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Working Paper



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## Working Papers in Interdisciplinary Economics and Business Research

The Study of the Effects of Exchange Rates on the  
Stock Companies in the Eurozone's Petrochemical  
Industry

Jana Šimáková

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## **Working Papers in Interdisciplinary Economics and Business Research**

Silesian University in Opava  
School of Business Administration in Karviná  
Institute of Interdisciplinary Research  
Univerzitní nám. 1934/3  
733 40 Karviná  
Czech Republic  
<http://www.iivopf.cz/>  
email: [iiv@opf.slu.cz](mailto:iiv@opf.slu.cz)  
+420 596 398 237

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## **Abstract**

**Jana Šimáková: The Study of the Effects of Exchange Rates on the Stock Companies in the Eurozone's Petrochemical Industry**

*Company's involvement in global activities is the primary source of its foreign exchange exposure. Many empirical studies suggest the negative impact of uncertainty about the development of the exchange rate on cash flow and profitability of companies, and thus their market values. Some economic studies show that foreign revenues are positively correlated with the exchange rate exposure and in a short period, currency depreciation negatively affects the market value of listed companies. On the other hand, there are studies that show no statistically significant links between the value of the companies and exchange rates. Considering the importance of the petrochemical industry as one of the strategic sectors in Eurozone's economy, the aim of this study is to evaluate the relationship between exchange rate fluctuations and stock market prices in petrochemical industry. This paper applies Jorion's model and panel regression framework during the period of 2002-2017. This paper provides evidence on the magnitude and speed of the impact of exchange rate shocks.*

### *Key words*

exchange rate, petrochemical industry, stock exchange, currency exposure

*JEL: F31, G12*

### *Contacts*

**Jana Šimáková**, Department of Finance and Accounting, School of Business Administration, Silesian University, Univerzitní nám. 1934/3, 733 40 Karviná, Czechia, e-mail: simakova@opf.slu.cz.

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## Introduction

Relationship between exchange rate and stock prices have been currently under the wide research interest. Existing economic theory support the existence of a causal relationship between stock prices and exchange rates. The supporting approaches for this existence can be divided into two channels. The first one is very well known goods market channel (e.g., Dornbusch and Fischer, 1980), which is based on an argument that development of exchange rates affect the competitiveness of companies involved in international economic activities what lead to changes of cash flows and stock prices. Depreciation of the domestic currency is supposed to make exporting goods cheaper and lead to increasing of foreign demand, but this exchange rate development is beneficial for importers. Contrary, appreciation of domestic currency has the opposite effect. Furthermore, exchange rates have impact on the values payables and receivables denominated in foreign currencies. Nevertheless, it is important to note that not only companies engaged in export or import activities are exposed to foreign exchange risk. Even pure domestic firms operating only in domestic currency could face this kind of risk. Indirect impact of the exchange rates is through the market competition, and domestic macroeconomic conditions such as development of aggregate demand, employment and output. Thus, a potentially wide range of firms could be exposed to movements in foreign exchange rates, regardless of their direct financial exposure (Flota 2014). The second channel is represented by the asset market approach, which says that exchange rates are determined by market mechanism. An expected increase in stock prices would cause increasing of capital from foreign investors and therefore increasing of the demand for the domestic currency. This should cause an appreciation of the local currency (e.g., Gavin, 1989).

Many empirical studies suggest the negative impact of uncertainty about the development of the exchange rate on cash flow and profitability of companies, and thus their market values (e.g. Frazer and Pantzalis, 2004; Muller and Verschoor, 2006). Some economic studies show that foreign revenues are positively correlated with the exchange rate exposure and in a short period, currency depreciation negatively affects the market value of listed companies (e.g. He and Ng, 1998). On the other hand, there are studies that show no statistically significant links between the value of the companies and exchange rates (e.g. Stavárek, 2005).

Considering the fact that more than 95% of the facilities and devices being used, are produced by petrochemical industry through a series of simple or complex process of gas and oil conversion (Abbasi et al, 2015), this industry has found a special importance in the economy of Eurozone and is seen as one of the strategic sector of its economy. Therefore, the aim of this study is to evaluate the relationship between exchange rate fluctuations and stock market prices in petrochemical industry. This paper fully addresses the criticism of existing studies on the determinants of firms' exposure to exchange rate movements which tend to use cross-sectional analysis, which ignores the temporal dimension of both dependent and explanatory variables. Therefore, this study uses Jorion's model and panel data approach, which pools the data across firms and time, in order to improve estimation efficiency.

To this end, the next section reviews relevant literature published in the examined field. The following section introduces the empirical model and data used in estimation. The next section presents and discusses the empirical results. Finally, the last section makes concluding remarks.

## 1. Review of Relevant Literature

Theoretical expectation of a link between firm performance and exchange rates has led to many empirical researches. According to Adler and Dumas (1984), exchange rate exposure is a regression coefficient. Jorion (1990) followed this assumption in the pilot study explaining changes in stock prices by changes in the market index and exchange rates. Market approach for foreign exchange exposure identification is based on Jorion (1990) and with various modifications according to the methodological development has been used continually by applying for various geographic areas and timeframes. Initial empirical studies predominately showed almost no impact of currency value on the stock prices of companies (e.g. Jorion, 1990; Bartov and Bodnar, 1994; Bernard and Galati, 2000; Griffin and Stulz, 2001). There are also studies that showed the clear effects of exchange rate fluctuations on it (e.g. Doukas et al., 1999; Patro et al., 2002). However, more recent research provides mixed results. For instance, Dominguez and Tesar (2006) tested many publicly listed companies from eight industrialized and emerging markets. They found that exchange rate movements do matter for a significant fraction of firms, though which firms are affected and the direction of exposure depends on the specific exchange rate and varies over time, suggesting that firms dynamically adjust their behavior in response to exchange rate risk. Exposure is correlated with firm size, multinational status, foreign sales, international assets, and competitiveness and trade at the industry level.

Nevertheless, as Ampomah et al. (2013) state, several firm-level studies reveals the weak empirical findings considering three basic determinants of overall foreign exchange exposure – firm, industry and macroeconomic characteristics. Firm characteristics, especially international economic activities, hedging, size, leverage, liquidity and growth opportunities are shown to affect foreign exchange exposure. Companies involved in international economic activities can benefit from a depreciation of the domestic currency. Assuming the unchanged export sales, company's revenues increase in proportion to the currency depreciation. Furthermore, the company's competitiveness is increasing by the decreasing of the international price of the exported goods. For example, Jorion (1990) find that companies with high levels of export activities reveal more positive exchange rate exposure in case of USA. Furthermore, Bodnar and Wong (2003) show that small firms are more exposed to currency value development than large companies. Some studies shows that exposure increases as firm size increases (He and Ng, 1998). This can be caused by the fact that larger firms can have more international activities, but also be more likely to hedge than the smaller firms (e.g. Allayannis and Ofek, 2001; Hagelin and Pramborg, 2006; Brown and Minton, 2010). Use of derivatives can reduce exchange rate exposure (Nguyen and Faff, 2003). Nance et al. (1993) reveal that hedging is often used by companies with considerable growth opportunities.

Economic theory further suggests industrial sector affiliation correlated with exposure (Marston, 2001). Even some empirical studies confirm the assumption that foreign exchange exposure is significantly different across industries. Bodnar et al. (2002) discuss company's exposure as a dependent variable of its ability to pass on the increased expenses or prices caused by exchange rate changes to the consumers. As Ampomah et al. (2013) states, this, depends on industry competitiveness, which determines the price elasticity of demand, and the degree of substitutability of the goods.

Country's macroeconomic fundamentals and their impact on company's exchange rate exposure is examined for example by Patro et al. (2002). They find that imports, exports, credit ratings and tax revenues significantly affect currency risk. Even the openness can have an

impact on the company's degree of foreign exchange rate exposure. Significantly positive relationship between openness of the domestic country and a company's exposure to the exchange rate changes is revealed for example by De Jong et al. (2006) or Hutson and Stevenson (2010). However, currency depreciation can increase competitiveness even of the purely domestic companies. This situation can occur if the company competes with import-oriented companies. Hence, depreciation might lead to a net positive impact on its stock prices. However, this indirect impact is limited by the characteristic of the depreciation as depreciation often signals more fundamental problems. Therefore, declines in the currency value might often be accompanied by economic contractions and stock prices decreasing.

As was mentioned above, exposure coefficient can suffer from measurement biases. Therefore, grouping firms by certain characteristics, notably industry sector and firm size can lead to a less noisy estimate of their currency exposure. Existing studies on the determinants of firms' exposure to exchange rate movements tend to use cross-sectional analysis, which ignores the temporal dimension of both dependent and explanatory variables. Therefore, this study uses a panel data approach, which pools the data across firms and time, in order to improve estimation efficiency.

## 2. Methodology

To measure foreign exchange exposure, this paper employs a regression model based on Jorion (1990). It is a two-factor model (1), where the return on the market index is the first factor and exchange rate change is the second factor. Exchange rate and market index represents the independent variables. The model is formed into equation as follows:

$$R_{it} = \alpha_i + \beta_i RM_t + \delta_i RFX_t + \varepsilon_{it} \quad (1)$$

where  $\alpha_i$  is the constant term,  $R_{it}$ , is the stock return of firm  $i$  over time period  $t$ ,  $RM_t$  is the return on the market index,  $\beta_i$  is the firm's market beta and  $RFX_t$  is the real effective exchange rate in relevant country. Hence, the coefficient  $\delta_i$  reflects the change in returns that can be explained by movements in the exchange rate after recognition on the market return. To include the control variables into model we follow Cakan and Ejara (2013) and extent the model by gold  $G$  and oil  $O$  price (2):

$$R_{it} = \alpha_i + \beta_i RM_t + \delta_i RFX_t + \gamma_i RG_t + \lambda_i RO_t + \varepsilon_{it} \quad (2)$$

Standard models usually employ cross-sectional data to estimate trade patterns in a given year. We employ a panel data regression which pools the data across firms and time to avoid the risk of choosing an unrepresentative year and to monitor unobservable individual effects. This can provide additional insight into tested relationships. Before estimating ordinary least squares regression on panel data, it is necessary to determine dataset effects as random or fixed. Fixed effects are present when the heterogeneity in the model is unobservable but correlated with any variable included in model. Per contra, the heterogeneity in random effects is also unobservable, but it is not correlated with any other variable. In this case we use the Breusch-Pagan Lagrange multiplier test.

$$LM = \frac{nT}{2(T-1)} \left[ \frac{\sum_{i=1}^n \left( \sum_{t=1}^T e_{it} \right)^2}{\sum_{i=1}^n \sum_{t=1}^T e_{it}^2} - 1 \right]^2 \quad (3)$$

The test criteria are calculated from equation (3), where  $T$  is the length of time series,  $n$  is the number of units in the cross-sectional dimension, and  $e_{it}$  is a residual term. The Breusch-Pagan Lagrange multiplier test revealed random effects in this case.

### 3. Results

Sample period for the estimation covers the period from 2002:01 to 2017:06. Due to the fact that period of companies operating on the market can differ, panels used for the regression testing are unbalanced. All time series used for estimation are on a monthly frequency, due to the exposure of foreign exchange rate the impact can be even indirect and comes from the competitive situation. The measures of change in exchange rate coefficients provide the relationship through the effect of the exchange rate on stock return. Real bilateral EUR/USD exchange rate is used as variable FX and it is obtained from Eurostat database. Selected exchange rate was chosen because of position of USD in trading of production factors in petrochemical sector. Data for market indices are obtained from the OECD iLibrary statistical database. A summary of descriptive statistics related to model variables are presented in Tab. 1.

**Tab. 1: Descriptive statistics of research variables**

Variable	Average	Standard deviation	Skewness	Kurtosis
Company's return	0.752	0.224	0.194	2.731
Market's return	0.867	0.288	0.187	2.514
Exchange rate	1.254	124.233	0.226	1.267
Gold price	1288.630	214.682	-0.154	2.681
Crude oil price	82.067	15.804	-0.925	3.127
Beta risk	0.249	0.085	-0.015	2.914
Company's size	24.632	3.672	0.143	1.658

Source: author's calculation

The results of panel regression are presented in Tab. 2. For studying the significance of the whole model at a confidence level of 95 % it is confirmed that the whole model is significant. Coefficient of determination of the model also indicates that 38.67 % of changes in stock return are explained by this model.

**Tab. 2: Results of panel regression**

Variable	Coefficient	T-Value	P-Value
Market's return	0.341	5.681	0.0001
Exchange rate	0.001	4.771	0.0001
Gold price	-0.004	-0.560	0.2134
Crude oil price	0.015	5.698	0.0392
Beta risk	0.245	-3.227	0.0001
Company's size	0.002	6.287	0.0001

Model's coefficient of determination	39.91		
Adjusted coefficient of determination	38.67		

Source: author's calculation

Tested petrochemical sector in the Eurozone is shown to be exposed to the exchange rate risk at 1 % significance level during the sample period. Positive exposure coefficient suggest that depreciation of domestic currency is followed by an increase of firm's stock returns. Results obtained from this paper are similar of those by Abbasi et al. (2015). However this coefficient is almost zero, what could be caused by using of natural hedging or other sophisticated instruments on the hedging markets. Companies in Eurozone have good resources and strategies to hedge against exchange rate risk.

## Conclusion

Company's involvement in global activities through international trade is the primary source of its foreign exchange exposure, but there are many factors which can cause the indirect exposure as well. Considering the fact that more than 95% of the facilities and devices being used, are produced by petrochemical industry through a series of simple or complex process of gas and oil conversion, this industry has found a special importance in the economy of Eurozone and is seen as one of the strategic sector of its economy. Therefore, the aim of this study was to evaluate the relationship between exchange rate fluctuations and stock market prices in petrochemical industry. This paper applied panel data approach, which pools the data across firms and time, in order to improve estimation efficiency.

This paper showed that tested petrochemical sector in the Eurozone is exposed to the exchange rate risk at 1% significance level during the sample period. Positive exposure coefficient suggest that depreciation of domestic currency is followed by an increase of firm's stock returns. However this coefficient is almost zero, what could be caused by using of natural hedging or other sophisticated instruments on the hedging markets. Considering the existence of a significant linear relationship between the exchange rate fluctuations and the stock return of the companies operating in petrochemical sector, investors are advised to consider the historical and predicted changes and trends in exchange rate development as part of the basis of their decision process.

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