Assessing the impact of exchange rates on international trade in the manufacturing sector of CEE countries: A specific focus on SMEs

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Abstract: *This paper aims to analyze the impact of exchange rates on international trade in the manufacturing sector in selected Central and Eastern European (CEE) countries. To accomplish this, a distinctive combination of econometric techniques is employed, enabling an assessment of both macro- and micro-level perspectives concerning the mutual relationship between foreign exchange rates and international trade. At the macroeconomic level, the examination employs the J-curve methodology, utilizing Johansen cointegration and vector error correction models to assess the influence of currency exchange rate dynamics on international trade within the manufacturing industry in Bulgaria, the Czech Republic, Croatia, Hungary, Poland, and Romania. At the micro level, the generalized method of moments is applied to company data from the manufacturing industry in each respective country. The research period encompasses data spanning from 2011 to 2021. The research findings highlight a significant disjunction between macroeconomic and microeconomic perspectives on the impact of exchange rates within the manufacturing industry. While macroeconomic analysis indicates a general trend towards expected outcomes, such as increased exports and improved trade balance following domestic currency depreciation, miecroeconomic regression analysis reveals a more nuanced picture. Contrary to macroeconomic assumptions, the microeconomic perspective, particularly in the case of Romania and Hungary, suggests that exchange rate effects may have opposite impacts on return on assets (ROA) in the manufacturing sector in tested small- and medium-sized companies. This discrepancy underscores the complexity of exchange rate dynamics and emphasizes the need for nuanced, context-specific analyses when assessing the influence of exchange rate fluctuations on international trade and financial performance.*

Keywords: *Company's performance, exchange rate, international trade, J-curve, manufacturing industry.*

JEL Classification: *F23, F31, F41.*

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Introduction

Exchange rates exert a crucial influence on international trade flows acting as a crucial determinant of competitiveness in the global marketplace (Bahmani-Oskooee & Hegerty, 2011; Bussiere et al., 2009). The value

of currencies significantly shapes the pricing dynamics of exports and imports, thus directly impacting the trade landscape, especially within the manufacturing sector. This sector holds substantial importance in the economies of Central and Eastern European (CEE) countries, as it constitutes a significant proportion of their international trade activities (Dobrzanski, 2018; Farkas, 2017).

In this context, our study delves into the relationship between exchange rates and international trade within the manufacturing sector of selected CEE countries, aiming to address two notable research gaps. Firstly, prevailing research often concentrates solely on either macroeconomic implications or microeconomic considerations concerning the effects of exchange rates on international trade. Our paper endeavors to bridge this gap by adopting a comprehensive approach that integrates both macro and micro perspectives. Through simultaneous examination of the broader macroeconomic trends and the specific impacts on SMEs within the manufacturing sector, we endeavor to offer a more nuanced understanding of exchange rate dynamics in CEE countries and their implications for various stakeholders.

Secondly, while small- and medium-sized enterprises (SMEs) play a crucial role in international trade, there exists a lack of research specifically focusing on their experiences within the manufacturing sector of CEE countries. Eurostat's (2023a) data underscores the substantial role played by SMEs in international trade within the CEE region, with SMEs accounting for approximately 60% of total employment and over 50% of value added in the non-financial business economy. Nevertheless, SMEs encounter myriad challenges in navigating the intricacies of international trade, with exchange rate risk emerging as a prominent concern. Research by Gurgul and Lach (2014) and insights from Badshah and Borgersen (2020) shed light on the adverse effects of exchange rate volatility on the competitiveness and export performance of SMEs, thereby emphasizing the imperative of effective risk management strategies. However, hedging might be difficult in SMEs due to the flexibility of decision-making, financial resources, and accessibility of effective tools. Therefore, Badshah and Borgersen (2020) highlight the prominent role of exchange rate risk as a significant barrier to internationalization for SMEs. To thoroughly understand the complex relationship between exchange rates and international trade in Central and Eastern European (CEE) countries, additional research is required. In particular, a comparative analysis that combines both macro-level and micro-level perspectives would offer a more comprehensive insight into this dynamic.

Specifically, our focus extends to Bulgaria, Czechia, Croatia, Hungary, Poland, and Romania – countries characterized by robust economic growth trajectories in recent years. These nations, all members of the European Union (EU), exhibit a pronounced reliance on the manufacturing sector, which not only contributes significantly to their GDP but also serves as a major source of employment. According to data from ILOSTAT (2024), manufacturing employment constitutes a substantial portion of total employment in these countries, with percentages ranging from 16.8% in Croatia to 25.3% in Czechia, underscoring the sector's pivotal role in shaping their economies. Additionally, GDP figures further highlight the significance of the manufacturing sector, with contributions varying from 12% in Croatia to 21% in Czechia, as reported by the World Bank (2023) data.

The significance of our research is further underscored by the growing integration of these CEE countries into the global supply chain, rendering them increasingly susceptible to international economic fluctuations. CEE countries have historically served as formidable manufacturing bases, with exports in the machinery and transport equipment category alone accounting for a noteworthy share of the EU-27 total. In 2022, CEE represented 19% of the EU-27 total machinery and transport equipment international trade – an increase from 14% in 2011 (Eurostat, 2023b). This trend is indicative of the region's evolving economic landscape, wherein manufacturing prowess assumes heightened importance in the context of international trade dynamics. Moreover, the Eurozone accession of Croatia and the pending accession of Bulgaria further accentuate the relevance of our study. As these nations transition towards adopting the euro, their trade dynamics are poised for significant transformation, particularly concerning their interactions with non-Eurozone counterparts. Thus, elucidating the nuances of exchange rate effects on international trade (both from macro and micro perspectives) assumes paramount

importance for policymakers, businesses, and investors operating within the region.

In light of these considerations, our paper aims to analyze the impact of exchange rates on international trade within the manufacturing sector of selected CEE countries. Spanning the period from 2011 to 2021, our study encapsulates significant economic events, including the Eurozone crisis, the Ukrainian conflict, and the COVID-19 pandemic. Employing a unique blend of econometric techniques, we aim to assess the macroeconomic implications using Johansen cointegration and vector error correction models while concurrently scrutinizing the microeconomic dimensions through the generalized method of moments (GMM) applied to SME-specific data within the manufacturing industry. By doing so, we aspire to offer nuanced insights that can inform policymakers, businesses, and SMEs alike, thereby facilitating informed decision-making and fostering enhanced competitiveness in international markets. While SMEs stand to gain specific insights tailored to their needs and challenges, larger companies can also leverage the findings of our study to optimize their international trade strategies, especially in the strategies within the supply chain, including the SMEs.

1. Theoretical background

The literature review serves as the foundation for delineating the assumptions regarding the impact of exchange rates on international trade within the manufacturing sector of selected CEE economies, with a focus on both macro and microeconomic perspectives. As such, it is structured to align closely with the overarching objectives of our research. This review is bifurcated into two primary sections, initially concentrating on the macro effects of exchange rates, followed by a detailed examination of the micro-level implications.

1.1 Macro level perspective of exchange rate-effects

The relationship between the exchange rate and trade balance has been a subject of extensive debate in macroeconomics. The theoretical premise suggests that a weaker domestic currency should boost exports and reduce imports, thus enhancing the trade balance. Conversely, a stronger domestic currency is expected to have the opposite effect. However, empirical evidence has shown that these assumptions may not hold in all cases and are dependent on data and methodological approaches. An influential theory is Magee's (1973) J-curve theory, which distinguishes between short-term and long-term effects. The initial negative effect of home currency depreciation is followed by a positive effect on the trade balance, forming a J-shaped curve. This theory has undergone extensive examination across various countries, utilizing diverse datasets and employing different methodological approaches. Nevertheless, earlier studies predominantly relied on aggregated international trade data and effective exchange rates, which resulted in notable aggregation bias (Bahmani-Oskooee, 1986; Mahdavi & Sohrabian,1993; Rose & Yellen, 1989). Second-generation studies, such as those by Baharumshah (2002), Bahmani-Oskooee and Brooks (1999) and Bahmani-Oskooee and Ratha (2004), used bilateral exchange rates and bilateral trade balances to decrease the bias. Nevertheless, these studies still suffered from aggregation bias caused by grouping products with different price elasticities into one basket. To address this, third-generation studies emerged (Bahmani-Oskooee & Fariditavana, 2019; Bahmani-Oskooee & Hegerty, 2011; Bahmani-Oskooee & Nasir, 2020), which disaggregated trade balance data at the product level. These studies are particularly relevant in understanding the exchange rate's effects from the perspective of companies in specific sectors.

Bahmani-Oskooee and Kutan (2009) investigated the classical J-curve, focusing on data from 12 countries, including CEE countries, during the estimation period of 1990–2005. Empirical evidence supported the J-curve effect in Bulgaria and Croatia but not in other CEE economies. In a more recent study, Nusair (2013) applied a similar methodology, namely autoregressive distributed lag (ARDL) cointegration and an error correction model, to data from 17 emerging and transitioning countries over the period 1991–2012. While the J-curve effect was evident in Armenia, Georgia, and Ukraine, it was absent in the CEE countries. In their study, Kurtovic et al. (2017) analyzed the impact of the exchange rate on Serbia's export and import demand function during the period 2004–2015. The findings revealed the presence of a J-curve effect in the cases of Germany, Austria, and Croatia. Evidence of the J-curve effect is found in Croatia also

in a study by Stučka (2003). The issue is that due to the country's dynamic trade environment and outliers, the results are somewhat sensitive to the inclusion of dummy variables. Hacker and Hatemi-J (2004) examined the J-curve for Czechia, Hungary, and Poland. They observed a deterioration in the trade balance with Germany shortly after depreciation, followed by a rise to a long-term equilibrium value higher than the initial exchange rate. However, there are studies reporting no, or adverse evidence of a J-curve pattern. For instance, Hsing (2009) explored the J-curve for bilateral trade involving Croatia, Czechia, Hungary, Poland, Slovakia, Slovenia, and the USA. No evidence of the J-curve effect was found in any of the analyzed economies. In a study conducted by Fetahi-Vehapi and Jonuzi (2022), it was observed that Poland and Bulgaria experienced an inverse J-curve effect in their trade with North Macedonia, where the trade balance initially improved and then worsened due to exchange rate fluctuations.

Šimáková and Stavárek (2015) employed the Johansen cointegration test to conduct product-level studies in Czechia covering the period from 1993 to 2013. Their research revealed an enduring relationship between the exchange rate and various sub-trade balances encompassing the manufacturing industry. The findings from these studies demonstrated the advantageous impact of Czech koruna's depreciation on a significant majority of the examined product categories. Similarly, Šimáková (2018) brought attention to a crucial dimension of the exchange rate effect by highlighting the dissimilarity in exchange rate elasticity between depreciation and appreciation. The study uncovered that the intensity of exchange rate effects on bilateral trade relationships fluctuated when considering the effects of depreciation and appreciation in distinct product categories. Such variations were attributed to differing reactions from companies and consumers to changes in prices.

1.2 Micro-level perspective of exchange rate-effects

The traditional view on the exchange rates' effect on the relative domestic and foreign prices states that exchange rate change causes shifts in expenditures between domestic and foreign goods (Benita & Lauterbach, 2007; Betts & Kehoe, 2006; Khan et al., 2010). However, some studies show that exchange rate fluctuations have limited short-term effects on relative prices (Cheong, 2004). In practical terms, domestic currency depreciation typically results in higher import prices for companies operating in countries that function as international price takers, while appreciation leads to lower import prices. The depreciation of the domestic currency can potentially increase the cost of imported inputs, raising the marginal costs and consequently leading to higher prices for domestically produced goods (Kandil, 2004). Additionally, import-competing firms might respond to price increases by foreign competitors to improve their profit margins. The extent of such price adjustments depends on various factors, including market structure, the relative presence of domestic and foreign firms, government exchange rate policies, and product substitutability (Fouquin et al., 2001; Sekkat & Mansour, 2000). In the case of CEE countries, the majority of manufacturing companies rely on imported inputs, encompassing equipment, plant and machinery, and various other materials. Persistent changes in exchange rates could create operational and strategic risks for manufacturing companies operating in international markets, leading to discrepancies in cost and revenue models, changing the competitive landscape, and exposing supply chains to risk. Allayannis and Ofek (1997) argue that exchange rate fluctuations have significant impacts on manufacturing firms as they affect their anticipated future cash flows and, consequently, their overall value by altering the home currency value of their foreign revenues and costs. Nevertheless, their empirical analysis disclosed that manufacturing firms could significantly mitigate their exchange rate exposure by extensively adopting foreign currency derivatives and other hedging instruments.

Dekle and Ryoo (2002) found that exchange rates and cash flow shocks are correlated, but the nature of the correlation could be either positive or negative. In the case of negatively correlated exchange rates and cash flow shocks, the firm suffers from low cash flows when its exchange rate depreciates. The firm's production is constrained at precisely the time when export opportunities are greatest, providing the rationale for the firm to hedge against cashflow shocks. They also found that export volumes are strongly affected by changes in exchange rates and that export prices are sticky in the buyer's currency.

The substantial impact of exchange rate fluctuations on export volumes is not primarily due to alterations in the buyer's currency prices. Instead, it is primarily attributed to the loosening of financing constraints, which can result from the advantageous effects of exchange rate shocks on cash flows or from hedging activities. Dominguez and Tesar (2006) conducted an investigation using firm- and industry-level stock returns to examine the existence of exchange rate exposure. Their findings indicated a significant level of exposure to various exchange rates. They postulated that exchange rate exposure may be linked to several firms- and industry-level characteristics, with exposure being more prevalent in small- rather than large- or medium-sized firms and naturally present in those companies engaged in international economic activities, evidenced by multinational status, international asset holding, and foreign sales.

Sekkat and Mansour (2000) conducted a study exploring the sectoral sensitivity to exchange rate fluctuations in Europe. Their findings indicated that the food, paper products, chemicals, metals, machinery, electrical products, and transport equipment sectors respond differently to changes in exchange rates concerning both exports and imports. In general, these sectors demonstrated a high level of sensitivity in both their exports and imports, with the exception of the transport equipment sector. Fouquin et al. (2001) studied the impact of euro/dollar fluctuations on the European manufacturing industries and found that the energy, food, paper products, machinery, and electrical products sectors were the most sensitive to exchange rate fluctuations for imports and energy, machinery, and transport equipment for exports. The determinants of exchange rate sensitivity were identified as concentration on the supply side and dynamics on the demand side. Šimáková (2017) serves the results of the cross-sectional panel regressions concerning firm size in Visegrad countries. The results demonstrate that smaller companies tend to engage in less hedging compared to larger firms, leading to a higher prevalence of currency exposure. Moreover, the hedging approach varies across different industries. The findings from the cross-sectional panel regressions indicate that hedging against currency risk can significantly influence the nature of exchange rate risk exposure. This is fully in line with Šimáková and Rusková (2019), who compared petrochemical and pharmaceutical companies in their study devoted to the Visegrad region. They found out that the significant effect of the exchange rate on the stock price was evident only in one sector, namely in the pharmaceutical industry, exhibiting limited access to hedging instruments.

From the perspective of SMEs, Demian and di Mauro (2018) observed that the exchange rate effects are more pronounced for currency appreciations than for depreciations, particularly among small firms, which often rely on partnerships with foreign entities to enter export markets. Belghitar et al. (2021) highlight that because of the entry barrier, SMEs tend to impose upper limits on exported quantities in the event of currency depreciation, prompting firms to elevate the prices of their exported goods while maintaining constant volumes. Conversely, small firms operating in highly competitive markets face downward pressure on their profit margins and prices during currency appreciation, negatively impacting their competitiveness and forcing them to reduce export volumes. Furthermore, Fornes and Cardoza (2018) found that exchange rates are perceived to be critical for the performance of business expansion. Their research provides deep insights into the barriers faced by SMEs from emerging economies when conducting business abroad, particularly in discerning among various sources of liabilities.

Overall, the literature highlights the important role of exchange rates in shaping international trade in CEE countries on either a macro or micro level. Exchange rate stability is crucial for promoting international trade, and exchange rate fluctuations can have both positive and negative impacts on the volume and competitiveness of international trade in specific industries.

2. Research methodology

The data analysis is divided into two stages. The first stage covers macroeconomic analysis based on the J-curve modelling. The second stage covers microeconomic insights into the relationship between exchange rates and profitability in the companies in the manufacturing sector.

2.1 Macro level model

Macroeconomic empirical analysis aims to investigate whether macroeconomic fundamentals

are cointegrated with trade balance development in selected CEE countries. In this study, the cointegration test reflects methods demonstrated by Johansen and Juselius (1990). To conduct these analyses, a fundamental prerequisite is to ascertain the stationarity of variables at their original levels. The Johansen cointegration technique is utilized to establish a long-term equilibrium between the observed variables and to confirm the existence of cointegrating vectors in non-stationary time series. The primary mathematical expression utilized is that of a vector autoregressive (VAR) model is as follows:

$$\begin{aligned}&\Delta Z_t = C_0 + \sum i = 1\ K\Gamma_i\, \Delta Z_{t-1} + \Pi Z_{t-1} + \\ &+ \eta_t\, \Delta Z_t = C_0 + \sum i = 1 K\Gamma_i\, \Delta Z_{t-1} + \\ &+ \Pi Z_{t-1} + \eta_t\end{aligned} \quad (1)$$

where: Z_t – a vector comprising non-stationary variables; C_0 – the constant term; η – the white noise term; the matrix variables Γ and Π contain the values of the cointegrating vectors.

Johansen and Juselius (1990) defined two ratio test statistics to determine the number of cointegrating vectors. The first ratio statistics is the maximum Eigenvalue statistics used to test the null hypothesis of exactly *r* cointegrating vectors against the alternative hypothesis *r* + 1 vectors. The second statistics, known as the trace test, is employed to test the hypothesis of at most *r* cointegrating vectors.

For empirical analysis of manufacturing trade, the specified model is as follows Equation (2):

$$\begin{aligned}&\ln TB_{p,t} = \alpha + \beta \ln Y_{d,t} + \gamma \ln Y_{f,t} + \\ &+ \lambda \ln ER_{f,t} + \varepsilon_t\end{aligned} \quad (2)$$

The trade balance in time period *t*, denoted as TB_p, is measured as the ratio of exports from the individual CEE country to country *f* over the imports of the CEE country from country *f* in the manufacturing industry. Y_d represents the measure of domestic income (GDP), while Y_f represents the income of the trading partner *f*. GDP is presented in index form to ensure unit-free representation. ER_f signifies the nominal bilateral exchange rate, where an increase indicates a depreciation of the domestic currency. ε_t is the error term. Based on expectations, an increase in foreign income (Y_f) is anticipated to lead to higher exports to the respective country, implying a positive estimate for the parameter γ. Conversely, an increase in domestic income (Y_d) is assumed to boost imports, resulting in a negative estimate for the parameter β. Additionally, the parameter λ is expected to be positive as a depreciation of the domestic currency should improve the trade balance of the respective industry.

If the variables are found to be cointegrated, vector error correction models (VECM) can be estimated. A short-term dynamic component is incorporated into the long-run model to examine the short-run relationship. Following Hsing (2009), the following error correction model is applied:

$$\begin{aligned}&\Delta \ln TB_{p,t} = \alpha + \sum_{k=1}^{n} \omega_k\, \Delta \ln TB_{t-k} + \sum_{k=1}^{n} \beta_k\, \Delta \ln Y_{d,t-k} + \sum_{k=1}^{n} \gamma_k \Delta \ln Y_{f,t-k} + \sum_{k=1}^{n} \Delta \ln ER_{f,t-k} + \\ &+ \vartheta_k EC_{t-1} + \varepsilon_t \\ &\Delta \ln TB_{p,t} = \alpha + \sum_{k=1}^{n} \omega_k\, \Delta \ln TB_{t-k} + \sum_{k=1}^{n} \beta_k\, \Delta \ln Y_{d,t-k} + \sum_{k=1}^{n} \gamma_k \Delta \ln Y_{f,t-k} + \sum_{k=1}^{n} \Delta \ln ER_{f,t-k} + \\ &+ \vartheta_k EC_{t-1} + \varepsilon_t \sum_{k=1}^{n} \omega_k\, \Delta \ln TB_{t-k} + \sum_{k=1}^{n} \beta_k\, \Delta \ln Y_{d,t-k} + \sum_{k=1}^{n} \gamma_k \Delta \ln Y_{f,t-k} + \sum_{k=1}^{n} \Delta \ln ER_{f,t-k} + \\ &+ \vartheta_k EC_{t-1} + \varepsilon_t\end{aligned} \quad (3)$$

where: *EC* – the disequilibrium term; $\vartheta_k EC_{t-1}$ – the error correction mechanism.

2.2 Micro level model

Due to the nature and volume of input data from companies, we employ panel regression methods, commonly used to examine relationships within a two-dimensional space that combines time and cross-sectional data. Panel data is utilized when there is a collection of units that are related or closely associated with a specific characteristic, allowing for repeated observations over time. In this study, we design a panel framework where the profitability of companies is regressed against both company-specific and

macro-specific determinants. As stated by Nandi et al. (2015), this framework helps to account for unobserved heteroscedasticity among variables and captures their interrelationships. The initial condition for conducting tests and regression analyses in modern econometrics is the stationarity of the time series used. Stationarity implies achieving time series with consistent patterns and stable trends. A unit root test is employed to confirm stationarity. Additionally, multicollinearity among variables is crucial to verify. This was addressed simultaneously by utilizing Pearson's correlation coefficient to detect potential multicollinearity. The regression methods used in this study, such as GMM (generalized method of moments), are suitable for capturing the influence of independent variables on the dependent variable in annual data tracking, as described by Hall (2005):

$$L_{it} = \alpha_1 + \beta_1 * \Delta L_{it-1} + \beta_2 * X_{1it} + \\ + \beta_3 * X_{2it} + ... + \beta_n * X_{nit} + \varepsilon_{it} \quad (4)$$

The dependent variable L_{it} in the formula represents the financial performance of the companies; macroeconomic factors are characterized by the unknown variable X, the regression constant, the final parameter of the regression function, and the residual component are elements in the regression analysis. The model employs factors of current liquidity (*LIQ*), debt/equity ratio (*LEV*), bilateral exchange rates (*EXR*), money market interest rate (*IR*), and annual rate of change of *HICP*. To ensure the adequate explanatory power of the obtained results, all explanatory variables will be tested for their statistical significance. Simultaneously, it will be crucial to examine and confirm the overall robustness of the observed model using the Sargan/Hansen J-test (J-statistics). The Sargan/Hansen J-test evaluates the model's capability to produce consistent results even when subjected to minor parameter variations. The final assessment of the model's robustness will be based on statistical significance, with the results of the probability test expected to exceed the selected significance level of 5%.

2.3 Data

The dataset for SME characteristics between the years 2011 and 2021 is based on the Orbis database. Microlevel modelling covers the period between 2011 to 2021 and is based on the yearly level data from six CEE countries. All-time series used for macro-level estimation cover the same period from 2011Q1 to 2021Q4 but are based on quarterly data. Thus, the analysis encompasses data from Bulgaria, Czechia, Croatia, Hungary, Poland, and Romania over an eleven-year period. Data for the SMEs operating in the manufacturing industry in CEE countries include data on sales,

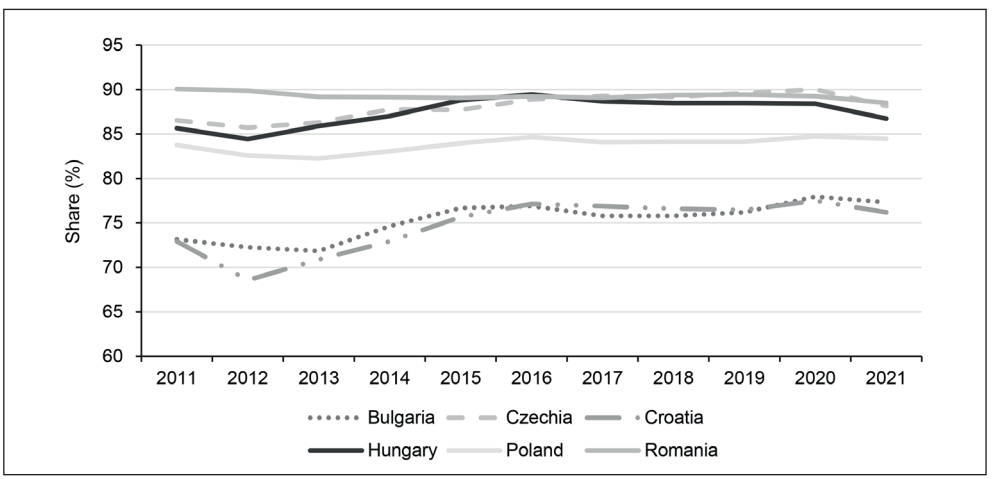

Fig. 1: **Share of manufactured goods in total international trade in goods of respective country**

Source: own

return on assets, level of debt-to-equity ratio, and net income. Subsequently, the Eurostat database was used to obtain macroeconomic data. Specifically, the dataset for each respective country includes total exports and imports of goods, exports, and imports of the manufacturing industry, GDP indicators, inflation, interest rates, and the development of the bilateral exchange rate of local currency against the euro. The manufacturing industry is represented by the Standard International Trade Classification (SITC) 5–8 product categories according to the UNCTAD transfer system. Therefore, this sample covers the sector of chemicals and related products, manufactured goods, machinery and transport equipment, and miscellaneous manufactured articles. The importance of the manufacturing industry in analyzed countries is shown in Fig. 1, which depicts the proportion of the trade with manufactured goods in the total international trade in goods of each country.

Between 2011 and 2021, Romania reached a peak ratio of up to 90%. Czechia, Hungary and Poland also achieved a ratio of more than 80%. On the other hand, Bulgaria and Croatia had the lowest ratios of the countries surveyed. At the same time, it is evident that the trade balance was negatively affected by external economic shocks during the period under review. In 2012, the trade balance was significantly influenced by the global economic crisis. In the subsequent years, 2020 and 2021, the results were negatively affected by the COVID-19 pandemic. Tab. 1 contains basic descriptive statistics in the form of the number of surveyed enterprises that had annual data available and the median values of the microeconomic indicators.

Tab. 1: Descriptive statistics

	Bulgaria	Croatia	Czechia	Hungary	Poland	Romania
Number of companies	12,093	6,087	6,056	14,130	7,099	14,848
ROA	6.28	4.59	4.26	4.93	6.04	5.90
LEV	60.17	46.07	54.41	53.73	55.64	47.04
LIQ	1.57	1.14	1.52	1.05	1.23	1.09
EXR	1.96	7.53	26.33	311.44	4.25	4.57
HICP	0.00	0.70	2.10	2.20	0.90	2.60
IR	1.60	2.77	1.55	3.06	3.20	3.96

Note: *ROA* – return on assets; *LEV* – debt/equity ratio; *LIQ* – current liquidity; *EXR* – bilateral exchange rate; *HICP* – harmonised index of consumer prices; *IR* – money market interest rate.

Source: own (Eviews calculations based on Orbis data)

The total number of analyzed enterprises obtained from all analyzed countries between the years 2011 and 2021 is 55,313. Each ratio is computed based on the individual financial performance of the respective company, resulting in unique ratios for different entities. The calculation is based on the average financial performance of each company, and panel data analysis was employed to derive these outcomes for each state. From the given data, it can be observed that Romania has the highest number of companies, followed by Hungary. Croatia has the lowest number of companies among the listed countries. Return on assets (*ROA*) indicates the profitability of companies in generating income from their assets. Based on the provided data, Hungary has the highest *ROA*, followed by Bulgaria and Romania. Croatia has the lowest *ROA* among the listed countries.

Leverage represents the ratio of debt to equity capital in a company. According to the given data, Bulgaria has the highest leverage, followed by Poland, Czechia, and Hungary. Croatia and Romania have relatively lower leverage values. Subsequently, the measurement of liquidity assesses a company's capability to convert its assets into available cash. Based on the provided data, Bulgaria has the highest liquidity, followed by Czechia and Poland. Hungary and Croatia have lower liquidity values.

In the sample period, *HICP* (harmonized index of consumer prices) indicates the level of inflation in each country. According to the provided data, Romania has the highest inflation rate, followed by Hungary and Czechia. Bulgaria has the lowest inflation rate among the listed countries. Finally, the interest rate represents the cost of borrowing or the return on savings. Based on the given data, Romania has the highest interest rate, followed by Hungary and Poland. Czechia has the lowest interest rate among the listed countries.

3. Research results

The results are divided into two parts, with the first part presenting the outcomes of macroeconomic research, and the second part focusing on microeconomic analysis.

3.1 Results for macro-level perspective

To estimate the long-term relationship between exchange rates and corresponding manufacturing trade balances, we utilize the Johansen cointegration approach applied to Equation (2). This approach can be employed for both stationary data series at their original levels and stationary first-differenced ($I(1)$) variables. This assumption holds for macroeconomic variables in general and is applicable to the data series analyzed in this study. The model is estimated using bilateral data between the selected CEE countries and the Eurozone, as this international trade represents the majority of international trading flows in the CEE region. The results for the long-term relationships obtained from each model are presented in Tabs. 2–3.

Tab. 2: Results of cointegration analysis

	Bulgaria	Croatia	Czechia	Hungary	Poland	Romania
Trace-statistics (none)	128.0304	59.20093	102.2709	92.4594	62.7193	79.5719
Probability	0.0000	0.0163	0.0002	0.0000	0.0070	0.0001
Trace-statistics (at most 1)	47.9210	30.4138	46.6606	53.8205	27.9589	42.5309
Probability	0.0013	0.1496	0.1938	0.0002	0.2431	0.0068
Trace-statistics (at most 2)	26.5543	14.0374	23.0673	27.1258	12.3610	16.1327
Probability	0.0059	0.2868	0.5239	0.0048	0.4170	0.1683
Trace-statistics (at most 3)	9.2936	2.7044	8.3555	6.5536	3.4260	4.2985
Probability	0.0473	0.6372	0.7944	0.1521	0.5043	0.3695
Max-Eigen statistics (none)	80.1094	28.5880	55.6101	38.6389	34.7604	37.0410
Probability	0.0000	0.0472	0.0001	0.0019	0.0071	0.0033
Max-Eigen statistics (at most 1)	21.3667	16.3764	23.5933	26.6947	15.5978	26.3980
Probability	0.0671	0.2724	0.1909	0.0114	0.3278	0.0126
Max-Eigen statistics (at most 2)	17.2606	11.3329	14.7118	20.5722	8.9350	11.8343
Probability	0.0303	0.2281	0.3991	0.0085	0.4408	0.1958
Max-Eigen statistics (at most 3)	9.2936	2.7044	5.2781	6.5536	3.4260	4.2985
Probability	0.0473	0.6372	0.8631	0.1521	0.5043	0.3695

Source: own (based on Eurostat data)

Tab. 3: Number of cointegration vectors

	Bulgaria	Croatia	Czechia	Hungary	Poland	Romania
Number	4	1	1	3	1	2

Source: own (calculations based on Eurostat data)

From the estimated models in Tabs. 2–3, the analysis reveals a general pattern of long-term co-movements between the majority of tested manufacturing trade balances and the variables included in the analysis. The numbers of cointegration equations vary from 1 to 4 and prove the long-term tights between exchange rate and international trade in the manufacturing industry.

The specific models for individual manufacturing trade balances are stated in Equations (5–10). There, we report the statistically significant coefficients of long-term analysis:

$$TB\_Bulgaria = -22.85 - 41.54\ GDP\_Bulgaria + 46.36\ GDP\_EA + 0.52\ Leva \quad (5)$$

$$TB\_Croatia = -4.55 + 0.13\ GDP\_Croatia - 0.15\ GDP\_EA + 2.98\ Kuna \quad (6)$$

$$TB\_Czechia = -43.24 + 3.22\ GDP\_Czechia + 5.88\ GDP\_EA + 0.34\ Koruna \quad (7)$$

$$TB\_Hungary = 131.76 + 37.61\ GDP\_Hungary - 66.33\ GDP\_EA + 0.06\ Forint \quad (8)$$

$$TB\_Poland = -8.88 - 29.26\ GDP\_Poland + 31.32\ GDP\_EA - 0.29\ Zloty \quad (9)$$

$$TB\_Romania = 1.51 - 2.89\ GDP\_Romania + 2.53\ GDP\_EA + 0.22\ Leu \quad (10)$$

We use the GDP of domestic countries as a proxy for home demand for imports from the Eurozone. Therefore, the expected effect of GDP growth on the particular trade balance is negative. The findings indicate that only half of the statistically significant coefficients hold this assumption. Particularly, Bulgaria, Poland, and Romania illustrate that an increase in their GDP is followed by the worsening of the manufacturing trade balance. In contrast, the GDP of the Eurozone represents the proxy for demand for goods from individual CEE countries; hence, we expect the positive coefficients of estimation. In this case, the majority of coefficients followed the theoretical assumption. Exceptions are Croatia and Hungary.

The comparison of employed variables in the model shows that the sizes of the coefficients of exchange rates are lower than the coefficients of GDPs, but they do matter in the development of manufacturing international trade. We employ the bilateral exchange rate quoted in a direct manner, therefore, an increase in it means a depreciation of the domestic currency. Therefore, the expected results are positive coefficients of the exchange rate. Estimations show that almost all tested relationships fulfil this presumption. An inverse relationship is proved only for Poland. This means that the Polish manufacturing trade balance is positively affected by the Polish zloty appreciation. This can be explained by import-intensive export. Albinowski et al. (2017) find that exchange rate movements affect firms' decisions to enter export markets. However, the effect depends on the intensity with which firms use imported intermediates and participate in international production networks. This structure in combination with low hedging used by SMEs in Poland can be followed by an adverse relationship between exchange rate and manufacturing international trade than expected.

Tab. 4 presents the estimates of the short-term effects of exchange rate fluctuations. The results indicate a limited statistical significance of the short-term coefficient for both positive

Tab. 4: Number of cointegration vectors

	Bulgarian leva	Croatian kuna	Czech koruna	Hungarian forint	Polish zloty	Romanian leu
VECM (−1)	−0.21	0.59	0.05	0.05	0.02	1.03
VECM (−2)	1.57	−1.58	−0.40	−0.11	−0.31	−0.06

Source: own (calculations based on Eurostat data)

and negative changes in the tested exchange rates. Nevertheless, there can be an observed pattern concerning the J-curve issue in the case of Bulgarian leva. This means that in the case of the Bulgarian manufacturing trade balance, after the depreciation of Bulgarian leva, one can observe the initial worsening of this trade balance followed by increasing in the levels higher than the initial ones, resembling the letter J.

Policymakers need to factor in the differentiated effects of GDP growth and exchange rate movements on manufacturing trade balances when shaping economic policies. Similarly, businesses in the manufacturing sector, notably in Bulgaria, Poland, and Romania, should remain cautious about the potential adverse impacts of domestic GDP growth on their trade balances. Furthermore, Polish firms should evaluate their vulnerability to exchange rate fluctuations, particularly given the import-intensive nature of their exports and the limited hedging practices among SMEs. Lastly, stakeholders involved in trade finance and risk management should incorporate the observed pattern of the J-curve effect in the Bulgarian manufacturing trade balance into their strategies for mitigating exchange rate risks.

3.2 Results for micro-level perspective

In order to investigate the influence of basic economic aspects on the profitability of firms, the data used in the first stage had to be adjusted into a panel form. Subsequently, the data used was log-logarithmized and a stationarity test was performed on these data. The results confirmed that the data were stationary and were subsequently used for regression analysis using the GMM method. Simultaneously, the results of correlation coefficients indicate the absence of multicollinearity among the observed indicators, as none of the correlation coefficients exceed 0.8. Tab. 5 exhibits the results of the regression coefficients. At the same time, the J-statistics values are also shown, indicating the robustness of the models used.

The provided regression analysis results show the coefficients and statistical significance of the variables in the model for each country. The coefficient *ROA* (−1) represents the effect of the lagged value of *ROA* on the current *ROA*.

Tab. 5: Results of regression analysis

	Bulgaria	Croatia	Czechia	Hungary	Poland	Romania
***ROA* (–1)**	0.23*	0.22*	0.07*	0.29*	0.23*	0.21*
LEV	0.22*	0.23*	0.24*	− 0.01	0.24*	0.26*
LIQ	−0.18*	−0.10*	−0.16*	0.09*	−0.06*	−0.08*
EXR	−1,948.16	0.04	0.30	−0.02*	−1.43	−10.44*
HICP	0.06*	0.39*	0.44*	0.28*	0.06	0.58*
IR	0.27	0.89*	−0.09	0.08	0.29*	−1.06*
J-statistics	15.06	31.35	27.62	24.72	12.15	15.17

Note: * statistical significance at the 0.05 level.

Source: own (based on Orbis data)

The positive and statistically significant coefficients indicate that the past *ROA* has a positive influence on the current *ROA* for all countries. The following coefficient represents the effect of the leverage on *ROA*. The statistically significant coefficients suggest that higher leverage is associated with higher *ROA* for Bulgaria, Croatia, Czechia, Poland, and Romania. However, in Hungary, the impact of the leverage variable on *ROA* is not statistically significant. For the *LIQ*, all statistically significant coefficients indicate that higher liquidity is associated with lower *ROA* for all countries. This suggests that more liquid assets may lead to lower profitability. This discrepancy highlights the nuanced nature of the relationship between leverage and profitability, indicating that country-specific factors and market conditions play a significant role in shaping these dynamics.

Macroeconomic control variables were also examined. Research on these variables is particularly important for the robustness of the results in the model. Statistically significant coefficients of inflation (*HICP*) indicate that higher inflation is associated with higher *ROA* for Bulgaria, Croatia, Czechia, Hungary, and Romania. However, in Poland, the impact of inflation on *ROA* is not statistically significant. The last coefficient represents the effect of the interest rate on *ROA*. In this case, Croatia, Poland, and Romania have statistically significant coefficients, suggesting that the interest rate has a significant impact on *ROA* in these countries. However, for Bulgaria, Czechia, and Hungary, the interest rate does not show a statistically significant relationship with *ROA*. According to the results of the Sargen Hansen test (J-statistics) for robustness of models, it can be confirmed that all models yield statistically significant results.

For SMEs, understanding the nuanced relationship between financial metrics and profitability is crucial. The findings suggest that past performance strongly influences current profitability, highlighting the importance of maintaining consistent financial health. Moreover, the impact of leverage and liquidity on profitability underscores the need for prudent financial management strategies tailored to each country's economic context. SMEs should pay particular attention to the potential adverse effects of excessive liquidity on profitability, especially in countries where this relationship is statistically significant.

In the case of exchange rates, only Hungary and Romania have statistically significant coefficients, suggesting that changes in the exchange rate have a significant impact on *ROA* in the manufacturing of international trade between Romania and Hungary. These two countries have the highest number of companies represented in the data sample. However, the coefficients show opposite relationships to those assessed in the macroeconomic model. The other countries do not show statistically significant relationships between exchange rates and *ROA*. The Bulgarian leva was pegged to the euro in the sample period and has been in the ERM II mechanism, similarly to Croatia. This could affect non-statistically significant results in the microeconomic analysis. Therefore, this study proposes that the effects of exchange rates differ between the macroeconomic and microeconomic perspectives within the manufacturing industry. The magnitude of exchange rate effects on the bilateral trade relationships under investigation shows noticeable disparities when examining the impacts of exchange rate fluctuations on SME data. Moreover, the significant impact of exchange rates on profitability highlights the need for policies that mitigate the adverse effects of exchange rate fluctuations, especially for countries heavily reliant on manufacturing exports.

Overall, the research findings highlight a significant disjunction between macroeconomic and microeconomic perspectives on the impact of exchange rates within the manufacturing industry. While macroeconomic analysis indicates a general trend towards expected outcomes, such as increased exports and improved trade balance following domestic currency depreciation, microeconomic regression analysis reveals a more nuanced picture. Contrary to macroeconomic assumptions, the microeconomic perspective, particularly in the case of Romania and Hungary, suggests that exchange rate effects may have opposite impacts on return on assets (*ROA*) in the manufacturing sector in tested small and medium-sized companies. This discrepancy underscores the complexity of exchange rate dynamics and emphasizes the need for nuanced, context-specific analyses when assessing the influence of exchange rate fluctuations on international trade and financial performance.

Conclusions

This paper analyzed the effects of exchange rates on international trade in the manufacturing

sector in selected CEE countries. The manufacturing sector is an essential part of their economies, and these countries are becoming increasingly integrated into the global supply chain, making them more exposed to international economic fluctuations. Understanding the effects of exchange rates on their manufacturing international trade is crucial for policymakers, businesses, and investors operating in the region. The macroeconomic results showed that only half of the statistically significant coefficients held the assumption that an increase in domestic GDP leads to increased imports and decreased exports resulting in the worsening of the manufacturing trade balance. Although the coefficients of exchange rates were smaller compared to the coefficients of GDPs, they still hold significance in the context of the growth and development of international trade in the manufacturing sector. The expected results were positive coefficients of the exchange rate, and almost all tested relationships fulfilled this presumption, except for Poland. The short-term effects of exchange rate changes were limited, but there was a pattern concerning the J-curve issue in the case of the effects of Bulgarian leva on the manufacturing trade balance between Bulgaria and the Eurozone. In the long run, the combined import and export price elasticities exceed one, indicating a greater responsiveness of trade volumes to changes in prices compared to the short run. The short-term negative impact of Bulgarian leva on manufacturing international trade is followed by the long-term increase in trade balance eventually.

Based on the microeconomic regression analysis results, we can draw conclusions regarding the factors influencing return on assets (*ROA*) across the examined countries. These findings shed light on the intricate relationships between key variables and the financial performance of companies in each respective economy. Firstly, leverage emerges as a factor with varying effects across the countries under scrutiny. While Bulgaria, Croatia, Czechia, Poland, and Romania exhibit a positive relationship between leverage and *ROA*, Hungary displays no statistically significant impact. Furthermore, liquidity levels demonstrate consistent negative associations with *ROA* across all examined nations. This implies that increased liquidity, characterized by a higher ability to convert assets into cash, may hinder overall profitability. The impact of exchange rates on *ROA* is less uniform, with only Hungary displaying a statistically significant relationship. Moreover, inflation exerts an impact on *ROA* in several countries. Bulgaria, Croatia, Czechia, Hungary, and Romania all experience a positive and statistically significant relationship between inflation and *ROA*. This implies that higher inflation rates coincide with enhanced profitability in these nations, potentially signaling a favorable business environment. Finally, the findings reveal that interest rates play a significant role in determining the profitability of companies in specific countries. Croatia, Poland, and Romania display statistically significant relationships between interest rates and *ROA*. The findings underscore the multifaceted nature of profitability determinants, highlighting the significance of factors such as past performance, leverage, liquidity, and inflation.

The exchange rates were found to be statistically significant only in the case of Romania and Hungary. However, the coefficients show opposite relationships to those assessed in the macroeconomic model. Therefore, this study suggests that the impact of exchange rate effects differs between the macroeconomic and microeconomic perspectives within the manufacturing industry. The intensity of exchange rate effects on the examined bilateral trade relationships is notably diverse when considering the effects of exchange rate changes in SME data. The findings of this research demonstrate that the role and influence of the exchange rate on analyzed CEE international trade cannot be generalized. It cannot be assumed that the depreciation of the local currency will automatically enhance exports, reduce imports, and improve the manufacturing trade balance or that the opposite will occur following an appreciation.

The firm's production faces constraints precisely at the time when export and import opportunities are most abundant, prompting the firm to hedge against cash flow shocks. Empirical results indicate that changes in exchange rates affect the performance of international trade flows and that export prices tend to remain fixed in the buyer's currency. The response of international trade volumes to fluctuations in exchange rates stems not only from changes in the buyer's currency prices but also from the relaxation of financing constraints, either through the direct positive impact of exchange rate shocks on cash flows or through hedging activities.

The findings of this study carry important implications for policymakers, investors, or businesses operating in the CEE region. Policymakers can utilize these insights when formulating strategies to support the manufacturing sector and enhance international trade competitiveness. Understanding the nuanced effects of exchange rates on international trade and financial performance is vital, especially for SMEs, given their increasing integration into the global supply chain and exposure to international economic fluctuations. The findings suggest that SMEs need to adopt proactive strategies to manage exchange rate risk effectively and capitalize on export opportunities. Policymakers can use these insights to formulate targeted policies that support SMEs in navigating exchange rate dynamics and enhancing their competitiveness in international markets. Moreover, investors should consider the implications of exchange rate movements on SMEs' financial performance when making investment decisions in the CEE region, while SMEs themselves can leverage these findings to inform strategic decision-making processes, particularly regarding exchange rate risk management and international market expansion.

The study is subject to certain limitations. Firstly, it exclusively focuses on the manufacturing sector within selected Central and Eastern European countries, potentially restricting the generalizability of findings to other sectors or regions. Secondly, reliance on secondary data sources may introduce limitations, including issues related to data availability and accuracy. Lastly, the study predominantly examines the effects of exchange rates on international trade and financial performance, overlooking other potentially influential factors such as political instability or technological advancements. For further research, there is a need to explore the impact of additional variables, such as political stability or technological innovation, on international trade and financial performance within the manufacturing sector. Also, further investigation into the long-term effects of exchange rate fluctuations on trade dynamics and financial performance could provide deeper insights into underlying mechanisms.

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