

The Impact of FX Exposure on the Firm's Stock Market Return

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Abstract:

It is generally acknowledged that one of the risks faced by any company is FX risk, especially when the business operates internationally. For individual companies, exposure to FX risk results in different financial implications, stressing such parameters as the industry affiliation and the company's size with respect to the level of FX risk exposure. In this paper we analyse how FX exposure of companies of different size and operating in industrial and service sectors affects their stock market returns. Using the panel regression with macroeconomic and companies' specific factors for 208 European companies analysed over the period 2012–2018, we show that the link between changes in the exchange rate and the stock return is statistically significant and that medium-size companies as well as firms operating in the service sector of economy are more exposed to this impact.

Key words: Stock return; Stock price; Exchange rate; FX exposure; FX risk.

JEL classification: F31; G12; G32.

1. Introduction

It is generally acknowledged that companies universally experience market, interest and FX risks, especially when they operate internationally. Each of these types of risk may affect the performance of the given company and that is why it is important to understand what the channels of their potential impact are. To date, there have been many theoretical and empirical papers dedicated to the analysis of a relationship between FX risk and company's stock price

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or return (Jorion, 1990), (Bartov, Bondar, 1994), (Stavarek, 2005), (Dominguez, Tesar, 2006), (Flota, 2014), (Tomanova, 2016), (Šimáková, 2017) and others. Nevertheless, while there are numerous papers within this topic which have analysed American or Asian financial markets (Jorion, 1990), (Amihud, 1993), (Bartov, Bondar, 1994), (He, Ng, 1998), (Doukas, Hall, Lang, 2003), (Dominguez, Tesar, 2006), only few of them are dedicated to the analysis of European companies (Stavarek, 2005), (Tomanova, 2016), (Šimáková, 2017). Moreover, consideration of the size and industrial effects in the relationship between FX risk and company's stock price is not overly popular in the financial literature, and those pieces of research which exist within this topic to date give ambiguous results.

Another aspect of this topic is a different exposure to exchange rate movements of various companies. It is natural that due to their higher level of involvement in international business, large companies get more exposed to FX risk. On the other hand, performance of even small domestic companies may worsen due to undesirable movements of exchange rate, because there are still some indirect channels of potential impact and small companies are usually not hedged against FX risk.

Moreover, the existing literature gives ambiguous results regarding the industry's exposure to FX risk. There are numerous pieces of research confirming that industrial companies, primary from the manufacture business, are more exposed to FX risk than any other sector of the economy (Bodnar, Gentry, 1993), (He, Ng, 1998), (Allayannis, Ihrig, 2001), (Doukas, Hall, Lang, 2003), etc. Nevertheless, for example wholesale and retail sectors, conditionally included in the service industry, are not overly popular within the analysis of the relationship between exchange rate changes and the company's performance, although such companies are also highly involved in international trade.

Since the existing empirical literature lacks investigation of the significance of industry affiliation and the size of companies with respect to the relationship between FX risk and the company's stock return in the case of Europe (although this topic is highly relevant nowadays), this paper contributes to the academic literature by analysing the relationship between movements of exchange rate and stock return of companies on European sample for the period 2012–2018. To investigate this topic in more depth, we postulate three main research questions for the analysis: 1) Do foreign exchange rate fluctuations affect stock returns of European firms? 2) Is there any difference on how exchange rate movements impact stock return of companies of different size? 3) Is there any difference on how exchange rate movements impact stock return of companies from different sectors?

As our analysis shows, there is statistically significant relationship between exchange rate fluctuations and European companies' stock return during the period 2012–2018. Moreover, stock returns of medium-size companies and firms operating in the service sector are more exposed to FX risk than stock returns of small and large businesses from the manufacturing industry.

The remainder of this paper is organised as follows: section 2 covers the theoretical background; section 3 discloses methodological side of this research; results and their discussion are presented in section 4, followed by the conclusion of the paper in section 5.

2. Literature Review

2.1. Stock price behaviour and FX risk

The theoretical background of stock price behaviour is highly extensive and includes numerous theories. One of the existing ways of determining behaviour of the stock price is to apply fundamental or technical approach, as they contradict each other. Fundamental theory postulates that it is possible to estimate the “intrinsic value” of the stock using three basic groups of factors (company-specific, industry-relevant, and macroeconomic) and compare it with the market price, determining whether the stock is undervalued or overpriced (Graham, Dodd, 1934). Technical approach considers patterns of prices' movements, trading signals, and other sophisticated analytical tools to estimate the strength or weakness of an individual share title, suggesting that stock price is fully determined by market forces and thus can be predicted using only historical market data (prices and volumes) (Levy, 1966).

As contradiction to both the fundamental and technical analysis, Efficient Market Hypothesis (EMH) was presented by Eugene Fama in 1960s. According to EMH, efficiency of markets leads to the lack of initiatives for market participants to speculate as asset prices reflect all the relevant and available information completely and always conform to their intrinsic value. It is therefore impossible to “beat the market”, because asset prices react only to new information, which are random in their nature (Fama, 1965). So if EMH holds, FX rate changes have no predictable impact on the stock price, as they are unpredictable in their nature. This theory is supported by Random Walk Hypothesis (RWH), according to which stock prices move according to random walk, depending not only on the past prices, but also on some unpredicted shocks. That is why changes in the current price cannot be predicted using past data on price changes (Malkiel, 1973). Nevertheless, empirical evidence of these theories is quite ambiguous. On the one hand, (Bachelier, 1900), (Slutsky, 1937), (Kendall, Hill, 1953), (Osborne, 1959), (Fama, 1965), (Van Horne, Parker, 1967) and (Pinches, 1970)

support the idea of random nature of financial assets' prices with respect to empirical data. According to their results, stock prices do not have a memory. On the other hand, (Ball, Brown, 1968), (Bernard, Thomas, 1990) (Jegadeesh, Titman, 1993), (Pettit, Venkatesh, 1995) and (Drew, Noland, 2000) challenged the existence of EMH and RWH in their papers.

Another popular financial model used to determine the theoretically appropriate required rate of asset return is CAPM (Sharpe, 1964), (Lintner, 1965), (Mossin, 1966). According to CAPM, assets' return is determined by risk-free rate and a premium for the systematic risk. Any rational investor will always hold a market portfolio, which represents the best result of maximisation of returns for the given level of risk (Berk, DeMarzo, 2007). As an extension of a local version of CAPM, international CAPM (ICAPM) was created, initially presented by (Adler, Dumas, 1983), since FX risk is a part of the systematic risk of globally oriented companies. While the classic CAPM assists in defining the required rate of return for a specific risk on investment in a domestic market, the global version of CAPM looks at investments from the international perspective. The main finding of ICAPM is that it incorporates the international aspect through FX risk by adding an extra risk premium for exchange rate volatility. According to ICAPM, FX risk affects stock return and, therefore, the value of a company. In practice, (Black, Jensen, Scholes, 1972) and (Macbeth, Fama, 1973) found evidence confirming the validity of CAPM, while (Adler, Dumas, 1983), (Phylaktis, Ravazzolo, 2004) and (Wu, 2008) apart from the basic CAPM model associate foreign FX risk with inflation risk and market risk, and confirm the validity of the international version of CAPM.

2.2. FX exposure: do sector and size matter?

Following the end of Bretton Woods system and announcement of the US dollar as a free-floating currency, firms became exposed to exchange rate fluctuations. That fact brought attention of companies' financial managers to FX risk itself and the possible techniques of hedging against it. Foreign exchange exposure is an exposure of the company to the changes in exchange rates. In other words, it is a likelihood that the companies' financial result, its cash flow, market value and other parameters will change due to the volatility of exchange rate (Eiteman, 2016). Usually, the company is exposed to FX risk when it is involved in international transactions such as import/export business with cash flows, denominated in a foreign currency, foreign funding or investments, etc. But even conjuncture of domestic market (and fully domestic companies) may be exposed to exchange rate volatility due to the fact that even national demand and supply, products' prices sold at home currency, competitors prices etc. are quite sensitive to the movements of exchange rate (Eiteman, 2016). Therefore, it is crucial

to determine to which particular type of risk (transaction, translation or operating) is the company exposed and what ways of protection against such a risk is better to implement (internal or external).

The idea that various industries are differently exposed to exchange rate fluctuations was originally assumed by (Bodnar, Gentry, 1993) and later supported by (He, Ng, 1998) and (Miller, Reuer, 1998). The results of these papers were similar: industry sectors are statistically exposed to exchange rate volatility and the industry structure in which company operates matters. Later, (Marston, 2001) confirmed this idea while noting the importance of competitive structure of economic sector's impact on FX exposure. Moreover, (Allayannis, Ihrig, 2001) and (Doukas, Hall, Lang, 2003) confirmed that manufacturing companies are more exposed to FX risk than low- or non-exporting industries.

Even though the industrial sector is favoured by authors analysing FX exposure the most, there are few papers which consider the service sector as the primary industry for testing real FX exposure. For example, (Baggs, Beaulieu, Fung, 2008), (Hutson, Stevenson, 2010), (Flota, 2014) and (Mohapatra, 2016) confirm that service companies are also exposed to FX risk like manufacturing industry, although the level of their exposure may be different due to various level of involvement into international market.

Among other factors which potentially affect the company's FX exposure, various authors accentuate the company size. Of course, there is a wide range of other explanatory variables, such as the market value of company's equity, the level of firm's foreign sales, quick ratio, etc. (Zubairu, Iddrisu, 2019), but almost all authors emphasise the significance of firm's size on the level of FX exposure. For example, results of (Flota, 2014) show that medium-size companies (with market capitalisation between \$2.52 and \$7.34 billion) are more exposed to FX risk compared to small-size companies (with market capitalisation less than \$2.3 billion). This result is particularly significant in the manufacturing, retail, and transportation sectors. The same result applies to large-scale companies, whose market capitalisation exceeds \$7.79 billion. Other papers (Jorion, 1990) and (He, Ng, 1998) also confirm the idea that exposure increases with the growth of firm's size. In some way, this approach has its logic: the bigger the company, the more it is involved in international trade, therefore, the more exposure to FX risk.

Another approach to this issue is that small companies, on the contrary, are more exposed to exchange rate volatility than the large ones (Bodnar, Wong, 2003), (Hunter, 2005), (Dominguez, Tesar, 2006). The possible explanation for such effect is that larger companies are more likely to hedge their FX exposure than

the small ones, because it is cheaper for them to stay unhedged (Allayannis, Ofek, 2001), (Hagelin, Pramborg, 2006), (Bartram, Brown, Minton, 2010).

So despite the theme of company's FX exposure is quite common in academic literature, there is still an open discussion regarding the exposure of small/big companies operating in different sectors of the economy to exchange rate fluctuations. That is why there is still a room for empirical investigation of this issue.

2.3. Relationship between FX exposure and stock price of the company – empirical testing

The theory itself expects the existence of a significant impact of exchange rate movements on the company's performance. At least two types of FX exposure (transaction and operating) impact the future contractual cash flow and thus the market value of the company. Moreover, in the international version of CAPM, foreign FX risk is included as an explanatory variable of the stock return. So theoretically the link between stock price and changes in the exchange rate should exist if FX risk is not hedged by the company completely. However, a large layer of practice oriented researches shows rather mixed results.

(Jorion, 1990), analysing American multinational companies, found only limited impact of changes in the dollar value on the stock return: small significance was only in the case of individual firms, and even this significance was not robust. (Amihud, 1993) investigated that there is no significant link between changes in exchange rate and the market value of large U.S. exporting companies. (Bartov, Bondar, 1994) confirmed the results of the previous papers as well: they found out that dollar fluctuations have a pure explanatory power for abnormal stock returns. Another paper, suggesting mixed results regarding the impact of exchange rate on the stock price, is (Stavarek, 2005). Author analysed 4 old (Austria, France, Germany and the UK), 4 new (Czech Republic, Poland, Hungary, Slovakia) EU members and USA in different period of times, and found out that in the long run, there is no impact of exchange rate fluctuations on the stock price over the period 1970–1992, but within the period 1993–2003 the relationship between these two variables is statistically significant for developed countries.

(Dominguez, Tesar, 2006) also proved statistically significant effect of exchange rate volatility on the firm value on the example of eight industrialised and emerging markets, although the authors note that the direction of exposure is not permanent and varies over time as companies correct their behaviour with respect to fluctuations in exchange rate. The existence of the relationship between exchange rate changes and the firm value on the Eastern European market was tested by (Stavarek, Tomanova, 2014), (Tomanova, 2014), (Akel, 2014),

(Tomanova, 2016) and (Šimáková, 2017). The results of these papers are highly ambiguous: for example, (Flota, 2014) investigated that only 54% of Czech firms show significant impact of exchange rate fluctuations on the stock price; (Tomanova, 2014) confirmed this relationship for 18% of Hungarian firms, while (Akel, 2014) explored that there is no linear causality between the exchange rate and stock prices in the case of Bulgaria, Czech Republic, Estonia and other Eastern European countries; however, the relationship gets statistically significant when the methodology changes to non-linear Granger causality.

All these papers confirm there is yet no clear answer to the question whether there is an impact of exchange rate volatility on the company's value, measured by the stock price. Moreover, analysis of existing literature shows that: a) European market is rarely analysed within this topic; b) Only few works cover the relatively recent period (most of the literature relates to the period before 2010); c) There is a lack of empirical papers analysing both the industrial and service sectors of the economy and testing the relationship between FX risk and stock price. This question is still open for further investigation, and in our paper, we will try to analyse this issue to contribute to the existing literature.

3. Methodology

3.1. Hypotheses

Before we specify the basic theoretical model used in this paper, we will formulate the main hypotheses for testing:

Hypothesis 1: *Changes in foreign exchange rate have statistically significant impact on stock returns of European companies.*

All the companies selected for analysis are purely international firms and consequently have a significant share of revenues in foreign currency. Changes in exchange rate may lead to different results: for example, exporters will benefit from depreciation of home currency, while importers will lose from it (Jorion, 1990), (Bartov, Bondar, 1994), (Stavarek, 2005).

Hypothesis 2: *The impact of exchange rate fluctuations on stock return will be different for companies of different size.*

On the one hand, big companies are more involved in international transactions and therefore also more exposed to FX risk than the small companies. As a result, the impact of exchange rate fluctuations on the stock return will be more significant for big companies (Jorion, 1990), (He, Ng, 1998), (Flota, 2014). On the other hand, small companies have in practice less incentives and experiences to hedge their exposure than the big ones, thus, such small companies without hedging of FX exposure will have more effect of exchange rate

movements on their stock price (Bodnar, Wong, 2003), (Hunter, 2005), (Dominguez, Tesar, 2006).

Hypothesis 3: *The effect of exchange rate movements on stock return will vary by sectors.*

Although both the manufacturing and service sector of the economy are included in international financial market and, therefore, are exposed to FX risk, hedging techniques are more popular among industrial companies than service-related firms. Consequently, the effect of exchange rate fluctuations to the stock returns will be deeper and more significant in case of service sector of economy (Bodnar, Gentry, 1993), (He, Ng, 1998), (Marston, 2001), (Flota, 2014).

3.2. Model specification

For testing our hypotheses, we will use panel regression estimated using OLS method using macroeconomic and companies' specific factors. The basic model specification is presented below.

Formula 1 – Basic model specification:

$$R_{i,t} = \alpha_i + \beta_1 R_{i,t-1} + \beta_2 ER_{i,t} + \beta_3 RP_{i,t} + \beta_4 Infl_{i,t} + \beta_5 Int_{i,t} + \beta_6 Size_{i,t} + \beta_7 ROA_{i,t} + \beta_8 LEV_{i,t} + \beta_9 MtB_{i,t} + u_{i,t} \quad (1)$$

The precise calculation methodology of the dependent and independent variables and their expected sign is available in Table 1.

As we can see, the stock return lagged by one period ($R_{i,t-1}$) is expected to have a positive impact on the current return. This idea is justified by Random Walk Hypothesis, according to which future stock price movements are partially determined by the historical prices together with unpredictable shocks.

The main explanatory variable ($ER_{i,t}$) we want to test corresponds to the international version of CAPM, in which exchange rate is included as well (Adler, Dumas, 1983), (Phylaktis, Ravazzolo, 2004) and (Wu, 2008). In our work, we will apply exchange rate as the *Nominal Effective Exchange Rate (NEER)*, provided by the European Central Bank. It represents “*geometrically weighted averages of the bilateral exchange rates of the given currency against the currencies of the euro area's main trading partners*”¹. It should be mentioned that positive change of NEER indicates the appreciation of euro against the weighted basket of currencies of the main trading partners. Expected sign of this independent variable is ambiguous, because it depends on the position,

¹ URL: <<http://sdw.ecb.europa.eu/browse.do?node=9691299>> (05.04.2020).

taken by the company in relation to foreign currencies: if the company takes short position in foreign currency, only the appreciation of euro will be the benefit for this company, while depreciation of euro will cause a reduction in the stock return. Hence, the expected sign of ER for export-oriented companies will be positive due to the reason that both variables move in the same direction. On the contrary, if a firm takes long position in foreign currency, it will benefit from depreciation of euro, but loose from euro appreciation. Therefore, the expected sign for import-oriented companies will be negative, because the impact is in this case inversed.

Market risk premium ($RP_{i,t}$) is defined as the difference between return on the market index $MR_{i,t}$ and risk-free interest rate R_f , presented in the form of the yield on respective government bond. This indicator is included into the model in line with CAPM, where risk premium is expected to have a positive effect on the market stock return: if an investment is risky, there should be a compensation for such undertaken risk, so the return on the stock should be higher than the usual risk-free investment (Sharpe, 1964), (Lintner, 1965) and (Mossin, 1966).

Tab. 1 Table of dependent and independent variables

Variable	Calculation	Expected sign	Source
$R_{i,t}$	$Ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right)$,		Amadeus
$R_{i,t-1}$	$Ln\left(\frac{P_{i,t-1}}{P_{i,t-2}}\right)$	(+)	Amadeus
$ER_{i,t}$	$Ln\left(\frac{NEER_t}{NEER_{t-1}}\right)$	(+/-)	ECB Database
$RP_{i,t}$	$(MR_{i,t} - R_f)$, $MR_{i,t} = Ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right)$	(+)	ECB Database, Yahoo! Finance / Investing.com
$Infl_{i,t}$	$Ln\left(\frac{CPI_t}{CPI_{t-1}}\right)$,	(+/-)	OECD Database
$Int_{i,t}$	$Ln\left(\frac{cost\ of\ borrowing_t}{cost\ of\ borrowing_{t-1}}\right)$	(-)	ECB Database
$Size_{i,t}$	$Ln(MC_{i,t})$	(+/-)	Amadeus

Variable	Calculation	Expected sign	Source
Size_{new}_{i,t}	$\ln(\text{Total Assets}_{i,t})$	(+/-)	Amadeus
ROA_{i,t}	$(\frac{EBITDA_t}{\text{Total Assets}_t} - \frac{EBITDA_{t-1}}{\text{Total Assets}_{t-1}})$	(+)	Amadeus
LEV_{i,t}	$(\frac{\text{Total Debt}_t}{\text{Total Assets}_t} - \frac{\text{Total Debt}_{t-1}}{\text{Total Assets}_{t-1}})$	(+/-)	Amadeus
MtB_{i,t}	$\frac{\text{Total Assets}_{i,t} + MV(Equity)_{i,t} - BV(Equity)_{i,t}}{\text{Total Assets}_{i,t}}$	(+)	Amadeus

Source: authorial computation. Note: $P_{i,t}$ – is the closing stock price of i-firm at t-period, $P_{i,t-1}$ – is the closing stock price of i-firm at previous, t-1 period, NEER – nominal effective exchange rate, CPI – Consumer Price Index.

Together with exchange rate, inflation (***Infl_{i,t}***) was also included in the original ICAPM (Adler, Dumas, 1983), (Phylaktis, Ravazzolo, 2004) and (Wu, 2008). The sign of this variable is expected to be ambiguous: on the one hand, rise in the inflation rate will lead to an increase in the company's expenses and decrease in its revenues; therefore, we can expect a negative link with the stock return. On the other hand, if company's expenses remain the same, raise in the inflation rate may stimulate companies to rise prices on their production, leading to sales increases. Therefore, in this case the link between the inflation rate and the stock return will be positive. So the sign of the variable depends on the unique position of a company on the market.

Moreover, according to ICAPM interest rate (***Int_{i,t}***) will negatively affect company's stock return, because rise in the interest rate means more expensive debt for the company and less consumer expenditures in general (Adler, Dumas, 1983), (Phylaktis, Ravazzolo, 2004) and (Wu, 2008). As a proxy of the interest rate, we will adopt the cost of borrowing for households and non-financial corporations.

Expected sign of company's size variable (***Size_{i,t}***) is ambiguous and we can expect both positive and negative sign, because, on the one hand, exposure to FX risk increases with the firm's growth, because it becomes more involved in international activities (Jorion, 1990), (He, Ng, 1998), (Flota, 2014), but, on the other hand, large companies are aware of their FX exposure and they use effective hedging techniques to decrease this risk, while small companies may leave some exposure unhedged (Hunter, 2005), (Dominguez, Tesar, 2006), (Hagelin, Pramborg, 2006), (Bartram, Brown, Minton, 2010).

As for the return on asset (***ROA_{i,t}***), this indicator is one of the main stock return predictors, and its impact is quite straightforward: increase in the company's profitability positively affects the firm's stock return (Menike, Dunusinghe,

Ranasinghe, 2015). Additionally, according to (Fama, French, 1992), (Dennis, Perfect, Snow, Wiles, 1995) and (Davis, Fama, French, 2000), the Market-to-Book ratio ($MtB_{i,t}$) positively affects the company's stock return, which is quite logical: a firm with high growth prospects expects to earn higher returns than a company with low growth prospects.

Betas (β) in the model are estimated parameters, and $u_{i,t}$ is an error term.

To test the three underlying hypotheses, we run two rounds of regressions: the first round, the basic one, will include 5 regressions – for the pooled data sample and to test the size and industry affiliation significance (therefore, for small-cap and big-cap companies, from the manufacturing and service sectors). During the second round, we will test the results from the first round of regressions on their robustness by violation of specific assumptions. As a result, it will include 6 regressions – for the pooled data sample, for small/medium/big companies and from the manufacturing and service sectors. It should be noted that on first sight there may seem better to test the hypotheses no. 2 and no. 3 using dummy variables for Size and Industry. However, if we add a dummy variable in our model and assign it two values of “0” and “1”, we will test the explanatory significance of the size/industry affiliation in the stock return value, not in the relationship between exchange rate fluctuation and the dependent variable. That is why the best strategy to test both hypotheses is to divide whole sample into small/big companies and firms from the manufacturing/service industry.

3.3. Data

As mentioned above, in Table 1 there can be seen not only the calculation methodology of the individual variables and their expected signs, but also the data sources. For data collection we used the following sources:

- **Amadeus** – a database provided by Bureau van Dijk containing financial information of public and private European countries. The data for all firm-specific explanatory variables and dependent variables were extracted from this source.
- **OECD Database** – data pool of international Organisation for Economic Cooperation and Development (OECD), offering different sets of economic and social indicators. Data for Consumer Price Index for analysed countries were extracted from here.
- **ECB Database** – data pool of important financial statistics of the European Central Bank. Borrowing interest rates, risk-free rates and nominal effective rate were retrieved from the ECB statistics. As for NEER, exchange rate of Euro against EER of 19 basic trading partners was used for the analysis: Australia, Canada, Denmark, Hong Kong, Japan, Norway, Singapore, South

Korea, Switzerland, Sweden, the United Kingdom, the United States of America, Croatia, Czech Republic, Poland, Hungary, China, Bulgaria and Romania.

- **Yahoo! Finance / Investing.com** – popular internet-providers of various financial information: news, quotes, comments, reports, etc. Data for underlying market index prices for stock exchanges, included in the sample, were retrieved from this portal.
- After collecting the initial data set (nearly 6, 000 companies), the preliminary sample was checked for outliers and cleaned using the following criteria:
- to exclude companies with missing values for selected variables (approximately 5,300 firms).
- to exclude companies with negative value of “Total assets” and “Market Capitalisation” items (not reliable data).
- to exclude companies with Leverage value more than 1. Only companies with $Lev < 1$ is presented in the final sample, because if the value of Total debt amount exceeds the amount of Total assets, it means that a company has a negative equity. Such companies are outliers in the initial sample; that is why to get more accurate estimations we exclude these outliers from the final sample.

As a result, following all these steps the final sample included 208 companies from the manufacturing and service sector from Germany (28%), France (22%), Italy (14%), Spain (12%), Finland (8%) and other European countries (16%). As discussed in Chapter 2.2, numerous researchers have conducted the analysis of a relationship between the stock price and FX exposure based on the industrial sector. (Allayannis, Ofek, 2001), (Doukas, Hall, Lang, 2003) and (Mohapatra, 2016) together with other scientific papers confirmed the significance of FX risk impact on the market price of a stock in the manufacturing and construction sectors of economy, while (Hutson, Stevenson, 2010) and (Flota, 2014) added to the results the significance of the service sector as well (tourism, entertainment and wholesale and retail). Therefore, the final sample consists of companies from the wholesale and retail (21%), manufacturing (65%), construction (9%) and others (5%) sectors.

Tab. 2 Descriptive statistics

	R	R_1	ER	RP	INFL	INT	SIZE	SIZE_NEW	ROA	LEV	MTB
Mean	0.070	0.079	-0.006	0.038	-0.142	-0.106	14.122	14.650	-0.001	-0.003	1.512
Median	0.097	0.103	0.023	0.083	-0.077	-0.100	14.044	14.491	-0.000	-0.005	1.208
Max.	1.962	1.962	0.033	0.349	3.713	0.247	18.436	19.943	0.658	0.351	10.979
Min.	-2.639	-2.639	-0.100	-0.433	-2.605	-0.439	9.436	10.816	-0.406	-0.558	0.520
Std. Dev.	0.365	0.356	0.048	0.132	0.894	0.116	1.755	1.643	0.047	0.063	0.971
Obs.	1,456	1,456	1,456	1,456	1,456	1,456	1,456	1,456	1,456	1,456	1,456

Source: authorial computation.

Both the descriptive statistics and correlation matrix for the pooled data are available in Table 2 and 3, respectively. As can be seen, there is no significant correlation between the variables: all coefficients are below 50%. The highest correlation coefficients of almost 39% are between *ER* and *Interest*, followed by 32% between *ER* and *Inflation*. This positive relationship is quite logical: increase in the cost of borrowing and inflation rate signals worsening of the economic situation, causing depreciation of currency. Nevertheless, the size of correlation is not too high to affect the results.

Tab. 3 Correlation Matrix

	R	R_1	ER	RP	INFL	INT	SIZE	SIZE_NEW	ROA	LEV	MTB
R	1.000										
R_1	-0.058	1.000									
ER	-0.094	0.251	1.000								
RP	0.151	0.178	0.145	1.000							
INFL	-0.082	-0.031	0.322	-0.076	1.000						
INT	-0.138	-0.014	0.388	-0.036	0.198	1.000					
SIZE	0.077	0.086	0.042	0.054	0.046	-0.064	1.000				
SIZE_NEW	-0.045	-0.027	0.023	-0.006	n/a	n/a	n/a	1.000			
ROA	0.280	-0.019	-0.066	0.012	-0.023	-0.027	0.034	0.019	1.000		
LEV	-0.097	-0.088	0.004	-0.018	-0.021	-0.017	-0.011	0.011	-0.088	1.000	
MTB	0.131	0.108	0.012	0.056	0.024	-0.039	0.001	-0.141	0.001	-0.016	1.000

Source: authorial computation.

4. Results and Discussion

The first round of regressions represents the set consisting of 5 models, general results of which are presented in *Table 4* (detailed regression results are illustrated

in the Appendix section). To test the first hypothesis, we run a regression for the pooled data sample. Initial results show the insignificance of FX factor which contradicts the research of (Adler, Dumas, 1983), (Phylaktis, Ravazzolo, 2004) and (Wu, 2008) who confirmed the validity of the international version of CAPM, insignificance of the Size variable in the model but significance of the other variables: risk premium, company's profitability and growth potential show strong positive impact on the company's stock return at 1% significance level, while the interest rate and leverage have a statistically significant, negative impact. Inflation has a negative effect on the company's stock return at 10% significance level. Therefore, due to insignificance of FX factor the first hypothesis is preliminary rejected.

To test the significance of Size, we divide the sample based on capitalisation into companies with big market capitalisation (over 1.5 mil. EUR) and small market capitalisation (below 1.5 mil. EUR). As we can see, FX factor is significant at 10% level only in the case of big companies, along with profitability of the company, its growth prospect, capital structure and risk premium, suggested on the financial market. Small companies are less involved in international business, so for them FX risk is not so vital, as inflation in the country and cost of borrowing. These findings are in line with the conclusions of (Flota, 2014), (Jorion, 1990) and (He, Ng, 1998). Nevertheless, such results can be caused by the fact that we assign medium-size firms to the group of companies with small capitalisation. Nevertheless, the preliminary results allow us to conclude that the second hypothesis can be accepted.

Tab. 4 First round of regressions – results

	Size significance			Industry affiliation significance	
	Pooled data	Small-cap	Big-cap	Industrial	Service
C	-0.132* [0.072] (-1.815)	-0.337** [0.152] (-2.208)	-0.211 [0.174] (-1.210)	-0.067 [0.085] (-0.791)	-0.196 [0.144] (-1.350)
R_1	-0.103*** [0.027] (-3.859)	-0.071** [0.034] (-2.078)	-0.204*** [0.042] (-4.886)	-0.131*** [0.030] (-4.332)	-0.043 [0.055] (-0.789)
ER	-0.157 [0.223] (-0.705)	-0.358 [0.304] (1.176)	-0.907*** [0.314] (-2.893)	0.211 [0.255] (0.829)	-1.086** [0.449] (-2.416)
RP	0.418*** [0.069] (6.022)	0.359*** [0.094] (3.825)	0.437*** [0.098] (4.459)	0.409*** [0.078] (5.229)	0.462*** [0.145] (3.183)

	Pooled data	Small-cap	Big-cap	Industrial	Service
INT	-0.329*** [0.084] (-3.909)	-0.452*** [0.112] (-4.038)	-0.043 [0.123] (-0.349)	-0.464*** [0.095] (-4.879)	0.021 [0.176] (0.121)
SIZE	0.006 [0.005] (1.178)	0.017 [0.012] (1.361)	0.014 [0.011] (1.266)	0.001 [0.006] (0.285)	0.011 [0.011] (0.958)
ROA	2.051*** [0.191] (10.756)	1.939*** [0.236] (8.206)	2.223*** [0.325] (6.858)	1.739*** [0.210] (8.270)	3.017*** [0.437] (6.898)
LEV	-0.463*** [0.141] (-3.284)	-0.286 [0.174] (-1.642)	-0.825*** [0.240] (-3.434)	-0.374** [0.159] (-2.348)	-0.615** [0.296] (-2.076)
MTB	0.045*** [0.009] (4.754)	0.095*** [0.022] (4.334)	0.032*** [0.001] (3.364)	0.043*** [0.011] (4.039)	0.056*** [0.021] (2.632)

Source: authorial computation.

Note: *, **, *** - significance level 10%, 5% and 1% respectively, [std. error], (t-stat).

For testing the third hypothesis, we divide our initial sample into two main segments: industrial, including manufacturing and construction companies, and service, including wholesale and retail, tourism and other firms. As we can see in the table 4, we can preliminary accept the third hypothesis, because FX factor is statistically significant at 5% level in case of the service sector firms, while stock returns of industrial firms do not show any statistical dependence. FX factor significance for the service sector group confirms the previous findings of (Baggs, Beaulieu, Fung, 2008), (Hutson, Stevenson, 2010), (Flota, 2014) and (Mohapatra, 2016) which have identified the service sector companies to be exposed to FX risk same as the manufacturing industry companies. On the other hand, the results do not confirm FX factor relevancy for industrial sector which contradicts the findings of (Marston, 2001), (Allayannis, Ihrig, 2001) and (Doukas, Hall, Lang, 2003). As for other explanatory variables, we can see that the market risk premium, profitability of the company and its growth prospect remain to be statistically significant determinants of the stock return both for the industrial and service companies, leverage also has a statistically significant negative influence, but inflation and the cost of borrowing are significant only in the case of industrial companies.

To check the stability of these obtained results, we perform the robustness test, implementing certain changes in the initial model specification. First, we omit the factors which potentially influence the performance of the underlying variable – FX factor. In our sample, such variables are the interest rate and inflation as they

have the highest correlation with the *ER* variable. Secondly, we apply a new approach for determination of the size variable. A new variable was calculated as a natural logarithm of Total Assets of the company, assuming that Market Capitalisation data may give biased results due to the possible over-, under-valuation of the company on the market. And thirdly, to obtain more accurate results when we apply a new criterion for the sample division by size in adding a new, separate group of medium-size companies, determining the companies with Total Assets lower than 1.2 mil. EUR as small-size firms, companies in the range 1.2 mil. EUR – 25 mil. EUR as medium-sized firms, and the rest as the big ones.

As a result of these changes, new sample was generated. Descriptive statistics, presented in Table 2, shows that there are almost no changes in the *Size_new* variable except for the increase in both the maximum and minimum values (other variables in the model were not changed). Table 2 shows the correlation matrix for pooled data sample including *Size_new* variable to ensure that the *ER* variable has correlation no longer higher than 30%. As can be seen, *Size_new* variable has small but negative correlation with *Market-to-Book ratio*, *Stock Return* and *Risk Premium*, but this low correlation should not bias our results, so it can be neglected.

As can be seen from Table 5, our results remain stable with respect to the significance of risk premium, company profitability, growth prospects and leverage. However, the significance of FX factor changes. While previously this variable was not significant for the pooled data sample, now it is significant on 1% level. Moreover, new approach for sample division by size leads us to the significance of FX factor only in the case of the medium-size companies, showing the small and big companies are indifferent to ER changes. Also, we can see that FX risk becomes significant for industrial companies as well, but the level of significance is lower than in the case of the service sectors. This can be explained by the fact that hedging strategies are more popular among industrial companies than service-related firms. That is why the significance level of exchange rate movements is lower in case of the industrial sector of the economy. These results allow concluding that all the three hypotheses can be accepted.

Tab. 5 Second round of regressions – robustness test

	Pooled data	Size significance			Industry affiliation significance	
		Small	Medium	Big	Industrial	Service
C	0.087 [0.084] (1.039)	0.286 [0.325] (0.882)	-0.037 [0.224] (-0.165)	0.648 [0.493] (1.315)	0.170* [0.098] (1.739)	0.006 [0.167] (0.037)
R_1	-0.085*** [0.026] (-3.221)	-0.008 [0.042] (-0.194)	-0.165*** [0.037] (-4.439)	-0.164* [0.086] (-1.909)	-0.109*** [0.030] (-3.615)	-0.044 [0.054] (-0.818)
ER	-0.615*** [0.195] (-3.157)	-0.481 [0.329] (-1.457)	-0.597** [0.270] (-2.213)	-0.429 [0.422] (-1.107)	-0.446** [0.224] (-1.990)	-1.002*** [0.387] (-2.591)
RP	0.457*** [0.069] (6.613)	0.611*** [0.124] (4.937)	0.359*** [0.089] (4.023)	0.406** [0.187] (2.171)	0.463*** [0.078] (5.905)	0.443*** [0.143] (3.094)
SIZE_new	-0.007 [0.005] (-1.269)	-0.021 [0.025] (-0.852)	-0.002 [0.014] (-0.136)	-0.042 [0.027] (-1.580)	-0.011* [0.006] (-1.772)	-0.005 [0.011] (-0.420)
ROA	2.067*** [0.192] (10.782)	1.994*** [0.281] (7.085)	2.110*** [0.287] (7.362)	2.188** [0.893] (2.449)	1.739*** [0.213] (8.171)	3.092*** [0.436] (7.088)
LEV	-0.434*** [0.141] (-3.067)	-0.106 [0.212] (-0.498)	-0.938*** [0.214] (-4.379)	0.361 [0.454] (0.794)	-0.335** [0.161] (-2.082)	-0.624** [0.295] (-2.113)
MTB	0.047*** [0.009] (5.085)	0.033*** [0.012] (2.672)	0.079*** [0.016] (4.909)	0.139** [0.068] (2.054)	0.042*** [0.011] (3.967)	0.064*** [0.019] (3.246)

Source: authorial computation.

Note: *, **, *** - significance level 10%, 5% and 1% respectively, [std. error], (t-stat).

Moreover, it should be noted that to ensure reliable and solid results, each model was tested on heteroscedasticity, multicollinearity and autocorrelation using the cross-sectional LR test, VIF test and Durbin-Watson statistics, respectively. As the tests showed (all the results are presented in the Appendix section), there is no evidence of any bias from this perspective.

5. Conclusion

The main purpose of this research was to investigate the relationship between FX exposure, presented in the form of exchange rate changes, and the stock return of 208 European companies. The secondary aim of the paper was to test whether this impact differs between the companies of different size and operating

in various sectors of the economy. To check this relationship, three hypotheses, and therefore three groups of regressions, were introduced: the first one checked the significance of this relationship on a pooled data sample; the second has analysed whether the stock return of companies of various sizes depends on FX changes differently; and the last group of regressions checked this significance by industry. After the first-round of regressions, initial results were tested for robustness in terms of violations of certain assumptions and approaches. All these steps lead us to the following conclusion.

There is an actual negative impact of FX changes on the company's stock return, which can be observed on the market for the period 2012–2018. If euro appreciates against the weighted basket of multiple foreign currencies, import-oriented companies will loose from and their stock return will decrease, while if there is Euro depreciation on the market, the stock return of these companies will increase.

It is interesting that the degree of this impact varies across the companies of different sizes and from various sectors. Theoretical background tells us that big companies are more involved in international transactions; therefore they will be more exposed to FX risk than the small firms. But usually big companies are aware of this risk, and they hedge their business against potential losses. That is why the significance level of the exchange rate changes impact on the company's stock return will vary for big and small companies. Empirical results of this paper show that this hypothesis is true, and that even different understanding of the "size" term does not change that fact. In this research, we have tried to divide the sample in two ways, and the last one, where we have separated the medium-sized companies into an individual cluster, is more accurate, because in this case we can see that changes of the exchange rate matter only for the medium-sized companies, while the stock return of small and big firms does not depend on this factor.

Regarding the significance of industry affiliation of the company, regression outcomes show that both the industrial and service-related companies are exposed to the impact of FX changes on their stock return. The only difference is that firms from the service sector (wholesale and retail, tourism and other) are more exposed to this impact than industrial companies. As discussed above, this can be caused by the fact that hedging strategy is more popular among the industrial companies than within the service-related firms. That is why the significance level of the exchange rate movements is lower in the case of the industrial sector of the economy.

Moreover, empirical analysis conducted in our research confirms the significance of other variables as well as the potential determinants of the stock price behaviour: market risk premium, profitability of the company and its growth

potential are constantly significant determinants of the stock return, positively influencing its value. Leverage, inflation and the cost of borrowing are indicators which have a significant negative impact on the company's stock return from time to time. That is why we cannot say with certainty that these factors constantly determine the company's stock return, because for some firms their influence is significant while for some other groups of companies it is not so.

Even though we may call the results of this research a success, there is still a room for possible future analyses. First, other possible determinants of the stock price behaviour can be included in the model to increase its explanatory power. Secondly, to test the potential influence of macro-variables on the company's stock return, another model specification may be created with additional macro-indicators of low inter-correlation. Thirdly, to confirm or to reject RWH theory, according to which the current stock price can be partially explained by the historical data, we can collect another pool of data with another frequency (quarterly, monthly, or even daily) and check the stability of results in this case. Simply put, there still remain numerous, different and interesting directions of this topic which may further contribute to the existing literature, as this topic of the stock price behaviour and its determinants, as well as impact of FX changes on stock performance, is by no means yet closed.

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Appendix 1:**Heteroscedasticity and Autocorrelation tests**

	Pooled data	Size significance		Industry affiliation significance	
		Small-cap	Big-cap	Industrial	Service
LR Test	743.061***	379.228***	341.526***	552.368***	173.543***
DW stat.	1.856	1.747	1.998	1.921	1.716

	Pooled data	Size significance			Industry affiliation significance	
		Small	Medium	Big	Industrial	Service
LR Test	740.657***	291.584***	363.316***	341.525***	555.183***	173.450***
DW stat.	1.873	1.892	1.859	1.569	1.934	1.735

Source: authorial computation.

Note:

Heteroscedasticity LR Test - Null hypothesis: Residuals are homoscedastic if p-value < significance level -> reject Null hypothesis,**Autocorrelation test** - DW stat. - Durbin-Watson statistics

DW = 2 -> no autocorrelation

DW \in [0;2) -> positive autocorrelationDW \in (2; 4] -> negative autocorrelation.

Appendix 2:

VIF test on multicollinearity

	Pooled data	Size significance		Industry affiliation significance	
		Small-cap	Big-cap	Industrial	Service
C	n/a	n/a	n/a	n/a	n/a
R_1	1.139	1.158	1.144	1.156	1.124
ER	1.441	1.416	1.531	1.452	1.424
RP	1.068	1.092	1.053	1.072	1.076
INFL	1.158	1.175	1.171	1.144	1.217
INT	1.218	1.191	1.296	1.238	1.179
SIZE	1.101	1.226	1.038	1.084	1.231
ROA	1.014	1.019	1.029	1.012	1.071
LEV	1.019	1.019	1.034	1.018	1.048
MTB	1.098	1.231	1.012	1.077	1.213

Source: authorial computation.

	Pooled data	Size significance			Industry affiliation significance	
		Small	Medium	Big	Industrial	Service
C	n/a	n/a	n/a	n/a	n/a	n/a
R_1	1.112	1.072	1.166	1.097	1.133	1.081
ER	1.086	1.067	1.131	1.109	1.099	1.058
RP	1.046	1.031	1.074	1.099	1.049	1.049
SIZE_new	1.022	1.015	1.005	1.019	1.027	1.028
ROA	1.013	1.006	1.047	1.009	1.012	1.069
LEV	1.107	1.011	1.051	1.019	1.015	1.044
MTB	1.033	1.008	1.032	1.039	1.037	1.028

Source: authorial computation.