - 05 + 0.763936R_{st}$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DL_SPOT(-1)	-0.873001	0.028181	-30.97862	0.0000
C	-0.000568	0.000921	-0.616232	0.5379

R-squared	0.436479	Mean dependent var	4.70E-06
Adjusted R-squared	0.436024	S.D. dependent var	0.043200
S.E. of regression	0.032443	Akaike info criterion	-4.017064
Sum squared resid	1.304094	Schwarz criterion	-4.008806
Log likelihood	2494.588	F-statistic	959.6751
Durbin-Watson stat	2.008265	Prob(F-statistic)	0.000000

Null Hypothesis: DL_FUTURES has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=22)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-32.55517	0.0000
Test critical values:	1% level	-3.435406	
	5% level	-2.863661	
	10% level	-2.567949	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(DL_FUTURES)
Method: Least Squares

Figure 4: ADF Test
Source: Authors

In conclusion hedging reduces the variance by about 76%, which means that hedging is effective.
The results can be summarized in the table 4.

Table 4: Regression results

	Without hedging (h=0)	OLS (h=β)
Rate	0.00000	0.763936
Return	0.01460	0.116880
Variance	0.032682	0.019189
Efficiency	-	76.39%

Source: authors

Hypothesis testing was performed through the following tests:

- Testing regression equation errors:
  According to the correlogram Q-state for the first lag of errors there is a serial correlation of errors (AC coefficients value exceeds point range in the graph). Existence of autocorrelation is confirmed by Q-state test and its associated probability.
  According to the econometric results from the correlogram quadratic residues for the estimated equation above, there is serial correlation of squared errors, so there may be the ARCH terms (There may be heteroskedasticity).
  According to the histogram and normality test, errors are not normally distributed but leptokurtotic.
  According to the LM-test probability is less than the chosen level of relevance, 0 hypothesis is rejected, showing that there is a serial correlation of regression equation errors up to a lag equal to 1.The LM test confirms the existence of serial correlation shown by the errors correlogram.
- Stability tests and the estimated coefficients of the equation:
  The CUSUM test has been used. Cumulative sum of recursive errors is within the 5% critical lines, so the parameters are considered stable, therefore equation coefficients are stable.

5. CONCLUSIONS

The model problems are the existence of serial correlation of errors and of heteroskedasticity. This should be corrected either by using weighted least squares method, or by redefining the regression model considering new combinations of explanatory variables.

Strengths of the models are stability parameters, statistically significant coefficients and a well defined regression equation according to statistical tests performed.

The study results confirm the proposed hypotheses and theoretical approach that the use of futures contracts allows portfolios effective hedging.

REFERENCES

Benet, B. A. (1990). Ex-ante reduction of foreign exchange exposure via hedge ratio adjustment, *Review of Futures Markets*, 9, 418-435.

Bera, A. K., Garcia, P., and Roh, J-S. (1997). *Estimation of time-varying hedge ratios for corn and soybeans: BGARCH and Random Coefficient Approaches*, The Office for Futures and Options Research, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign.

Brailsford, T. J., Corrigan, K., and Heaney, R. A. (2000). *A comparison of measures of hedging effectiveness: A case study using the Australian All ordinaries share price index futures contract*, Working Paper, Department of Commerce, Australian National University.

Butterworth, D., and Holmes, P. (2000). *Ex ante hedging effectiveness of UK stock index futures contracts: evidence for the FTSE 100 and FTSE Mid* 250 *contracts*, European Financial Management, 6, 441-457.

Chang, J., and Shanker, L. (1987). A risk-return measure of hedging effectiveness: a comment, *Journal of Financial and Quantitative Analysis*, 22, 373-376.

Chou, W. L., Denis, K. K. F. and Lee, C. F. (1996). Hedging with the Nikkei index futures: the conventional model versus the error correction model, *Quarterly Review of Economics and Finance*, 36, 495-505

Ederington, L. H. (1979) The Hedging Performance of the New Futures Markets, *Journal of Finance*, 34: 157-170.

Figlewski, S. (1984). Hedging performance and basis risk in stock index futures, *Journal of Finance*, 39, 657-669

Howard, C., and D'Antonio, L. (1984). A risk-return measure of hedging effectiveness, *Journal of Financial and Quantitative Analysis*, 19, 101-111

Hsin, C.-W., Kuo, J., and Lee, C. W. (1994). A new measure to compare the hedging effectiveness of foreign currency futures versus options, *Journal of Futures Markets*, 14, 685 - 707.

Jong, A., Roon, F., and Veld, C. (1997). Out-of-sample hedging effectiveness of currency futures for alternative models and hedging strategies, *Journal of Futures Markets*, 17, 817-837.

Kroner, K. F., and Sultan, J. (1993). Time varying distributions and dynamic hedging with foreign currency futures, *Journal of Financial and Quantitative Analysis*, 28, 535-551.

Lasser, D. J. (1987). A measure of ex ante hedging effectiveness for the treasury bill treasury bond futures markets, *Review of Futures Markets*, 6, 278-295.

Laws, J., and Thompson, J. (2002). *Hedging effectiveness of stock index futures*, Centre for International Banking, Economics and Finance (*CIBEF*), Liverpool John Moores University

Lypny, G., and Powalla, M. (1998), *The hedging effectiveness of DAX futures*, European Journal of Finance, 4, 345-355.

Marmer, H. (1986). *Portfolio model of hedging with Canadian dollar futures: a framework for analysis*, Journal of Futures Markets, 6, 83-92.

Park, T. H., and Switzer, L. N. (1995). *Time-varying distributions and the optimal hedge ratios for stock index futures*, Applied Financial Economics, 5, 131-137.