DETERMINANTS OF FX-RISK MANAGEMENT EVIDENCE OF HUNGARY

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ABSTRACT

This paper investigates the motives of FX-risk management based on the changes of forward open positions of Hungarian corporations. We have found that Hungarian companies are significantly more exposed in short EUR forward position, than in EUR long one. Our linear regression model also showed that changing market conditions have an essentially higher impact on the EUR short positions. Our results confirmed that expectations are determining in the risk hedging decisions proving that financial risk management also has a speculative motive.

INTRODUCTION

The management of risks is one of the main tasks of corporate management not only in the theory but also in practice. It is a more and more common opinion (Merton, 2008) that despite the traditional theory that defines the task of risk management in reducing risks to a minimum level, the concept of enterprise risk management (ERM) (Casualty Actuarial Society, 2003) refers to the potential added value of taking certain types of risks.

Based on the classic model of mean-variance optimization, where utility is a positive function of the expected value and a negative one of the variance of the random income at maturity, if the hedging instrument is costless, the optimal hedging ratio (w) depends both on the expected value of the hedging instrument ($E(y)$) (speculative hedge) and the covariance between the underlying asset (x) and the hedging instrument (pure hedge) (Rolfo, 1980).

$$w = \frac{E(y)}{2a\,\mathrm{var}(y)} - \frac{\mathrm{cov}(x,y)}{\mathrm{var}(y)} \qquad (1)$$

where the corporate specific risk aversion is denoted by *a,* while *var* stands for the variance.

For uninformed hedgers, the hedging ratio shall be equal to the second part of the equation, so that the variance of the whole portfolio is minimized (Duffie, 1989).

In practice, non-financial corporations are using derivatives not only for variance reducing purposes. Stulz (1996) explains this fact by showing that some companies may have a comparative advantage in forecasting price movements and bearing financial risk. Consequently, for them, risk management shall not necessarily aim to minimize variance, but it is worth to take risks in those areas where the company has comparative advantages, by ensuring the downside outcomes of significant costs at the required level.

According to Lessard (2008), the "hierarchy theory" of corporate risk management is as follows: the first and most important is to define those activities which the company has comparative advantages in, and risks shall be taken here. The first level of risk management is related to the operation of the company; business strategy and operative management are defined based on them. The management of financial risks means the management of the risks arising / remaining as a result of the strategic decisions.

Contrary to this, Hommel (2003) considers operating flexibility as an alternative to financial risk management, indicating the conditions under which it is worth to apply operative hedging instead of financial risk management at the company.

The available information about the practice of corporate risk management is limited, considering that companies have no recording or reporting obligation in this regard. The explanation of financial statements in the appendices of annual financial reports may contain guidance about the company's financial transactions relating to managing financial risk.

The international literature contains several empirical analyses in connection with corporate hedging, including Tufano (1996), Haushalter (2000), Mian (1996), Josepf and Hewins (1997), based on public databases and data from annual financial reports, or relying on the results of surveys. Dominguez and Tesar (2006) examined aggregate company exposure, Bodnar et al. (1998, 1999) have conducted a survey on the risk management practices of U.S. and German companies.

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In this paper, we aim to capture corporate hedging behavior based on the change of the foreign exchange forward positions.
The structure is the following: first, we introduce the data and the framework of the analysis, and then the results of the linear regression models are presented. Finally, we summarize our findings.

DATA

The most widespread assets of financial hedging are derivative products: options and forwards or futures. As FX market is a typical OTC (over-the-counter, non-exchange) market and the usage of options is marginal in risk management (Bodnar et al, 1998, 1999), we focus on the practice of forward FX-hedge.
The National Bank of Hungary (NBH) provided a database containing the daily aggregate *stocks* of forward transactions of domestic financial institutions with other resident partners (financial sector excluded) in the period between January 2003 and March 2016. The database is based on the reports of domestic banks and it also includes the positions' direction. Positions denoted by "EUR long" are those positions if the resident client of the bank buys the foreign currency for Hungarian Forint (HUF) on forward, and "EUR short" refers to the positions when the client sells the foreign currency. Foreign currencies are not restricted to the EUR, but as the major trading currency is the EUR, we will use it for the sake of simplicity.
"EUR short" forward position can derive either from the hedging activity of exporters or from speculation on the strengthening the forint. On the other hand "EUR long" forward position can serve the purpose of hedging import or speculation.
We could not differentiate the positions according to client type, so the data are based not only on corporate transactions, but retail forward deals as well.
Figure 1 shows the evolvement of the forward positions, it can be seen, that foreign currency short positions are higher than long positions; the currency sold on forward is about the double of forward currency purchases.

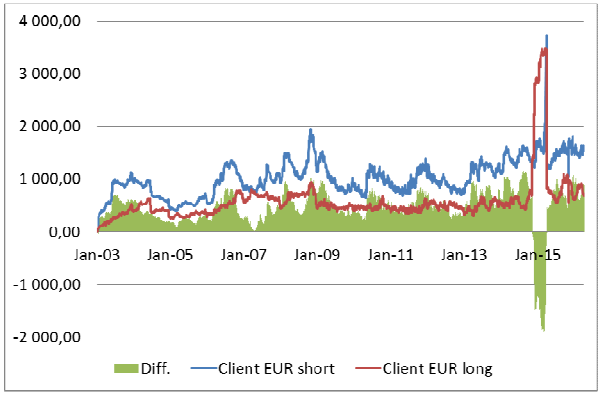

Figure 1: Aggregate open forward positions 2003-2016 (Bn HUF)
Source: the authors based on NBH data

The only exception is the period between November 2014 and March 2015, and it can be caused by the transactions relating to the compulsory conversion of the retail foreign currency loan portfolio.
The higher volume of the forward currency short positions can be explained either by the difference of the trading balance or by speculation.
The profit of a forward speculation is the difference between the forward rate and the spot price at maturity. According to the modern portfolio theory, the expected value of a forward position depends on the systemic risk of the currency. If the correlation between the spot FX-rate and the market prices of other assets is positive, the expected spot rate exceeds the forward price, so long FX-forward positions have positive expected value. If this correlation is negative, the systemic risk is also negative, resulting in a premium of the forward prices, and a positive expected value of forward currency sale (Hull, 2007).
In the studied period, the country risk premium of Hungary was positive, consequently, the expected value of the future spot price was lower than the forward price. The measures of the forward stocks prove the above fact, and that the expected value of the forward position has an important role in the risk management decisions.
In the followings, we investigate the forward positions and through that the corporate risk management behavior in details.

ANALYSIS

For analyzing the factors that influenced the changes of long and short forward positions[1], we built a multivariate linear regression model[2], in which the dependent variable is the monthly percentage change of the positions. Although the database allows for the analysis of daily data, we decided to examine monthly changes instead, due to the unsystematic effects and noises of the daily data. In doing so, we took the first available data of each month and assigned the percentage change to the expiration date. The study period consists of 145 months between January 2004 and March 2016. We decided to omit the data from the first year, 2003, because the data collection started then, and the scope of data collection was unstable in that period.
The open currency position to be hedged mainly derives from the foreign trade turnover, so the first set of explanatory variables is the monthly trading balance (export – import)[3].
As we aimed to capture the speculative motives of the hedge and the risk hedging behavior we included market data among the explanatory variables that can affect the expected value of the hedge and also of the speculative positions. According to market experience and our expectations, these factors could be the FX-rate, its

[1] SPSS 22 software package was used to the analysis.
[2] a description of the method is included in Kovács, 2009
[3] Data available from Bloomberg

volatility, the difference between the forward rate and the spot rate (swap-difference) and the foreign and domestic interest rates.

We used the data series of the spot exchange rate of two foreign exchange rates, EURHUF and EURUSD. Considering that a change in the spot exchange rate affects also the forward rate, changes in the spot rate are expected to determine the hedging decision, as in the case of an advantageous price movement, better hedging rates are available.

The next group of variables is the volatility of FX-rates. We downloaded the implied volatility of at-the-money option with 30, 90 days or 1-year maturity for both currency pairs[4]. Higher volatility of risk factors (foreign exchange rate) is expected to increase the utility available by hedging, and also the potential hedging needs.

The expected profit of a forward transaction is also affected by the difference of the forward exchange rate and the expected spot exchange rate, this difference, (swap-difference) is also quoted in the interbank market; its time-series is available on Bloomberg. The swap-difference is determined by the difference of the spot exchange rate and the interest rates of the two currencies. Therefore, in addition to the one-year development of swap-difference, 1-year BUBOR representing HUF interest level, and 1-year EURIBOR and 1-year USD-LIBOR data for the foreign interest were included among the explanatory variables.

In order to ensure the independence of the individual observations required by the methodology, both the dependent variable and the explanatory variables consist of the percent change in each factor.

By examining the time series of the derivative stocks (Figure 2), we found a periodicity in both the long and the short positions: they, in general, are strongly reduced between December and January.

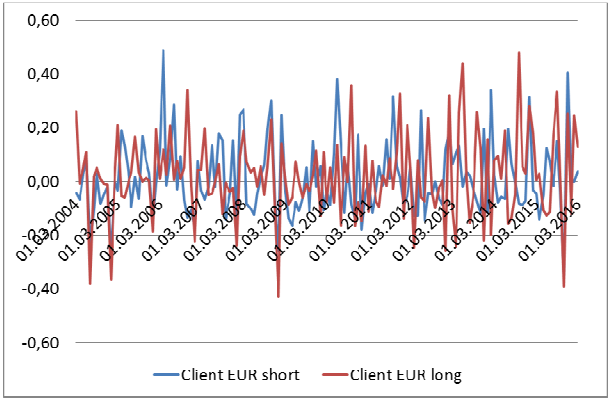

Figure 2: Monthly change of open forward positions
Source: the authors based on NBH data

This fall in the stocks may be explained by the positions expiring or closed out at the end of the year, since most corporations hedge to the reporting date, or in many cases, they do not want to report a substantial derivative portfolio in their annual statements.

Therefore, in addition to market factors, the "December effect" was included as a binary explanatory variable, with 1 standing for the period from the beginning of December to the beginning of January, in any other cases, it is 0.

The explanatory variables within a variable group are strongly correlated, but we included more variables to quantify the same factor, in order to find the variables with the highest explanatory power. However, variables are not uncorrelated between groups of variables either; therefore, we addressed the collinearity between the explanatory factors by choosing the stepwise method in the regression, thus the redundant variables are not included in the model.

Table 1 contains a summary of the explanatory variables of the regression model.

Variable clusters	Variable	Short name
Foreign trade	Monthly trade balance: export – import	Trade
Market prices	EURHUF spot rate	EURHUF
	EURUSD spot rate	EURUSD
	12-month BUBOR	BUBOR
	12-month EURIBOR	EURIBOR
	12-month USD-LIBOR	USDLIBOR
	12-month EURHUF swap difference	EURHUF_swap
	12-month EURUSD swap difference	EURUSD_swap
Market volatility	EURHUF 30-day implied volatility	EURHUF1MV
	EURHUF 90-day implied volatility	EURHUF3MV
	EURHUF 1-year implied volatility	EURHUF12MV
	EURUSD 30-day implied volatility	EURUSD1MV
	EURUSD 90-day implied volatility	EURUSD3MV
	EURUSD 1-year implied volatility	EURUSD12MV
December effect	The period is December	December

Table 1: Variables of the regression model
Source: the authors

We expect that EUR short positions (export hedge) are positively affected by the exchange rate, while EUR long positions (import hedge) correlate negatively with EURHUF.

[4] Data source: Bloomberg

RESULTS

In the first run the analysis of the residuals showed that one observation, 3rd November 2008, influenced critically the regression model, therefore, we excluded this month from the further analysis. Figure 3 shows Centered Leverage and Cook's Distance values. The horizontal and vertical lines represent acceptance limits based on the rule of thumb.

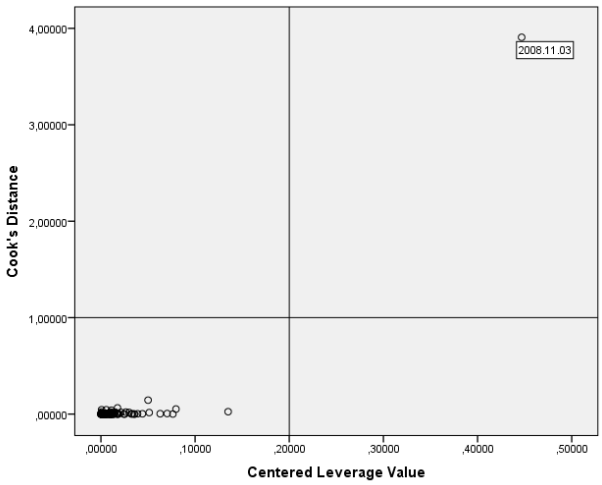

Figure 3: Exploring extreme data
Source: the authors based on NBH data

The extremity of this special date can be caused by the liquidity crisis of the Hungarian market in October 2008.

Modeling EUR short positions

Based on the *F-statistics* of the regression model, the model is significant at any conventional level (*p-value* 0.000), the adjusted R^2 coefficient is 0.58, i.e. nearly 60% of the total variance is explained. The essence of the stepwise method is that the independent variables are included gradually, on the basis of their explanatory power, as long as the new explanatory variable significantly improves the model. Table 2 shows that short forward positions were affected by three factors substantially: the change of the 30-day implied volatility of EURHUF; the EURHUF spot rate and the position closings in December.

It can be seen that the changes in foreign trade turnover had no effect on the derivative stock, which can be explained by the fact that products crossing the economic border of the country count to foreign trade, while hedging is carried out prior to the sale, in advance. In addition, we had data only about the net value of the foreign trade that proved to be almost uncorrelated to the forward positions.

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	,678[a]	0,46	0,46	0,10	0,46	120,66	1,00	142,00	0,00	
2	,735[b]	0,54	0,53	0,09	0,08	25,05	1,00	141,00	0,00	
3	,768[c]	0,59	0,58	0,09	0,05	16,67	1,00	140,00	0,00	2,18

a. Predictors: (Constant), EURHUF3MV

b. Predictors: (Constant), EURHUF3MV, EURHUF

c. Predictors: (Constant), EURHUF3MV, EURHUF, December

d. Dependent Variable: EUR_short

Table 2: Summary of the linear regression model of short FX-forward positions
Source: the authors based on NBH data

Table 3 contains the details of the regression model. On the basis of the high t-statistics and low p-values of the table, each variable is significant at all conventional levels. From the above volatility data, the 90-day (3 months) volatility of the EURHUF exchange rate proved to be determining; because of the correlation of the volatility data, additional volatility time series do not provide further explanatory power. 1 percent increase in the EURHUF market volatility, the portfolio increases by 0.475 percent.

1 percent rise in EURHUF exchange rate, meaning weakening of the forint against the euro, as expected, increases the sold foreign currency portfolio by 1.896 percent in the period.

Short currency positions are reduced by 11% on average in December.

Although the expected value of the forward sale can be increased by the EURHUF swap difference, it is surprising that this factor was not included in the explanatory variables of the model and so the higher forward price arising from the difference in interests alone does not cause changes in the forward portfolio. The reason for this is possibly the strong relationship between the swap difference and the EURHUF spot rate.

The correlation between the explanatory variables is acceptable, the tolerance value is close to 1, as well as its inverse, the variance inflation factor (VIF), the value of which is also close to one.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
3 (Constant)	,018	,008		2,340	,021	,003	,033					
EURHUF3MV	,475	,068	,471	7,021	,000	,341	,608	,678	,510	,380	,651	1,535
EURHUF	1,896	,350	,363	5,412	,000	1,203	2,588	,631	,416	,293	,651	1,537
December	-,110	,027	-,221	-4,083	,000	-,163	-,057	-,188	-,326	-,221	,998	1,002

Table 3: Coefficients of the linear regression model of short FX-forward positions
Source: the authors based on NBH data

The partial correlations cleaned from effects of other explanatory variables are moderate.
The distribution of the residuals slightly deviates from normal, which is confirmed by the result of the Kolmogorov-Smirnov test, p-value I s0.00.
All in all, the model is suitable for examining the relationship between the short forward position and the major market factors but about 40% of the variance is influenced by other factors like foreign trade and unsystematic effects.

Modeling EUR long positions
Similarly to the explanation of changes in short forward position, the changes of long forward FX-position is also analyzed in a linear regression model. The explanatory variables are the market-, foreign trade- and calendar factors as described above, while the dependent variable is the change in the stock of long forward stock. As mentioned above there was an extreme jump in the EUR long positions in October 2014 and a sudden fall in March 2015 due to a political regulation. That is why we substituted the values of the referring month by the average monthly change in the forward positions.

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	,324[a]	0,10	0,10	0,15	0,10	16,63	1,00	142,00	0,00	
2	,405[b]	0,16	0,15	0,14	0,06	10,03	1,00	141,00	0,00	
3	,452[c]	0,20	0,19	0,14	0,04	7,03	1,00	140,00	0,01	2,17

a. Predictors: (Constant), December

b. Predictors: (Constant), December, EURHUF

c. Predictors: (Constant), December, EURHUF, EURHUF12MV

d. Dependent Variable: EUR_long

Table 4: Summary of the linear regression model of long FX-forward positions
Source: the authors based on NBH data

Although the model is significant at all conventional significance levels; the *p-value* of the *F statistics* is 0.001, the model explains only 20% of the total variance, according to the *adjusted* R^2 indicator, as shown in Table 4.

Table 5 summarizes the explanatory variables, the regression coefficients and associated other statistics of the model.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
3 (Constant)	,036	,012		2,941	,004	,012	,061					
December	-,180	,043	-,319	-4,228	,000	-,264	-,096	-,324	-,336	-,319	,996	1,004
EURHUF	-2,334	,559	-,393	-4,176	,000	-3,439	-1,229	-,259	-,333	-,315	,642	1,558
EURHUF12MV	,475	,179	,250	2,651	,009	,121	,829	-,004	,219	,200	,641	1,560

Table 5: Coefficients of the linear regression model of long FX-forward positions
Source: the authors based on NBH data

In explaining the long forward positions, the constant proved to be significant; so if all other factors remain unchanged, the monthly portfolio increases by 3.6%.
For long forward position, the December effect is the most significant, this variable was involved first. The year-end position maturities and closings reduce the overall portfolio by almost 18% on average. The other two explanatory variables, similarly to the model in the previous subsection, are the change in the EURHUF exchange rate and the 12-month volatility of EURHUF. The weakening of the forint against the euro by 1 percent reduces the portfolio by 2.334%, in line with the expectations.
The growth of volatility is in positive correlation with the portfolio increase; however, in the case of long positions, the 1 year implied volatility had the highest explanatory power, so it was included in the model as an explanatory variable. All the three explanatory variables are significant at a level higher than 99%, tolerance is close to 1, and the VIF value supports that the explanatory variables are uncorrelated.
The distribution of residuals cannot be considered normal; the *p-value* of the Kolmogorov-Smirnov test is 0,004.
The foreign trade turnover and the EURHUF swap difference were not included as explanatory variables, the reasons can be similar to those referred to in the case of the short positions: the foreign trade turnover and the timing of the hedging decision are different, or may vary, while the swap difference does not have an additional significant effect on the development of the portfolio due to its co-movement with the EURHUF exchange rate.
The effect of the explanatory variables developed in line with the expectations, but the model does explain only one-fifth of the total variance, which indicates non-linear effects and further explanatory factors as well as the importance of individual factors also in the case of long positions.

CONCLUSION

We analyzed the aggregate long and short forward positions of the non-financial resident clients of Hungarian banks, in order to detect the motives of corporate FX-hedging and speculation. We found that market movements have an important impact on the change of the forward positions. As we expected, trading activity increased following favorable spot rate changes, long forward position correlated negatively, short forward positions correlated positively with the spot price. Higher volatility of the exchange rate caused an increase of the forward positions in both directions. We found that both positions fall significantly at the end of the year. We could explain the changes of the short foreign currency positions in 60 percent, but the explanatory power of the model was only 20% for long FX-positions.

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