METHODS OF ASSESSING THE FEASIBILITY OF HEDGE COMMODITY DERIVATIVES

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Abstract

In the given article, author examines the methodology for assessing the appropriateness of hedge commodity derivatives, which are carried out on the stock futures market. Relevance of the topic due to the fact that the economy, as the world's leading countries and countries with economies that develops, needs more enterprises are engaged in the issue of derivatives in the stock markets. That is why, it is necessary to improve the basic steps and methods to assess the feasibility hedge commodity derivatives. Methodology of research is the study and synthesis methods to assess the feasibility of hedge commodity derivatives. The main result of the study is to reveal the methodology for assessing the appropriateness of hedge commodity derivatives.

Keywords: analysis, exchange, derivatives, hedging

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Introduction

There are many works of European and Ukrainian scientists that dedicates to analysis of equity and currency derivatives transactions subject. For example, Azarenkova (2005) ., studied models and methods of analysis of financial flows Considerable attention was given by Jaroslaw Komarinskiy (1996) to analysis and

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operation of exchanges, organization and operation of securities markets, as well as the risks of investment. Kramarenko (2002, p. 101 - 109) discusses the features of the stock market indices analysis. Kramarenko (2002, p. 140 - 179) explores the methodological framework for the operations with currency derivatives in commercial bank analysis. Problems of automation stock derivatives paid attention Kudrenko (2003). Loptkina (2008, p. 886) studied modern approach to credit risk assessment, which is based on the concept of VAR, which became the accepted standard for the evaluation of market risk. Silchenko (2002) improved economic and mathematical approaches to the definition of hedging strategies sale option. Partly mathematical methods of hedging options were considered by Silchenko (2000) as well. The problems of assessment and mapping of economic risks in accounting explored Primostka (2011, p. 179-180).

European scientists are studying mainly analysis of futures and options, in particular mainly technical, fundamental analysis and trending. Alexis (1999, p.112-136) paid much attention to technical analysis of options and in particular the "riskless hedge" at the expense of the Black-Scholes model. Bernstein (2003, p.16) to assess the potential risks of securities transactions using the theory of "beta coefficient". Charles Lebo (1998) gives attention to the advantage of trending and fundamental analysis.

However, in some works of Ukrainian scientists consider and analyze transactions with commodity derivatives, in particular Boyko (2010, p.131-137) studying how to conduct a preliminary analysis of hedge. Drozd (2010, p.16-19) analysis examines the role of hedging in the management decision-making processing enterprises. Despite this, a number of problems analysis hedge commodity derivatives is not disclosed and needs further improvement.

1. The stages of feasibility commodity derivatives hedging

Given the variety as most of derivatives and financial transactions that are made with them, it is necessary not only to account derivatives correctly, as well as timely, but also it is important to analyses the effectiveness of the emergency operations implementation. An important factor of economic analysis of the effectiveness use of derivatives is the correct application of the technique for the analysis of hedging transactions that are carried out using derivatives, and a system of analytical support in the management of price risk, such as interest rate, currency, the risk that the market value of the securities or commodities.

There are always certain trends in price fluctuations. Sohatska (2008, p.193) were paid much attention to technical analysis of price trends, argues that prices vary for persistent temporal model. Scientific Nyman (1999, p.36) notes that the laws of physics, economy and psychology in different periods is constant and therefore the rules that were in effect in the past, are now, and will operate in the future, but because it gives the opportunity to determine the reliability of predicting the future.

To evaluate the risks hedge commodity derivatives it is necessary to determine such trends, that ensure the hedge will be really effective. In addition, it is necessary to calculate all additional costs incurred by the company.

Market prices of products and goods are constantly changing. Together with them and change the value of commodity derivatives. In order to assess the possible risks and losses is necessary to develop a specific mathematical mechanism of forecasting price fluctuations with some certainty over time, taking into account trends in price changes.

For such a prediction is necessary to have some sample data on historical price fluctuations as the hedged item and the hedging instrument. The larger the sample, the more accurate the forecast analysis of price fluctuations and risk analysis of the hedge relationship as a whole. In order to determine the need for assessing hedge commodity derivatives, it is proposed to apply the methodology of calculation in several stages (Fig. 1)

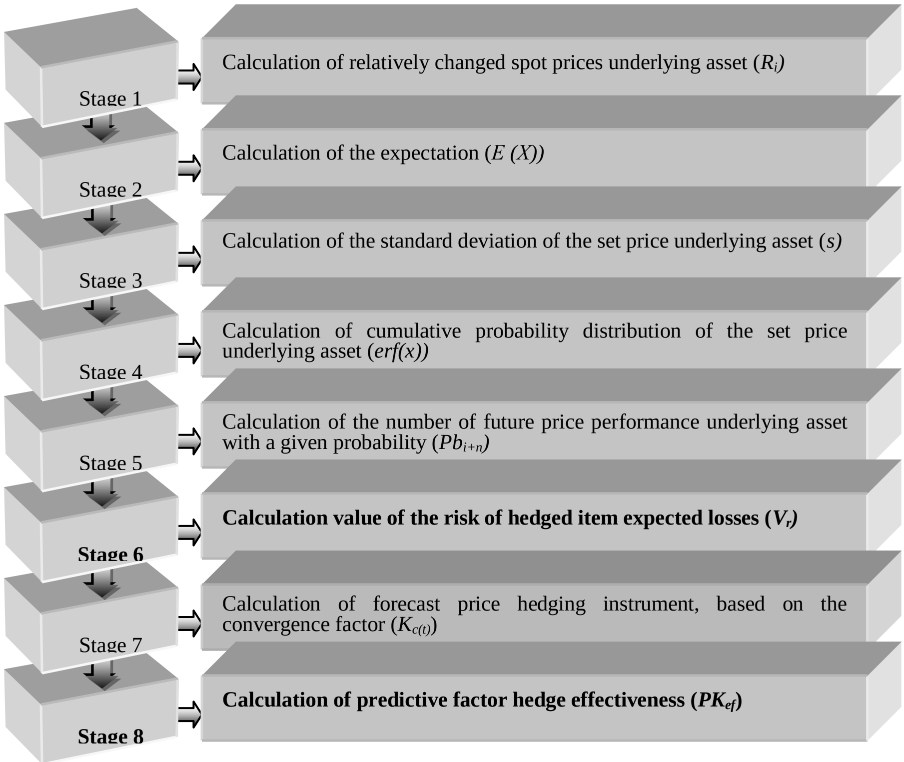

Fig. 1. The algorithm for determining the feasibility of assessing hedge commodity derivatives

Source: OECD

2. Method for determining feasibility of commodity derivatives hedging

In the first stage is proposed to calculate the relative change in monthly spot price (Hull , 2007). For its calculation we apply the formula of relative price changes over a period t. Then the formula will be as follows (1):

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \times 100\% \quad (1)$$

R_t - relative price change;

P_t - the current price of the hedged item;

P_{t-1} - previous price of the hedged item.

This indicator should be calculated for each day, or monthly, depending on the type of sample and frequency information on the prices of goods.

The second stage is to calculate the expectation to obtain a plurality of relative price changes. Mathematical expectation is one of the basic numerical characteristics of each numerical replacement. It is a generalization of the mean aggregate numbers, when elements of the set of values of this set have different prices, which is characteristic for a given set of values. Mathematical expectation is calculated for the formula (Zhaldak, 2000) (2):

$$E(X) = \sum_{x} x \cdot p(x) \tag{2}$$

$E(X)$ - expected value;

x - the value of a discrete set;

$p(x)$ - the probability of occurrence of value x in the set.

With that, should the condition (Danko, 1999): $\sum_{x} p(x) = 1$ (3)

The third step is to calculate the standard deviation. The standard deviation is used during the calculation of the standard error of the arithmetic mean, for the construction of confidence intervals, hypothesis testing, measurement of the linear relationship between random variables. Bakaev LO considers important indicator of the standard deviation to calculate the riskiness of the portfolio (Bakaev, 2000).

Standard deviation - is equal to the square root of the variance of the random variable (4) (Leschinsky, 2003):

$$\sigma = \sqrt{\sigma^2} \tag{4}$$

Accordingly, the formula calculates the variance (5) (Dougherty, 1999):

$$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (x_i - \bar{x})^2} \tag{5}$$

It should be noted that for small sample sizes (n <= 40-50) (Butuzov, 2008) introduced an amendment Bessel. Evaluation of the dispersion that is offset by an amount 1 / n-1 (6). Chumachenko M. in his work uses the calculation of the standard deviation for the purpose of risk analysis and management effectiveness of a portfolio of financial investments (Chumachenko, 2001).

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2} \qquad (6)$$

s - standard deviation;

σ^2 - dispersion;

x_i - sampling unit;

$\bar{x}$ - arithmetic average sample;

n - sample size.

For an infinitely large volume difference between said sample values disappears. In this case, the arithmetic mean of the sample is calculated by the formula (7) (Dougherty, 1999):

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad (7)$$

In the fourth step is to find a quantile of the normal distribution function. The normal distribution also known as Gauss distribution, there is one of the most prominent of continuous distributions. There are a number of normal distributions that differ only in scale, and offset. Under normal distribution is meant the so-called standard normal distribution - normal distribution with zero mean and unit standard deviation.

The density function of the reliability of the normal distribution is calculated by the formula (8) (Danko, 1999):

$$f(x) = \frac{1}{\sqrt{2\pi}} \exp(-\frac{x^2}{2}) \qquad (8)$$

Integral function of the reliability of the distribution is usually expressed in terms of function *erf(x)* (9) (Chumachenko,2001)*:*

$$erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x \exp(-u^2)du \qquad (9)$$

For risk assessment hedge commodity derivatives to be calculated inverse function of the normal distribution, or quantile. Quantile (Q) - the value of the distribution function (Gaussian functions) at specified values at which the value of the distribution function does not exceed this value with a certain probability.

In order to simplify the calculation, we use quantile means software Microsoft Excel. In this program, there is an automatic calculation of the quantile values according to the formula (Vedeneeva,2008) (10):

$$Q = \text{NORMINV}\ (V, E(x), s)\ , \qquad (10)$$

Q - quantile value for the normal distribution;

V- the accuracy of which corresponds to the normal distribution;

$E(X)$ - expected value;

s - standard deviation.

To calculate the cost of goods (finished products) on the market on the basis of existing statistical series pricing for the next period (depending on the type of sample it may be a day, a month or a year) should be multiplied by the last price index for quantile added to the unit (11):

$$X_{t+1} = (Q+1) \cdot X_t \qquad (11)$$

Q - quantile value for the normal distribution;

X_t - price value at the current time t;

X_{t+1} - price value for next moment of time t;

In the fifth step for calculating the number of underlying asset price indices for several periods ahead with a given certainty, it is proposed to calculate this indicator for the formula (12):

$$X_{t+n} = (\sqrt{n} \cdot Q + 1) \cdot X_t \qquad (12)$$

Q - quantile value for the normal distribution;

X_t - price value at the current time t;

X_{t+n} - price value for next moment of time t, a distant for the period n;

n - the number of periods ahead.

Moreover, in research observed during the calculation of the price values the next time point at a given reliability of V in the formula (1.10) is equal to 1% (Q_{min}), the price value of the next point in time takes its maximum possible value of the least (P_{min}) and reliability at a given V to equal 99% (Q_{max}), the price value of the next point in time takes its maximum possible value of the greatest (P_{max}). That is, according to this method for assessing the risk of hedging commodity derivatives can determine the most possible the least and the greatest value of the price index of goods or finished products on the spot Rinke goods.

The most probable value of future price index of the hedged item are encouraged to take the arithmetic mean value of P_{min} and P_{max} (13):

$$Pb_{t+n} = \frac{P_{min} + P_{max}}{2} \tag{13}$$

Pb_{t+n} - target price of the underlying asset hedged period n;

P_{min} - minimum target price of the hedged item;

P_{max} - maximum target price of the hedged item.

After calculating the value of target prices according to this formula, we have a series of numbers forecast price fluctuations and we have a predictive value of the hedged item price at the end of hedging period (P t+n) (14):

$$P\ t{+}1,\ P\ t{+}2,\ P\ t{+}3,\ P\ t{+}4,\ P\ t{+}5\ \ldots,\ P\ t{+}n \tag{14}$$

In the sixth stage, given the previous calculated parameters, we can calculate the risk of expected losses as the relationship changes target price of the hedged item at the end of the hedging period (P t + n) compared to the current price of the hedged item to the current price of the hedged item, which we denote by Vr, from the «Value of risk» (15):

$$Vr = \frac{Pb_{t+n} - Pb_t}{Pb_t} \times 100\% \tag{15}$$

Vr - the risk of expected losses of the underlying asset of the hedged item;

P_{t+n} - target price of the underlying asset hedged item for n periods;

P_t - the current price of the underlying asset of the hedged item.

The proposed indicator "risk of expected losses" is the basis for a decision on the need for hedging commodity derivatives.

At the same time it is necessary to calculate and forecast performance indicator hedging commodity derivatives. This indicator can be calculated only if the targets of the cost of fixed-term contracts. The need to identify the rank of count.

Predictive in commodity futures contracts (futures and options) can not be carried out in a straight linear regression based on previous performance, as it is known, the value of fixed-term contracts compared to the spot value of the underlying asset approach each one of the one with the passage of time performing fixed-term contract. This is due to the fact that the forecast figures for futures contracts with the passage of time their performance become more apparent. Therefore, it is necessary to calculate the predictive value of futures contracts by another method.

This method of calculation is proposed that the convergence coefficient method. This method is based on the assumption that the ratio of the value of the hedged item to the value of the hedging instrument with the approach to the date the futures contract on such derivative financial instruments is maintained. The convergence of the cost function of the hedged item to the function value of the hedging instrument are similar for similar underlying assets, but in different time intervals.

Therefore, the seventh stage, is proposed for each of the retrospective period, which is the basis for predictive analysis, calculate the coefficient of convergence for the formula (16):

$$\hat{E}_{\tilde{n}(t)} = \frac{P_{h(t)}}{P_{b(t)}} \tag{16}$$

$\hat{E}_{\tilde{n}(t)}$ - rate of convergence for the period t;

$P_{h(t)}$ - price hedging instrument for the period t;

$P_{b(t)}$ - spot price of underlying asset of the hedged item for the period t.

Then, on the basis of predicted values obtained by the formula (13) using the obtained coefficients of convergence, we expect prices to forecast figures hedging instruments (17):

$$Ph_{s+n} = Pb_{s+n} \times K_{c(t)} \tag{17}$$

Ph_{s+n} - target price hedging instrument for n periods

Pb_{s+n} - target price of the underlying asset hedged item for n periods;

$\hat{E}_{\tilde{n}(t)}$ - convergence rate for the same period t;

Thus, in the eighth stage, on the basis of the calculated target prices, as the underlying asset and the hedging instrument can determine and calculate the predictive effectiveness of the hedge to a specific underlying asset. Together with the use of risk indicators of expected losses can be concluded about the need to hedge.

3 Conclusion

Market prices for finished goods and goods are constantly changing. Simultaneously with them and change the value of commodity derivatives. In order to assess the possible risks and losses is necessary to develop a specific mathematical mechanism of forecasting price fluctuations with some certainty over time, taking into account trends in price changes. For such a prediction is necessary to have some sample data on historical price fluctuations as the hedged item and the hedging instrument. The larger the sample, the more accurate the forecast analysis of price fluctuations and risk analysis of the hedge relationship as a whole. To achieve this goal are encouraged to use developed a methodology to assess the need for hedge commodity derivatives.

The proposed methodology, in our opinion, gives every reason to calculate predictive indicators and should be applied to calculate the expected rate hedge effectiveness, as well as during the design documentation of intent to hedge.

Bibliography

AKELIS, S. 1999. *Tehnicheskiy analiz ot A k Ya* (Technical Analysis from A to Z). – Moscow. (in Russian)

AZARENKOVA, G. 2005. *Modeli ta metody analizu finansovyh potokiv* (Models and methods of analysis of financial flows). – Kharkiv. (in Ukraine).

BAKAEV, L. 2000. *Kilkisni metody v upravlinni investciyamy*: Navch. posibny`k. (Quantitative Methods in investment management). – Kyiv. (in Ukraine).

BERNSTEIN, L. 2003 *Analiz finansovoy otchetnosti: teoriya, praktika i interpretatsiya* (Financial Statement Analysis: Theory, Practice and Interpretation. Trans. from English). – Moscow. (in Russian)

BOYKO, K. 2010 *Metodyka provedennya poperednogo analizu operacij xedzhuvannya* (The methodology of the previous analysis of hedge). – Oblik i finansy APK, no 1, pp. 131-137. (in Ukraine).

BUTUZOV, V. 2008 *Matematicheskiy analiz v voprosah i zadachah* (Mathematical analysis of questions and tasks). – Krasnodar. (in Russian)

CHUMACHENKO, M., BOLYUH, M., BURCHEVSKY, V. 2001 *Ekonomichnyi analiz* (Economic analysis). – Kyiv. (in Ukraine).

DANKO, P. 1999. *Vyisshaya matematika v uprazhneniyah i zadachah.* (Higher mathematics exercises and tasks). – Moscow. (in Russian)

DOUGHERTY, K. 1999. *Vvedenie v ekonometriku.* (Introduction to Econometrics). Trans. from English). – Moscow. (in Russian)

DROZD, I., BOYKO, K. 2010. *Rol analizu xedzhuvannya u systemi pryjnyattya upravlinskyh rishen pidpryyemstv pererobnoyi promyslovosti* (Role in the analysis of hedge management decision-making processing enterprises), – Visnyk Kyivskogo nacionalnogo universytetu imeni Tarasa Shevchenka. Ekonomika, no 118., pp 16-19.

HULL, D. 2007. *Optsionyi, fyuchersyi i drugie proizvodnyie finansovyie instrumentyi* (Options, futures and other derivative financial instruments. Trans. from English). Kyiv. (in Russian)

KOMARINSKY, J., YAREMCHUK, I. 1996. *Finansovo-investytsiinyi analiz* (Financial and investment analysis). – Kyiv. (in Ukraine).

KRAMARENKO, J. 2002. *Oblik ta analiz operatsii z valiutnymy deryvatyvamy v komertsiinykh bankakh Ukrainy* (Accounting and analysis of operations with currency derivatives in commercial banks of Ukraine). – Kyiv. (in Ukraine).

KRAMARENKO, V., HOLOD, B. 2003 *Birzhova diialnist* (Exchange activity) – Kyiv. (in Ukraine).

KUDRENKO, D. 2003. *Analiz informatsiinykh tekhnolohii zadachi operatyvnoho analizu fiuchersnykh rynkiv* (Analysis of information technology tasks operational analysis of futures markets). – Dnipropetrovsk. (in Ukraine).

LEBO, C. 1998. *Kompyuternyiy analiz fyuchersnyih ryinkov* (Computer Analysis of the Futures Markets. Trans. from English). – Moscow. (in Russian)

LESCHINSKY, O. 2003. *Ekonometriya* (Econometrics). – Kyiv. (in Ukraine).

LOPATKINA, I. 2008. *Vplyv pokhidnykh finansovykh instrumentiv na rozvytok finansovoi kryzy v SShA* (Effect of derivative financial instruments for the development of the financial crisis in the United States). – Economics: Theory and Practice – Sciences works., no. 246, pp. 880-888

NYMAN, E. 1999. *Malaya entsiklopediya treydera* (Small traders encyclopedia). – Kyiv. (in Ukraine).

PRIMOSTKA, L. 2011. *Problemyi otsenki i otrazheniya ekonomicheskih riskov v buhgalterskom uchete.* (Problems of evaluation and reflection of economic risks in accounting). – Sokolovskie chteniya. Vzglyad iz proshlogo v buduschee., Vol 2, pp. 179-180

SOHATSKA, O. 2008. *Birzhova sprava* (Exchange business). – Kyiv. (in Ukraine).

SILCHENKO, M. 2000. *Matematychni metody u khedzhuvanni ryzykiv na rynku optsioniv* (Mathematical methods of risks hedge options market). – Finance of Ukraine, no. 11, pp. 100-105

SILCHENKO, M. 2002. *Ekonomiko-matematychne modeliuvannia protsesu tsinoutvorennia na rynku optsioniv* (Economic-mathematical modeling of the process of pricing in the options market). – Kyiv. (in Ukraine).

VEDENEEVA, E. 2008. *Funktsii i formulyi Excel 2007. Biblioteka polzovatelya.* (Functions and formulas Excel 2007. The user library). – St. Pererburge. (in Russian)

ZHALDAK, M. KUZMINA, N., MIHALIN, G. 2000. *Teoriya ymovirnostey i matematichna statistika: Pidruchnik dlya studentiv fIziko-matematichnih spetsialnostey pedagogichnih unIversitetiv* (Theory of Probability and Mathematical Statistics: A Textbook for students of physical and mathematical specialties of pedagogical universities). – Poltava. (in Ukraine).

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