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**Decision-making Process
and Automatization
in Corporate Governance**

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Decision-making Process and Automatization in Corporate Governance

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Summary:

The relationship between the managers and shareholders of a firm is one of the most important issues in corporate governance. Managers must make a lot of decisions every day. Some of these decisions are very subjective and depend on the individual skill, knowledge and expectations of the managers. Last, but not least, the individual interests of the managers play an important role in the decision-making process as well. Especially in the more technical areas, such as financial management, it is very difficult for the shareholders to control the managers' day to day decisions. Thus, automation of the decision-making process may be one good solution. This paper proposes the simulation of such decision-making processes in managing exchange rate risk, where the subjective decisions of financial managers are replaced by automatic actions based on clearly predefined hedging strategies, and fully computerized exchange rate forecasting.

Keywords: corporate governance, hedging, exchange rate forecasting

Automatizace rozhodovacích procesů v řízení firem

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Abstrakt:

Jedním z ústředních problémů korporátní governance je sladění individuálních zájmů vlastníků a manažérů firem. Zejména v technicky náročnějších oblastech firemního řízení mají manažéři mnohdy značnou informační převahu nad akcionáři, což v konečných důsledcích může vést až k jednání managementu, jež je v rozporu se základními cíly vlastníků. Předkládaná studie zkoumá na bázi simulační analýzy možnosti využití automatizace rozhodovacích procesů a uplatnění strojového učení v praxi řízení kurzového rizika. Navržený algoritmus eliminuje subjektivní stránku řízení rizika a nahrazuje ji předem jasně definovanou strategií uplatňovanou zcela automaticky.

Klíčová slova: teorie zastoupení, kurzové riziko, predikce měnového kurzu

JEL: G32, O16

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Introduction

Corporate governance may be defined “*as the relationship between the different stakeholders used to determine and control the strategic direction and performance of an organization*” (Eiteman et al., 2004: 7). Managers must make a lot of decisions every day. Some of these decisions are very subjective and depend on the individual skill, knowledge and expectations of the managers. Last, but not least, the individual interests of the managers are play an important role in the decision making process as well. However, sometimes the interests of managers do not agree with those of the shareholders.

Managing exchange rate exposures is a good example. Financial managers may reduce the variability of cash flows by hedging open positions in foreign currencies. This improves the planning capability of the firm and reduces the likelihood that the firm’s cash flow will fall below the necessary minimum. However, according to the agency theory, management often conducts hedging activities at the expense of the shareholders, because management is usually more risk averse than shareholders. Furthermore, foreign exchange losses are a highly visible item in the income statement, whereas the hedging costs are hidden within operating or interest expenses. Thus, managers may prefer hedging even if the costs of protection are higher than the expected foreign exchange loss. Since the expected loss on the open position depends on the individual expectations of the financial managers, the shareholders are not able to check whether the management acts in the shareholder’s best interests, or not.

Automation of the decision-making process could be a good solution to this problem. Management and shareholders may together define the hedging strategy that coincides with corporate wealth maximization. The strategy may consist of different hedging instruments that are used according to predictions based on the machine learning methods. Thus, individual predictions and decisions are replaced by automatic actions. The following text contains a simulation of such decision-making process.

1. Financial flows and transaction exposure

Simulation was based on the cash flow of a virtual firm and real market data and prices in the years 2005-2006. The firm sold merchandise on open account for €400,000 each month. The payment was always made in 1 month. The firm was exposed to the exchange rate transaction risk arising from the risk that Euro would weaken and the seller would receive less Czech Crowns.

2. Hedging portfolio

Hedging portfolio consisted of 5 instruments – forward contract, plain vanilla option, the option strategy “Vertical Spread” and the option strategy “Ration Forward”.

2.1 Forward contract

“Forward contract specifies the amount of a particular currency that will be purchased or sold at a predetermined point in the future” (Madura, 2006: 62). Thus, if the aim is to hedge receivables in a foreign currency the corporation may close the position by selling the specific amount of foreign currency on the forward market.

If the virtual firm sells €400,000 on the one-month forward market, the exchange rate at which the corporation will effectively sell €400,000 is locked, and equals the forward bid rate. In the simulation, forward rates were derived from the covered interest rate parity condition using LIBOR (London Interbank Offered Rate) and PRIBOR (Prague Interbank Offered Rate) as the reference interest rates.¹

2.2 Plain vanilla option

The virtual firm may also close the position by buying a put option, which gives the right to sell \$400,000 at a predetermined strike price. Since the option gives only the right, and not the obligation, to sell a given amount of foreign currency at a predetermined strike price, the company has to pay the option premium to the bank.

Assume the strike price is CZK 27.700 per Euro, and the forward rate equals CZK 28.000 per Euro.² The premium required by the bank is CZK 0.200 per Euro. Well, if the future spot rate at the expiration day lies above CZK 27.700 per Euro, the corporation will let the option expire and sell €400,000 at the prevailing spot rate. However, since the corporation has already paid the option premium, it will effectively sell €400,000 at CZK 0.200 per Euro cheaper in comparison with the future spot market conditions. Nonetheless, the maximum amount to be received for €400,000 is theoretically unlimited.

On the other hand, if the future spot rate on the expiry day is less than CZK 27.700 per Euro, the corporation will exercise the option, and sell €400,000 for CZK 11,080,000. Then, we shall deduct the paid option premium; i.e., CZK 80,000. Thus, the corporation will sell €400,000 at the effective exchange rate of

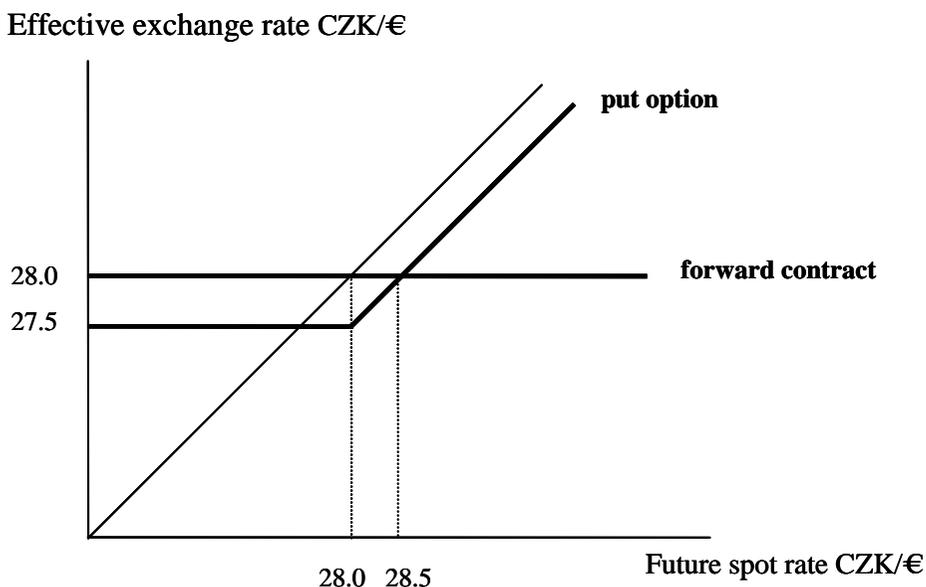
¹ For more details see Taušer (2007: 46-54).

² In the simulation, strike prices of all put options were always set about 1% below forward rate in order to reduce the option premium.

CZK 27.500 per Euro. It is also the worst possible effective exchange rate for the virtual company.

The contingency graph below compares the effective exchange rates at which the corporation will sell €400,000 if it buys the put option, or alternatively, the forward contract.

Fig. 1: Comparing the plain vanilla option and forward contract



Source: Author.

2.3 Option strategy “Vertical Spread”

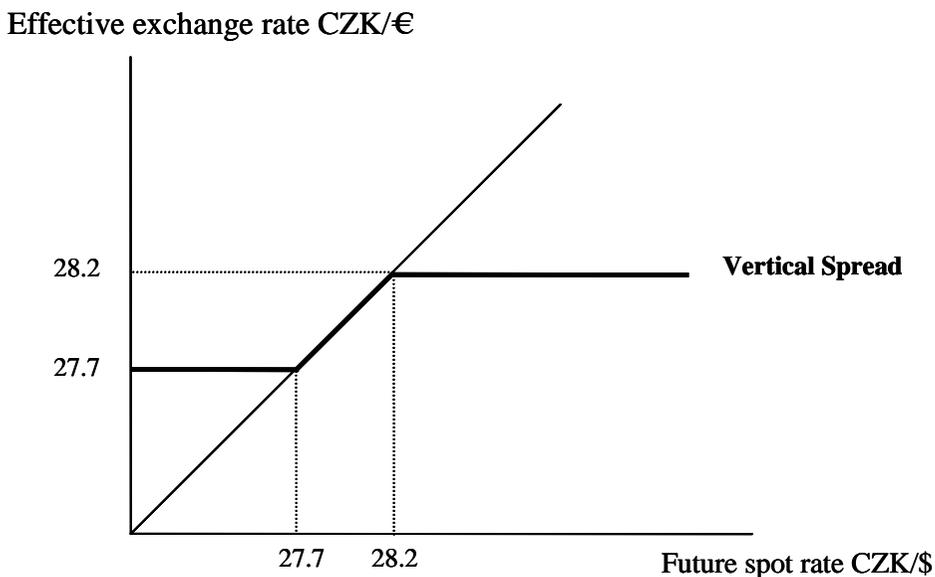
Option strategies generally represent a mixture of different option positions. The most popular ones are the so called “zero costs strategies” that represent mix of two or more option positions with the same amount of paid and received option premiums.

The so called “Vertical Spread” strategy consists of two basic option positions with the same amount of underlying currency and with different strikes. If the aim is to hedge the receivables, the corporation buys one put option, which gives it the right to sell a specific currency at a predetermined strike price within a specific period of time, and simultaneously it sells a call option, which grants the right to the bank to buy the same amount of foreign currency within the same period of time. Both options have different strikes, but, the same option premiums. The corporation sets a strike price of the put option and the bank calculates the strike price of the call option, both option premiums being equal.

Assume that the virtual corporation sets the strike price of the put option, which is, for example, CZK 27.700 per Euro. It is the worst acceptable exchange rate for the firm. The bank calculates the strike of the call option which is, for example, CZK 28.200 per Euro. The option premiums are the same. Thus, the company doesn't have to pay anything at the beginning.

So, if the future spot rate on the expiry day is above CZK 28.200 per Euro, the bank will exercise the currency call option and the company will let the put option expire. Thus, the corporation will effectively sell €400,000 for CZK 11,280,000. If the future spot rate on the expiry day lies between CZK 28.200 and CZK 27.700 per Euro, the bank and the corporation will let the options expire and the company will sell €400,000 at the prevailing spot rate. Finally, if the future spot rate on the expiry day is less than CZK 27.700 per Euro, the bank will let the currency call option expire and the company will exercise the put option, which means that the corporation will effectively sell €400,000 for CZK 11,080,000. To sum up, the company will effectively sell €400,000 for CZK 11,080,000 in the worst-case scenario and for CZK 21,280,000 in the best-case scenario. The contingency graph below illustrates the exchange rate at which the corporation will effectively sell €400,000.

Fig: 2: Hedging with “Vertical Spread”



Source: Author.

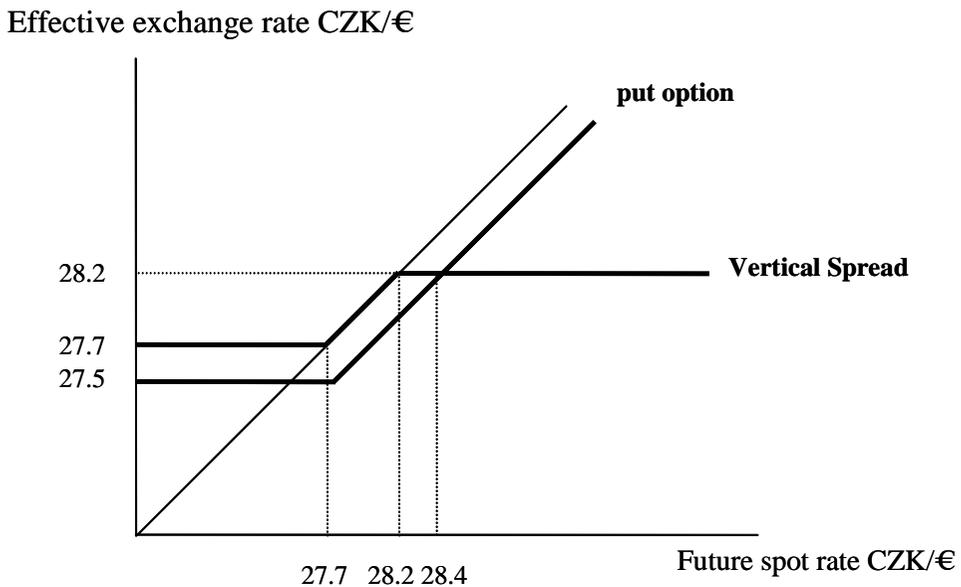
If the corporation uses the “Vertical Spread” strategy, the minimum amount to be received for €400,000 is CZK 11,080,000 in this case. The maximum sum is, however, also limited, which is the great difference between the “Vertical Spread” strategy and the plain vanilla option.

If the future spot rate is less than CZK 28.400 per Euro, the “Vertical Spread” strategy will be more favourable. However, if the future spot rate lies above CZK 28.400 per Euro, the plain vanilla put option will be more profitable.

Thus, the strategy allows hedging at a better exchange rate and the firm doesn’t have to pay anything at the beginning. But on the other hand, the strategy doesn’t provide the possibility of participating in positive exchange rate fluctuations to the same extent as the plain vanilla put option does.

The contingency graph below compares the effective exchange rates at which the corporation will sell €400,000 if it uses the “Vertical Spread” strategy, or alternatively, the plain vanilla put option, with the characteristics described in the paragraph focusing on hedging with the plain vanilla option.

Fig. 3: Hedging with the “Vertical Spread” and the plain vanilla option



Source: Author.

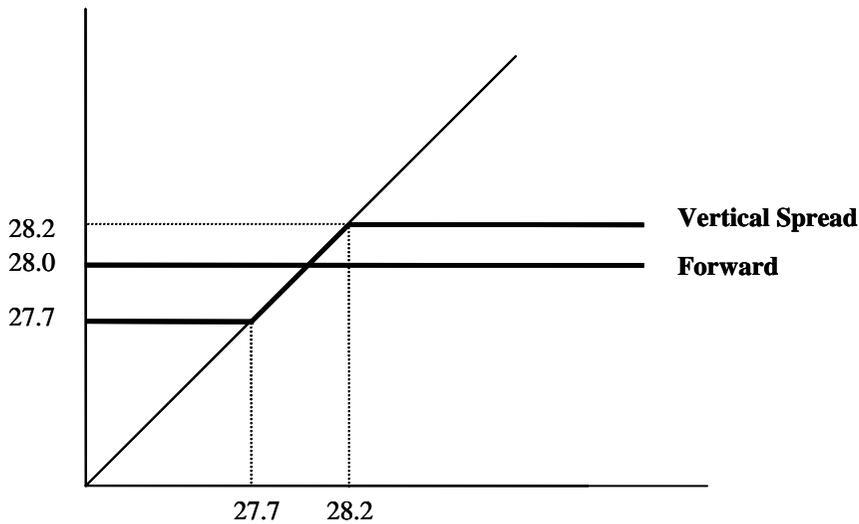
Last but not least, we shall compare the strategy with simple forward contract. Assume that the forward bid rate is CZK 28.000 per Euro. Then, if the firm uses the forward market, the effective exchange rate, at which the corporation will sell €400,000, equals CZK 28.000 per Euro. Thus, if the future spot rate is less than CZK 28.000 per Euro, the forward contract will be more favorable. Whereas if the future spot rate lies above CZK 28.000 per Euro, the option strategy will provide better financial results.

If the firm uses the option strategy, the amount to be paid for €400,000 may be less, but also more than CZK 11,200,000. It is quite a natural trade off. The “Vertical Spread” strategy consists of two options, whereas the corporation sets

a strike price of the put option and the bank calculates the strike price of the call option both option premiums being equal. The bank calculates the higher strike price of the call option, the lower strike price of the put option is set by the corporation (other things being equal). Thus, if the company accepts a relatively lower minimum amount to be received for €400,000, it simultaneously creates the opportunity to receive significantly more if the market conditions are positive.

Fig. 4: Hedging with “Vertical Spread” and with forward

Effective exchange rate CZK/€



Source: Author.

2.4 Option strategy “Ratio Forward”

The “Ratio Forward” option strategy represents a combination of two basic option positions. In this case corporation buys a put option and simultaneously sells a call option with different strikes and different amounts of underlying currency.

Thus, the virtual firm buys a put option that gives the right to sell €400,000 at some point in the future, and sets the strike price that is, for example, CZK 27.700 per Euro. At the same time the firm sells a call option, which grants the right to the bank to buy, for instance, €600,000 at some point in the future. The bank calculates the strike price of the put option so that the option premiums are the same. Since the amount of underlying currency of the put option is smaller than the amount of underlying currency of the call option, the strike price of the call option shall be greater in comparison with the “Vertical Spread” strategy. Let’s say the strike price of call option is CZK 28.400 per Euro.

Then, if the future spot rate on the expiry day is less than CZK 27.700 per Euro, the firm will exercise the currency put option and the bank will let the call option expire. The corporation will sell €400,000 for CZK 11,080,000.

Furthermore, if the future spot rate on the expiry day lies between CZK 27.700 and CZK 28.400 per Euro, the bank and the corporation will let the options expire. In this case, the company will sell €400,000 at the prevailing spot rate.

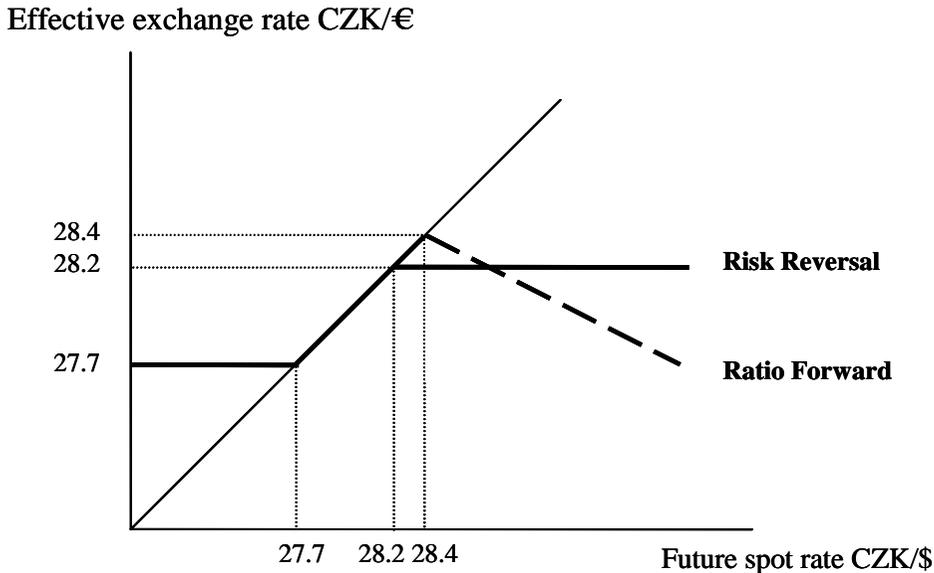
Finally, if the future spot rate on the expiry day is more than CZK 28.400 per Euro, the firm will let the currency put option expire and the bank will exercise the call option. Thus, the corporation will have to sell €600,000 for CZK 17,040,000. The receivables of the company are, however, only €400,000, which means that the company will have to buy €200,000 at the prevailing spot rate.

To sum up, if the future spot rate is less than CZK 27.700 per Euro, the corporation will effectively sell €400,000 for CZK 11,080,000. Within the rates of CZK 27.700 and CZK 28.400 per Euro, the corporation will sell €400,000 at the prevailing spot rate. If the spot rate is more than CZK 28.400, the corporation will sell €400,000 for CZK 11,360,000. The corporation will then buy €200,000 at the prevailing spot rate and sell for CZK 5,680,000. Total revenues from the transaction depend on the future spot rate. The company will receive CZK 11,360,000, minus the difference between the future spot rate and strike price of the put option multiplied by 200,000.

The corporation may use that strategy if it generally expects a depreciation of the domestic currency, but small fluctuations due to the intervention of central banks are possible as well. The strategy provides hedging against the appreciation of the domestic currency at CZK 27.700 per Euro and simultaneously enables participation in the slight depreciation of the domestic currency. If the depreciation is, however, too strong, the revenues will start to fall.

The strategy is to some extent similar to the "Vertical Spread" strategy. The receivables are hedged against the appreciation of the domestic currency. However, since the underlying amount of the call option is greater within the "Ratio Forward" strategy, the strike price of the call option is higher. The corporation can participate in the depreciation of the domestic currency to a larger extent. On the other hand, if the depreciation is too strong, the "Ratio Forward" strategy becomes less convenient.

Fig. 5: Comparing “Ratio Forward” and “Vertical Spread”



Source: Author.

3. Predictions and hedging strategy

In the simulation, forward rates were derived from the covered interest rate parity condition. Strike prices of the call options were set about 1% below the forward rates, and the strike prices of the put options were calculated by the bank.

As for the exchange rate forecasting two machine learning methods – the enhanced Group Method of Data Handling (GMDH) and the back propagation Neural Network were employed. The relevant algorithms were created by Buryan (2007) in MATLAB.

There were two main reasons for using machine learning methods for exchange rate forecasting. Firstly, although machine learning provides highly sophisticated non-linear modelling of exchange rate behaviour, financial managers can easily use these models on the “black box” principle. Therefore, as soon as an expert creates the model, it is relatively easy to use.

Secondly, the machine learning models provide short-term predictions of concrete values. This was very important for our decision-making process simulation, because managers of virtual firms could use the predictions not only as recommendations whether to hedge or not, but they could use the forecasts

also as instructions on which instrument to use. Thus, the process of hedging was fully automated.³

The hedging strategy was defined as follows:

If the predicted exchange rate is lower than the forward rate, the virtual firm sells €400,000 on the forward market.

If the predicted exchange rate lies between the forward rate and the strike price of the call option within the “Vertical Spread” strategy, the virtual firm uses the “Vertical Spread” strategy.

If the predicted exchange rate lies between the strike price of the call option within the “Vertical Spread” strategy and the strike price of the call option within the “Ratio Forward” strategy, the virtual firm uses the “Ratio Forward” strategy.

If the predicted exchange rate is higher than the strike price of the call option within the “Ratio Forward”, but lower than this strike price plus two thirds of the paid plain vanilla put option premium, including relevant interest⁴, the virtual firm stays with the “Ratio Forward” strategy.

If the predicted exchange rate is higher than the strike price of the call option within the “Ratio Forward,” plus, two thirds of the paid plain vanilla put option premium including relevant interest, then, the virtual firm buys the plain vanilla put option.

The last rule can be formally derived as follows:

$$S - P \cdot (1 + i) > X - (S - X) \cdot 0,5$$

So that $1,5 \cdot S > 1,5 \cdot X + P \cdot (1 + i)$

And finally $S - X > \frac{2}{3} P \cdot (1 + i)$

S ... spot exchange rate on the expiry day;

P ... put option premium;

X ... call option strike price;

i ... reference interest rate on a monthly basis.

³ For a detailed theoretical exposition of applied machine learning models, see: Buryan (2007).

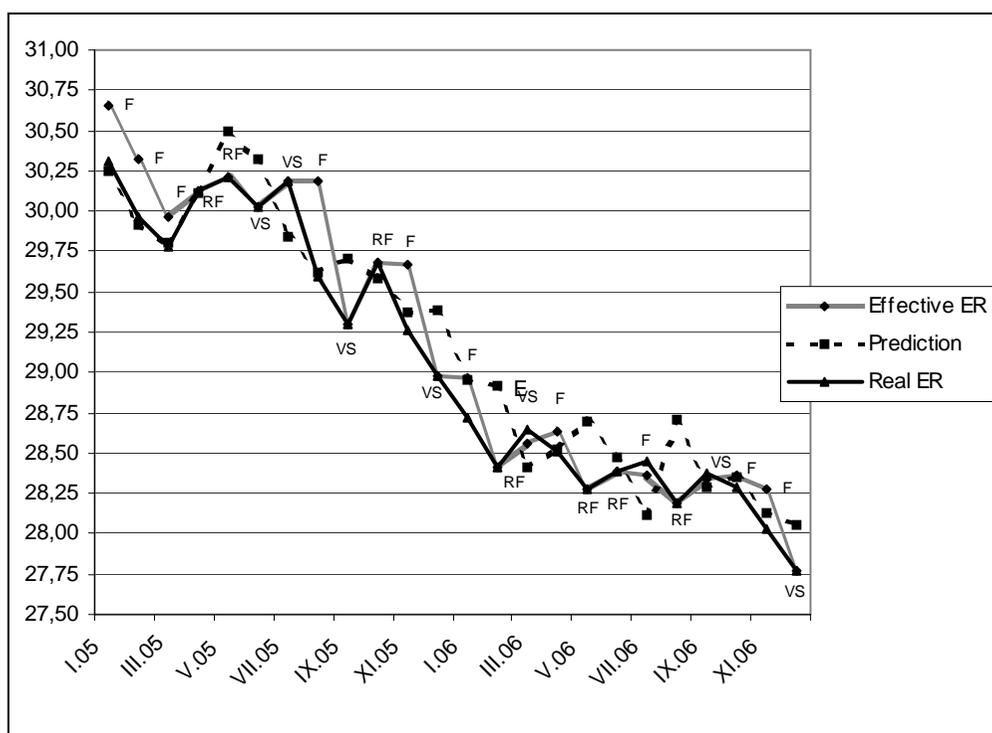
⁴ In the Czech Republic the option premiums are usually paid at the beginning of the option contracts. Thus, we have to calculate the interest for the period between the forming of the contract and the expiry day.

4. Results

In the simulation, the financial managers of the virtual firm hedged the receivables of €400,000 each month during the years 2005-2006. In total, 24 decisions were made. Hedging procedure was quite automatic, because all decisions were made with respect to the predefined strategy and the relevant exchange rate forecasts were based on machine learning models.

Graph 6 illustrates the hedging process. Three different exchange rates are plotted in the graph – the ex-ante predicted exchange rate, the real exchange rate and the effective exchange rate achieved through the hedging strategy. It is also noticeable which instrument was used in each month – forward (F), “Vertical Spread” strategy (VS) and “Ratio Forward” strategy (RF).

Fig. 6: Hedging process



Source: Author and Buryan (2007).

In total, the forward was used ten times. In seven cases, the open position was hedged with the “Vertical Spread” strategy. The “Ratio Forward” strategy was applied seven times as well. The plain vanilla put option wasn’t used at any time. In comparison with no hedging, the revenues of the virtual firm were higher by about CZK 939, 896. Thus, the hedging process was quite successful.

Conclusion

Managing exchange rate risk is a highly sophisticated process. Financial managers must usually make many decisions based on subjective expectations. However, according to the agency theory, managers often conduct hedging activities at the expense of the shareholders, because they are usually more risk averse than shareholders. Furthermore, foreign exchange losses are a highly visible item in the income statement, whereas the hedging costs are hidden in operating or interest expenses. Thus, managers may prefer hedging even if the costs of protection are higher than the expected foreign exchange loss.

Shareholders are not able to check whether the management acts in the shareholders' best interests, when hedging, or not, because they are not able to evaluate the managers expectations.

The decision-making process could be automated in order to replace the subjective decisions of the managers by automatic actions based on clearly predefined hedging strategies and fully computerized exchange rate forecasting. In simulation of such decision-making process we defined a hedging strategy that consisted of 4 different hedging instruments – forward, plain vanilla option, “Vertical Spread” strategy and “Ratio Forward” strategy. Each instrument was used according to the ex-ante predictions based on two machine learning methods – the enhanced Group Method of Data Handling (GMDH) and the back propagation Neural Network that had been created by an external expert.

The automatic hedging process simulated on the financial flows of the virtual firm, and on the real market data in the years 2005-2006 was quite successful. Financial managers of the virtual firm hedged the receivables of €400,000 each month in the years 2005-2006. In total 24 decisions were made. The hedging procedure was quite automatic, because all decisions were made with respect to the predefined strategy and relevant exchange rate forecasts based on machine learning models.

In total, forward was used ten times. In seven cases, the open position was hedged with the “Vertical Spread” strategy. The “Ratio Forward” strategy was applied seven times as well. The plain vanilla put option wasn't used at any time. In comparison with no hedging, the revenues of the virtual firm were higher by about CZK 939, 896.

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