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TARGET COSTING AND RISK MANAGEMENT

In order to achieve the desired results, an increasing number of companies around the world adopt target costing as a strategic managerial tool. The purpose of the paper is to examine the impact of risk management through financial derivatives on the achievement of target costing objectives. We show that hedging through a risk reversal strategy reduces the risk of costs higher than the target cost and also lowers the volatility of future cash flows.

Keywords: *target costing, risk management, hedging, derivatives.*
JEL classification: G12, G32, M41.

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ЦІЛЬОВІ ВИТРАТИ Й УПРАВЛІННЯ РИЗИКАМИ

У статті показано, що все більша кількість компаній по всьому світу починають використовувати метод цільових витрат як інструмент стратегічного управління. Вивчено вплив управління ризиками за допомогою фінансових деривативів на досягнення рівня цільових витрат. Показано, що хеджування за допомогою стратегії перегляду ризику знижує ризик витрат, вищих від цільових, а також у перспективі знижує волатильність грошових потоків.

Ключові слова: *цільові витрати, управління ризиками, хеджування, похідні.*
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ЦЕЛЕВЫЕ ЗАТРАТЫ И УПРАВЛЕНИЕ РИСКАМИ

В статье показано, что все большее число компаний по всему миру начинают использовать метод целевых затрат как инструмент стратегического управления. Изучено влияние управления рисками посредством финансовых деривативов на достижение уровня целевых затрат. Показано, что хеджирование с помощью стратегии пересмотра риска снижает риск затрат выше целевых, а также в перспективе снижает волатильность денежных потоков.

Ключевые слова: *целевые затраты, управление рисками, хеджирование, производные.*

Introduction. In present business conditions, increased competition, improved technologies and volatile markets lead companies to manage more efficiently their costs and adopt rigorous risk management policies. In such environment it is difficult for companies to maintain satisfactory returns or profits and, according to Gupta and Galloway (2003), accurate cost information is critical for every aspect of business.

In order to achieve the desired results, an increasing number of companies around the world adopt target costing as a strategic managerial tool. Yazdifar and Askarany (2012) show that target costing is equally used by both manufacturing and service companies.

Ansari et al. (2007) state that target costing is the system of profit planning and cost management used to ensure that new products and services meet market determined price and expected profit. The above idea can be expressed in the following simple equation:

$$\textit{Target Cost} = \textit{Target Price} - \textit{Target Profit} \quad (1)$$

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As one can observe, the exogenous variables in the above equation are expected profit and market price, being strongly influenced by competition at product and capital markets. The dependent variable in the relation is cost, suggesting that in order to meet its goals, a company has to manage it efficiently .

An important topic studied in literature is the situation in which target costing is most useful. Ansari et al. (1997), Baker (1995), Butscher and Laker (2000), and Gagne and Discenza (1995) concluded that target costing is a significant instrument for those entities which are functioning in competitive environments and have short product life cycles. According to Jackson (2003), the length of product life cycles, level of competition, and customer needs and requirements are the factors which determine the success of target costing.

Woods at al. (2012) studied the way that EVA can be introduced into the target costing system of a European company. Kee (2010) analyzed if production-related decisions made with target costing add significant economic value to the firm. The author compares a traditional target costing model to another model that incorporates the cost of capital, concluding that the traditional target costing model systematically overestimates the marginal cost of cash-related production resources and underestimates the marginal cost of invested funds.

Zengin and Ada (2010) state that especially in the case of small and medium enterprises, combining target costing with quality function deployment and value engineering techniques provides companies with a competitive cost advantage.

Based on the survey of Swedish manufacturing firms, Ax et al. (2008) show that the adoption of target costing is positively correlated with competition intensity. However, target costing is negatively correlated with perceived environmental uncertainty.

Regarding risk management, numerous papers study the impact of hedging on the value of the company. Although there are a few authors that found that hedging does not add value to company (Jin and Jorion, 2006; Lookman, 2003), the majority of studies show that hedging significantly increases company's value: Bartram et al. (2011), Carter et al. (2006), Graham and Rogers (2002), Allayannis and Weston (2001). The main theoretical rationales for corporate risk management in literature are the agent conflicts between shareholders and debtholders or managers, the costs of financial distress and tax reductions.

The purpose of the paper is to examine the impact of using risk management techniques through financial derivatives on the target costing objectives achievement. The paper is organized as follows: the first section briefly presents the main findings in the areas of target costing and risk management, in the second section is presented the examined case and the methodology. Further, the results and the conclusions of the study are given.

Methodology. The target cost is the result of subtracting the desired profit (Π) from the market-driven price (P).

$$TC = P - \Pi \qquad (2)$$

But also, cost can be represented as the function of the price of raw materials used (RM), the price of services purchased (S), the labor cost (L), the depreciation of fixed assets used (D), different taxes (T) and the exchange rate in the case that some costs are expressed in a foreign currency ($FXrate$).

$$C = f(RM, S, L, D, T, FXrate) \quad (3)$$

In this paper we examine the case of a Romanian importer that is exposed to the evolution of the EUR/RON exchange rate. Assuming that the rest of costs expressed in RON are already fixed and the price of raw materials imported is also fixed in EUR terms, the only financial variable that generates uncertainty in achieving the target cost is exchange rate. Another assumption is that foreign exchange will be made at the prevailing rate in 3 months (i.e., the maturity is in 3 months). The amount of EUR that should be paid at maturity is already known, but the amount in RON necessary to acquire those EUR is unknown, subject to the future prevailing EUR/RON rate, thus generating financial risk for a company. For simplifying reasons, we assume that the maximum EUR/RON exchange rate that allows achieving the target cost is 4,6000.

The solution examined here to mitigate the FX risk is the risk reversal, a structure that consists in trading a CALL and a PUT option, with different strikes.

The keystone in options pricing theory is the partial differential equation (PDE) developed by Black and Scholes (1973) and Merton (1973). The PDE describes the price of the option over time and it is constructed on the idea that a trader can perfectly hedge the option by selling and buying the underlying in the proper manner.

$$\frac{\partial V}{\partial t} + \frac{1}{2} \times \sigma^2 S^2 \times \frac{\partial^2 V}{\partial S^2} + r \times S \times \frac{\partial V}{\partial S} - rV = 0, \quad (4)$$

where V is the value of the option, S is the price of the underlying, σ is the volatility of the underlying, assumed to be constant and r is the risk-free rate.

The Black-Scholes-Merton model is used to price a stock that does not pay dividends. The Garman and Kohlhagen (1983) model is derived from the BSM model by solving the PDE and is used to price options on stocks paying continuous yield dividends and options on foreign exchange rates. According to Garman and Kohlhagen (1983) model, the values of the CALL and PUT options are given by the following formulas:

$$C = e^{-r_f \Delta t} \times S \times \Phi_{(d_1)} - e^{-r_d \Delta t} \times K \times \Phi_{(d_2)}, \quad (5)$$

$$P = e^{-r_d \Delta t} \times K \times \Phi_{(-d_2)} - e^{-r_f \Delta t} \times S \times \Phi_{(-d_1)}, \quad (6)$$

where C is the price of the CALL option, P is the price of the PUT option, Φ is the normal cumulative function of the standard normal distribution, S is the price of the underlying, K is the exercise price (strike), r is the risk-free rate, Δt is the time to maturity, r_f is the risk-free rate of the foreign currency, r_d is the risk-free rate of the domestic currency and d_1 and d_2 are given by the following relations:

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + \left(r_d - r_f + \frac{\sigma^2}{2}\right) \times \Delta t}{\sigma\sqrt{\Delta t}} \quad (7)$$

$$d_2 = d_1 - \sigma\sqrt{\Delta t} \quad (8)$$

Based on the above formulas, the call-put parity relation can be derived:

$$P = e^{-r_d \Delta t} \times K - e^{-r_f \Delta t} \times S + C \quad (9)$$

The normal cumulative function of the standard normal distribution has the following form:

$$\Phi_{(x)} = \frac{1}{\sqrt{2\Pi}} \times \int_{-\infty}^{x} e^{-\frac{z^2}{2}} \times dz \qquad (10)$$

The risk reversal strategy consists in simultaneously trading of a CALL and a PUT option. The paper examines the case of an importer, buyer of EUR, in order to construct the risk reversal strategy, the hedger has to sell a PUT option and simultaneously buy a CALL option. Accordingly, the price of the risk reversal is equal with the difference between the price of the sold PUT option (P) and the price of the bought CALL option (C). In this case, a positive value of the risk reversal will mean that the hedger receives money for entering into the strategy, while a negative value would mean that the hedger has to pay in order to trade risk reversal.

$$RR = P - C \qquad (11)$$

After replacing the prices of the CALL and PUT options with the above mentioned relations, the value of the risk reversal strategy can be also written as:

$$RR = e^{-rd\Delta t} \times \left(K_p \times \Phi_{(-d_2p)} + K_c \times \Phi_{(d_2c)}\right) - e^{-rf\Delta t} \times \left(S \times \Phi_{(-d1p)} + S \times \Phi_{(d_1c)}\right), \qquad (12)$$

where K_c and K_p represent the CALL option strike and the PUT option strike respectively, and $K_c > K_p$.

From the theoretical point of view, there can be constructed an infinite number of risk reversal strategies, by varying CALL and PUT strikes (K_c and K_p). In practice, however, just some possibilities are liquid. The most liquid risk reversal strategy is the 25Δ risk reversal, that consists from buying a CALL with a delta equal with 0.25 (25ΔCALL) and selling a PUT with delta equal with -0.25 (25ΔPUT). Delta represents the first derivative of the options' price in respect with spot (underlying price). The values of the delta of the CALL option (Δ_c), respective the delta of the PUT option (Δ_p) are given by the following equations:

$$\Delta_c = e^{-r_f \Delta t} \times \Phi_{(d_1c)}, \qquad (13)$$

$$\Delta_p = -e^{-r_f \Delta t} \times \Phi_{(-d_1p)} \qquad (14)$$

Based on the values of CALL and PUT deltas, time to maturity, respective on the market values regarding underlying price, domestic and foreign interest rates and volatility, there can be derived the formulas for the strikes of the CALL, respective of the PUT option.

$$K_c = e^{\ln S + \left(r_d - r_f + \frac{\sigma^2}{2}\right) \times \Delta t - \Phi^{-1}_{\left(\Delta c \times e^{r_f \Delta t}\right)} \times \sigma \sqrt{\Delta t}} \qquad (15)$$

$$K_p = e^{\ln S + \left(r_d - r_f + \frac{\sigma^2}{2}\right) \times \Delta t - \Phi^{-1}_{\left(\Delta p \times e^{r_f \Delta t}\right)} \times \sigma \sqrt{\Delta t}} \qquad (16)$$

In respect with the volatility, we used the same assumption of the Garman and Kohlhagen (1983) model, regarding the fact that volatility is constant. In this case, we considered the same volatility for both strikes.

In order to estimate the volatility necessary to compute the options' strikes and premiums, we used a database consisting of the EUR/RON fixing rates published by the National Bank of Romania during the period 04.01.2010–31.12.2012 (764 observations). Also, as an estimation of the domestic interest rate, we used the Romanian Interbank Offer Rate ROBOR 3M (6,05%) and as an estimation of foreign interest rate, we used the Euro Interbank Offer Rate EURIBOR 3M (0,187%), both published on 31.12.2012. Also, the EUR/RON spot used in calculations was the fixing published on 31.12.2012 (4,4287).

Given the fact that the Garman and Kohlhagen (1983) model uses annualized volatility, we had to annualize the standard deviation of daily logarithmic returns of the EUR/RON exchange rate, using the formula:

$$\sigma = \frac{\sigma SD}{\sqrt{P}}, \quad (17)$$

where σ is the annualized volatility of the EUR/RON exchange rate, σSD is the standard deviation of daily logarithmic returns of the EUR/RON exchange rate and P is the time period of returns, expressed in years. In our case, considering 252 business days in a year, P is equal to 1/252.

After computing the strikes of the risk reversal strategy and the premiums of options, we valued the probability that the exchange rate at maturity would be over the critical level for achieving the target cost in the absence of hedging. Given our assumptions stated above, this critical EUR/RON rate is 4,6000. We also observed the impact of hedging on this probability. In order to compute for this probability, the following formula was used:

$$P(X > x) = 1 - \Phi(x), \quad (18)$$

where Φ is the normal cumulative distribution function. In this case, the mean of the normal function is the market forward exchange rate and the standard deviation is computed based on historical market rates. Specifically, this standard deviation was calculated as the standard deviation of the 3 months logarithmic returns, multiplied with the spot rate. The forward exchange rate is given by the following formula:

$$F = S \times e^{(r_d - r_f)\Delta t} \quad (19)$$

Results. In applying the above methodology, the first step consisted in estimating the annualized volatility of the exchange rate in our sample. The outcome was an estimated volatility of 4,45% for the EUR/RON exchange rate over the sample period (04.01.2010–31.12.2012). This result was used as an input in order to compute the strikes of the 25ΔCALL and 25ΔPUT options that create the risk reversal strategy. We obtained a strike for the CALL option equal with 4,5615 RON/EUR and a PUT strike of 4,4283 RON/EUR. From the economic perspective, by trading this risk reversal, the hedger is protected against FX rate rising above 4.5615 at maturity by giving up the upside of FX rate falling below 4,4283 at maturity. Consequently, one can argue that if the exchange rate at maturity (3 months in our case) is above 4,5615, the hedger will buy EUR against RON at 4,5615, if the exchange rate at maturity is between 4,4283 and 4,5615 the hedger will buy EUR against RON at the prevailing market rate (because neither of the options would be exercised) and if the exchange rate at maturity is below 4,4283, the hedger will buy EUR against RON at 4,4283.

The next step consisted in valuing the two options by applying the Garman and Kohlhagen (1983) model. We obtained the same value for both options: 0.0149 RON/EUR. Consequently, the risk reversal strategy constructed in this particular case has the value equal with zero (it is the zero-cost strategy). The equality in the two options' prices can be explained by the fact that we estimated and used the same volatility for both options (both strikes). The model assumptions set a constant volatility, independent of maturity and strike, and also consider a normal distribution of returns, with no skew. However, the market practice relaxes these assumptions, allowing the use of different volatilities for different maturities and strikes. Analyzing the impact of considering a skew in the distribution of returns on the volatility and options prices can be a point for future research.

After computing the strikes of the risk reversal strategy and the premiums of options, we valued the probability that the exchange rate at maturity would be over the critical level for achieving the target cost in the absence of hedging. That is, we computed the probability that EUR/RON exchange rate will be above 4.6000 at maturity as an estimation of the risk that the company faces in achieving its target cost. Based on the historical dataset used, this probability is 14.61%, meaning there are 14.61% chances that the company will not achieve its target cost as a result of the foreign exchange risk in the case that it does not hedge. In order to obtain the probability, we first computed the 3 months forward rate (4.4941) and the 3 months standard deviation (0.1005). Taking into consideration that the strike of the CALL option in the risk reversal strategy is 4.5615, lower than the critical value of 4.6000, through hedging the company would completely eliminate the risk that will not achieve its target cost as a result of rising foreign exchange rate.

Also, the probability that EUR/RON exchange rate at maturity will be above 4.5615 is 25.13%. In other words, the company would eliminate 25.13% of its downside risk through this hedging strategy. Because the CALL premium is equal to the PUT premium, the company will not have to pay anything for risk reversal, but an opportunity cost still exists. By selling the PUT option, the hedger gives up to the upside of exchange rate falling below 4.4283 at maturity. Based on the historical data, the probability that the exchange rate would be under 4.4283 is 25.64%. Consequently, as a result of hedging with risk reversal, a company would eliminate 50.77% of possible outcome, thus reducing the volatility of its future cash-flows.

Conclusions. In order to achieve the desired results, an increasing number of companies around the world have adopted target costing as a strategic managerial tool.

The purpose of the paper is to examine the impact of using risk management techniques through financial derivatives on the target costing objectives achievement. Specifically, the paper examines the case of a Romanian importer exposed to the evolution of the EUR/RON exchange rate and hedges through a risk reversal strategy.

The risk reversal strategy is a structure that consists in trading a CALL and a PUT option, with different strikes. For valuing the options we used the Garman and Kohlhagen (1983) model. In the case of a constant volatility assumption, the prices of a CALL and a PUT option having the same delta is the same. We show, in the particularly studied case, that hedging through a risk reversal strategy reduces entirely the risk of having costs higher than the target cost. Also, hedging through the 25Δ risk reversal reduces the volatility of futures cashflows with approximately 50%.

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References:

Allayannis, G., Weston, J. P. (2001). The use of foreign currency derivatives and firm market value. Review of Financial Studies,14: 243–276.

Ansari, S., Bell, J., CAM-I Target Cost Group (1997). Target costing: the next frontier in strategic cost management. NY: Irwin-McGraw Hill.

Ansari, S., Bell, J., Okano, H. (2007). Target Costing: Uncharted Research Territory. Handbook of Management Accounting Research, 2: 507–508.

Ax, C., Greve, J., Nilsson, U. (2008). The impact of competition and uncertainty on the adoption of target costing. International Journal of Production Economics, 115(1): 92–103.

Baker, W. M. (1995). The missing element in cost management: competitive target costing. Industrial Management, 37(2): 29–33.

Bartram, S. M., Brown, G. W., Conrad, J. (2011). The effects of derivatives on firm risk and value. Journal of Financial and Quantitative Analysis, 46(4): 967–999.

Black, F., Scholes, M. S. (1973). The pricing of options and corporate liabilities. Journal of Political Economy, 81: 637–654.

Butscher, S. A., Laker, M. (2000). Market driven product development. Marketing Management, 9(2): 48–53.

Carter, D. A., Rogers, D., Simkins, B. J. (2006). Does hedging affect firm value? Evidence from the US airline industry. Financial Management, 35: 53–87.

Gagne, M. L., Discenza, R. (1995). Target costing. The Journal of Business and Industrial Marketing, 10: 16–18.

Garman, M. B., Kohlhagen, S. W. (1983). Foreign currency option values. Journal of International Money and Finance, 2: 231–237.

Graham, J. R., Rogers D. A. (2002). Is corporate hedging consistent with value maximization? An empirical analysis. Journal of Finance, 57: 815–840.

Gupta, M., Galloway, K. (2003). Activity-based costing/management and its implications for operations management. Technovation, 23: 131–138.

Jackson, A. (2003). The diffusion of accounting practices in the new managerial public sector. International Journal of Public Sector Management, 16(5): 359–372.

Jin, Y., Jorion, P. (2006). Firm value and hedging: Evidence from U.S. oil and gas producers. Journal of Finance, 61: 893–919.

Kee, R. (2010). The sufficiency of target costing for evaluating production-related decisions. International Journal of Production Economics, 126(2): 204–211.

Lookman, A. (2003). Does hedging really affect firm value? Working Paper, Carnegie Mellon University.

Merton, R. C. (1973). Theory of rational option pricing. Bell Journal of Economics and Management Science, 4(1): 141–183.

Woods, M., Taylor, L., Fang, G.C.G. (2012). Electronics: A case study of economic value added in target costing. Management Accounting Research, 23(4): 261–277.

Yazdifar, H., Askarany, D. (2012). A comparative study of the adoption and implementation of target costing in the UK, Australia and New Zealand. International Journal of Production Economics, 135: 382–392.

Zengin, Y., Ada, E. (2010). Cost management through product design: target costing approach. International Journal of Production Research, 48(19): 5593–5611.

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