BUDAPESTI CORVINUS EGYETEM

Doctoral Program in Management and Business Administration

THESIS OUTLINE
of

Barbara Mária Dömötör

Market risk hedging under liquidity constraints

Ph.D. dissertation

Supervisor:

János SZÁZ, CSc
Professor

Budapest, 2014

Department of Finance

THESIS OUTLINE
of

Barbara Mária Dömötör

Market risk hedging under liquidity constraints

Ph.D. dissertation

Supervisor:

János SZÁZ, CSc
Professor

© Dömötör, Barbara Mária

TABLE OF CONTENTS

1. PRELIMINARIES

1.1 The motivation and aim of the dissertation

Following the Financial Crisis that began in 2007, liquidity risk became a centre of interest in financial research, though several notable events of the twentieth century had already proved that inadequate management of liquidity can be a source of serious problems.

In December 1993, a banking consortium saved the German giant company Metallgesellschaft (MG) AG from bankruptcy, as its U.S. subsidiary MG Refining and Marketing reported a $ 1.3 billion loss on derivatives transactions. In September 1998, Long-Term Capital Management (LTCM), one of the most successful hedge fund monsters of the previous years, accumulated a loss of $ 4.6 billion on "arbitrage" transactions.

In both stories the financial difficulties caused by unrealised mark-to-market loss of financial derivatives and hedged positions led to the cut of MG's hedging program and even, in the case of LTCM, to the liquidation of the fund. Both events shocked the financial world, as experts neither inside nor outside those companies envisaged such serious consequences. It cannot be supposed that any of these companies would lack the tools or financial expertise to calculate the risk of the positions, as one of the owners of MG was the largest financial institution of the world, Deutsche Bank, and LTCM was created and led by the stars of Wall Street and two Nobel Laureates in the field.

A similar, but essentially smaller example of the Hungarian market that we can mention is the financial losses of Hungarian exporting companies in 2003 and in the post-crisis period of 2008-2009, which caused many of them financial distress.

In spite of the above examples, only after the financial crisis of 2007 did it become clear that the unlimited financial liquidity assumed in financial theory does not hold in reality. Financial markets dried up as a consequence of the crisis, making not only small investors and enterprises face financial constraints, but also the central participants, the financial institutions.

The rapid development in the global economy and better availability of financial markets have caused economic risks to become increasingly complex in recent decades. The management of financial risks is of primary importance, but as the above examples illustrated, although in theory hedging of market risk through financial derivatives decreases corporate exposure, liquidity risk deriving from the financing need of the derivative position can even lead a corporation to bankruptcy.

Risk management refers to a much wider range of tasks than hedging of certain types of risks, but in this thesis I examine exclusively the management of market risk, taking into account its consequences on the financing possibilities and liquidity of the company. The corporate strategy and the investment decisions are considered to be given. The company is presumed to not have any comparative advantage, either information or position, that would make it value enhancing to assume the risk.

The aim of this research is, on the one hand, to model and integrate the funding liquidity into models of corporate hedging theory; and on the other hand to compare the results of the theoretical model with the practice of corporate risk management that will be analysed in empirical research. The focus is to find and model the factors influencing the financial risk management in theory and practice and to analyse the effect of the financing need of the hedge position on the optimal hedging strategy, the hedging instruments, and the hedge ratio.

The answers to these questions are important not only from a theoretical perspective, but they can assist corporate decision making and even assist financial institutions in corporate analysis and product development.

Furthermore, the topic has relevance for regulators; better understanding of the process and motivation of corporate risk management is of macroeconomic importance and supports the decision-making of the regulating authorities.

1.2 Theoretical background

Risk management – like every economic decision – is optimal if it maximizes expected utility. Hedging of financial risk means acquiring tools and positions that protect against variance in value, so hedging decreases the variability of the possible outcomes.

A description of the risk attitude of individual investors and the formalization of their choices among risky investment possibilities first appeared in the works of Arrow (1970) and Pratt (1964). The value of risk management can be derived from the individual utility function.

The aim of the corporate management is to maximize the shareholders' value, so corporate risk management creates value only if it enhances expected profit and thus also corporate value. Miller and Modigliani (1958, 1963) proved that in a perfect market (no taxes, no transaction costs or information asymmetry), where all market participants have unlimited access to financing at the same price, changing the capital structure of the company in itself does not create value. It can be also shown that under the above assumptions hedging of financial risks does not create value either, as the individual investor can hedge under the same conditions.

In contrast with the above statement, risk management has an important role in corporate management, which can be traced back to both rational and irrational reasons. One direction of the theories describing corporate risk management models the value achieved by corporate hedging. These models explain the value of the hedge through the lack of the Miller-Modigliani assumptions, and the elements of the market imperfection – taxes, transaction costs, information asymmetry, and availability of financing – are analysed. Risk management practice can also be explained by analysing the incentives of the corporate management, but in that case hedging does not necessarily increase corporate value.

Two basic models explaining the value of corporate hedging with limited financing resources are the models of Froot et al. (1993) and Tirole (2006). In both models, corporate production and hedging is described as a two-period decision, presuming that the hedge position creates no cash-flow (except for the predetermined fees) or further risk and that bankruptcy can be avoided at the hedged price. The analysis of Froot et al. (1993) is based on interconnected corporate investment and financial decisions, while Tirole (2006) investigates the problem through agency-based considerations. Both models conclude that the costs or even the unavailability of external financing justify the rationale of hedging, as through hedging a certain level of internal financing resources can be ensured to implement the investments with positive net present value.

Although the analysis of Froot et al. mentions the trade-off between the variability of future cash-flow and the fluctuation of cash in the interim period if the hedging position is to be financed, they do not analyse this problem further.

However, the availability of financing is critical for the hedging position, as well. The maturity of the derivatives used for hedging can be measured in years, and their financing need affects the financing opportunity of the company.

The liquidity risk of the hedging position appears in the 2000's in the theoretical models. In the models detailed in the thesis, the optimization criterion is not the maximization of the expected profit, but the maximization of the (concave) corporate utility function. Although utility function is interpreted for individuals, the corporate utility function is used to incorporate the explicit and implicit costs of financial distresses. Liquidity risk is calculated through the modelling of the margin account, providing that the firm has no or limited financing source in case of a margin call (Deep, 2002). The other way of modelling liquidity risk is based on the financing costs deriving from the credit spread to be paid to collateralize the loss of the position (Korn, 2003).

1.3 Research problems and hypotheses

There are three directions in the research. I build a model to describe the hedging of the risk deriving from the stochastic market price. Based on this model, foreign exchange hedging strategies are analysed through Monte Carlo simulation.

The research also contains empirical analysis that investigates the risk management practice of Hungarian firms. The empirical research focuses on three topics, in which framework the following hypotheses are analysed:

Risk awareness, managed risk types

H1: Risk awareness and the size of the firm are correlated.

H2: Hungarian corporations do not hedge their positions exposed to interest rate risk.

Hedging methods

H3: The hedging ratio of currency risk depends on the direction of the exposure; it is higher for long foreign currency positions (against HUF).

H4: The ratio of options in the hedging of foreign-exchange risk is negligible, but increasing.

H5: The hedging ratio depends on the applied derivative (forward, option).

H6: The foreign-exchange risk is hedged by derivatives in the short term.

Execution of hedging

H7: The increasing volatility of the foreign exchange market increases hedging activity.

H8: Hedging activity increases with the rise of the expected value of the forward hedge position.

Data from three sources is used in the empirical analysis: statistics of foreign exchange market transactions and derivative stocks collected by the National Bank of Hungary (NBH), the time series of the foreign exchange transactions of a Hungarian commercial bank, and the results of a survey.

2. RESEARCH METHODOLOGY

In my own model based on the analysis of Korn (2003), the upper and lower bounds of the optimal hedging are derived, between them the hedging ratio is the function of the actual market prices and corporate specific parameters. This model lifts the assumption used in the literature of zero expected value from the hedging position, so hedging affects not only the variance of profit, and through financing costs its extent, but the expected value of the hedge also has an impact. Furthermore, I analyses the effect of non-static financing costs, where the credit spread is a function of the financing need as well.

The analysis is developed in a multistage simulation model, where the hedge position needs to be financed several times during its lifetime, while the hedging position itself is required for multiple maturities. The optimal hedging ratio based on the expected utility of different hedging strategies is analysed. The funding risk appears in the model not only as the potential cost of the credit spread, but explicit financial constraints of the financing are also built in. The risk factor is the fluctuation of the euro exchange rate against the Hungarian forint, which is simulated in a GARCH(1,1) model. The parameters of the model were calculated from the daily exchange rates for the period between 2006 and 2012. The expected value of the logarithmic change of the FX-rate (y_t) is zero – (1) equation –, the unconditional daily variance is 0.0000731 and the conditional variance (σ_t^2) is described by the (3) equation.

$$y_t = 0 + \varepsilon_t, \qquad \varepsilon_t \approx i.i.d.(0, \sigma_{\varepsilon,t}^2) \tag{1}$$

$$\varepsilon_t = \sigma_t z_t \qquad z_t \approx N(0,1) \tag{2}$$

$$\sigma_t^2 = 0.00000152 + 0.133741\varepsilon_{t-1}^2 + 0.84548\sigma_{t-1}^2 \tag{3}$$

The empirical research data is analysed using multivariate statistical methods. In addition to the descriptive statistics, a linear regression model is also built in order to analyses the aggregated data. In the regression model the dependent variable is the change of the total volume of the forward long and short positions, while the explanatory variables are the changes in the foreign trade positions, the EUR/HUF spot exchange rate, its volatility and the difference of the spot and forward fx-rate (swapdifference).

The empirical research contains a survey that was sent to treasury clients of a Hungarian commercial bank. The firms contacted are the largest companies in Hungary, belonging to the

Hungarian Top 500. All of the bank's active clients were approached, so the sampling method is a form of cluster sampling.

The analysis of the survey data is based on descriptive statistics, and principal component analysis is used to define the size and the risk awareness of the firms. The connection between them is investigated by means of their correlation.