The Role of CZK/PLN Exchange Rate in the Context of Foreign Trade between Czechia and Poland

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Abstract
The aim of this paper is to evaluate the impact of CZK/PLN development on trade flows between the Czech Republic and Poland in the context of disaggregated data on product-level trade balances. The dataset used in this study covers period from 1999 to 2014. We consider selected product categories determined on the basis of SITC classification. We employ the Johansen cointegration test to analyze the long term relationship and a vector error correction model to explore the short term effects of CZK/PLN exchange rate level. Our findings suggest that total bilateral trade balances and most of product groups are related with exchange rate in the long term. The commodity-level results are ambiguous and can not be generalized across different product categories.

Keywords: exchange rate, product-level trade balance, cointegration, vector error correction model
JEL codes: F1, F31

1. Introduction

The relationship between exchange rates and international trade belongs among the topics that have attracted considerable interest in both academic research and policy making. An extensive body of literature has been published, particularly since the collapse of the Bretton Woods system, which brought about floating exchange rates of the major world currencies and increased exchange rate uncertainty. In theory, the effect of exchange rate levels and their changes can be analyzed in terms of price and volume effects on exports and imports. Because the depreciation of the currency results in the reduction in the price of exports, the demanded quantity for them will increase. At the same time, the price of imports will rise, and their demanded quantity will decrease. A positive effect of currency depreciation on trade balance is, however, conditioned by the validity of the Marshall-Lerner condition, which states that the sum of export and import demand elasticity has to be at least one. This condition is usually not met in the short run. Therefore, the short-run deterioration and long-run improvement of trade balance after depreciation graphically resembles the letter "J" and is known in literature as the J-curve phenomenon.

For the purpose of analyzing the effect of exchange rate level on foreign trade in this paper is chosen foreign trade flow between the Czech Republic and Poland. From an economic perspective, it is a pair of geographically close open economies located in Central Europe, which has successfully completed the transition process to the market economies. After significant political transformation and reforms, these countries experienced significant changes in their foreign trade issues as well. This process began with redirecting trade from east to west, thus the structure and intensity of trade flows has significantly changed. Their initial limited interaction with the world economy was based more on the state restrictions then the market decisions and prices. Nowadays this former relatively isolated economies have turned into countries which significantly contributes to world foreign trade flows.

Despite many common economic features of this countries, in the area of international trade they represent two different subjects. We can present it in the openness of individual country which has been growing in time for each economy, but the total rate varies across them. This fact can be illustrated by using the share of foreign trade on their GDP between 1999–2014. For the Czech Republic this rate has increased from 74 % to almost 150 % and for Poland from 39 % to 78 %. The transformation process also reflected in the development of foreign exchange rates. Country abandoned the fixed exchange rate regimes and moved toward a flexible exchange rate regime. The country with the high rates of

participation in foreign trade and a gradual inclination to floating exchange rates make this countries eligible for this research. Paper takes into account the territorial and commodity structure of their foreign trade. Therefore, the aim of this paper is to evaluate the impact of CZK/PLN development on trade flows between the Czech Republic and Poland in the context of disaggregated data on product-level trade balances.

2. Literature Review

The theoretical assumption that currency depreciation temporarily worsens a country's trade balance and improves it later (J-curve effect) has not been conclusively validated by empirical research. The findings are mixed and depend on the country (region) and period under estimation and on the data and methodology used. Many studies have even confirmed a negative relationship or no long-term relationship at all. We refer to Bahmani-Oskooee and Ratha (2004) for an excellent in-depth review of the J-curve literature. According to Baek (2013), the literature concerning the J-curve issue tends to fall into one of the following categories based on data using:

- aggregate trade data (e.g., Bahmani-Oskooee, 1986; Felrningham, 1988; Mahdavi and Sohrabian, 1993);
- disaggregate trade data at a bilateral level (e.g., Wilson, 2001; Arora et al., 2003; Bahmani-Oskooee and Ratha, 2007);
- disaggregate trade data at the industry/commodity level (e.g., Bahmani-Oskooee et al., 2010; Bahmani-Oskooee and Hegerty, 2011; Bahmani-Oskooee et al., 2014).

The first-type studies suffer from a substantial aggregation bias of data. Those studies usually employ data on trade balance between a country and the rest of the world along with an effective exchange rate. Furthermore, one needs to construct a proxy for the world income, which can also be partly misleading (Rose and Yellen, 1989). The second-generation studies, therefore, use bilateral exchange rates and bilateral trade balance data between a country and its major trading partners. However, these studies still do not address the issue of different responses of trade balance on exchange rates across the industries and/or commodity groups. Hence, the third-type studies, which represent the most recent works, disaggregate the data to the industry level, as well. In other words, a greater availability of more precise data allows researchers to use exchange rates and industry/commodity-level data on a bilateral basis and simultaneously treats exports and imports separately to assess the relationship between exchange rate and trade balance accurately.

Although many studies on the J-curve effect have been published, few of them focus on Central and Eastern European (CEE) countries and Czechia and Poland in particular. Bahmani-Oskooee and Kutan (2009) is the most comprehensive study of the J-curve phenomenon in emerging Europe. Based on data from 12 countries covering the period 1990 - 2005, they found empirical support for the J-curve effect in Bulgaria, Croatia and Russia. By contrast, no evidence of the J-curve effect was revealed for Czechia and Poland. More recently, Nusair (2013) applied a similar methodology of autoregressive distributed lag (ARDL) cointegration and a corresponding error correction model on data from 17 emerging and transitioning countries over the period 1991 - 2012. In empirical estimations, an aggregate trade balance data and effective exchange rates are used. Although the J-curve effect was present in Armenia, Georgia and Ukraine, the Czech and Polish economy remained free of the J-curve effect. The specific estimation of J-curve effect in bilateral trade between Czechia and Poland can be found very rarely. The J-curve for their mutual trade flows was empirically confirmed by Šimáková (2012).

3. Methodology and Data

We follow Bahmani-Oskooee and Kutan (2009) in the empirical modelling of the long-term relationship between exchange rates and trade balance. We apply the cointegration procedure developed by Johansen (1997) to avoid the main criticism of early studies, whose results could suffer from a spurious regression problem because of non-stationary data. Equation (1) has the form:

$$lnTB_{p,t} = \alpha + \beta lnY_{d,t} + \gamma lnY_{f,t} + \lambda lnER_{f,t} + \varepsilon_t \quad (1)$$

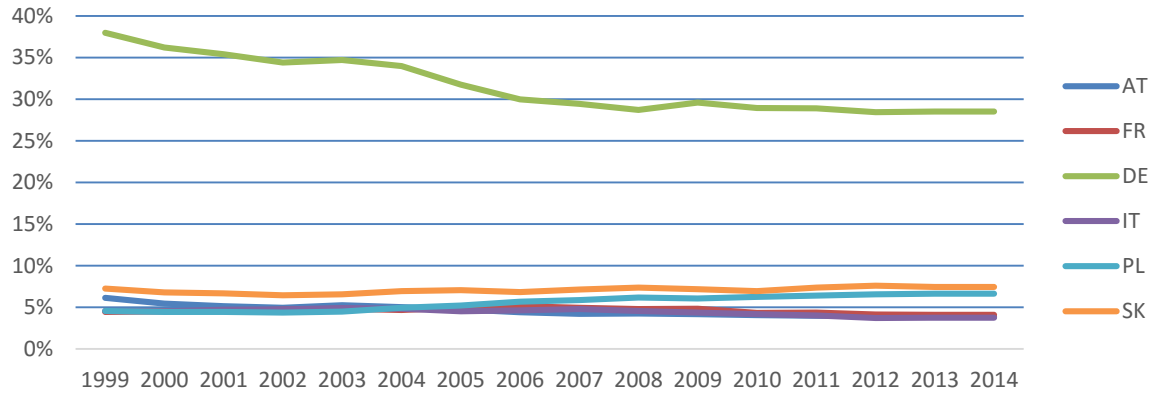
where TB_p is a measure of the trade balance in time period t defined as the ratio of exports of domestic country d to foreign country f over the imports from country f in a selected product group p. Y_d is GDP of domestic country set in index form to make it unit free (Bahmani-Oskooee, 1991); Y_f is the GDP in trading partner f, and ER_f is the bilateral exchange rate. The exchange rate is in a direct quotation, i.e., defined in a manner such that an increase reflects a depreciation of the domestic currency. ε_t represents an error term. Because an increase in foreign income Y_f is expected to increase the domestic exports to a certain country, an estimate of γ is expected to be positive. An increase in domestic income Y_d is assumed to increase the imports; therefore, an estimate of β is expected to be negative. Finally, we expect the parameter λ to be positive because the trade balance of an industry should improve due to domestic currency depreciation.

To test the short-run relationship, a short term dynamic is incorporated into the long-run model. In accordance with Hsing (2009), we apply the following modified error correction model (2), where EC is the disequilibrium term and $\vartheta_k EC_{t-1}$ represents the error correction mechanism:

$$\Delta lnTB_{p,t} = \alpha + \sum_{k=1}^{n} \omega_k \Delta lnTB_{t-k} + \sum_{k=1}^{n} \beta_k \Delta lnY_{d,t-k} + \sum_{k=1}^{n} \gamma_k \Delta lnY_{f,t-k} + \sum_{k=1}^{n} {}^{\lambda}{}_k \Delta lnER_{f,t-k} + \vartheta_k EC_{t-1} + \varepsilon_t \quad (2)$$

All time series except exchange rates used for estimation are on a quarterly frequency and cover the period from 1999 to 2014. The data of GDP, bilateral exchange rates and foreign trade are obtained from the OECD iLibrary.

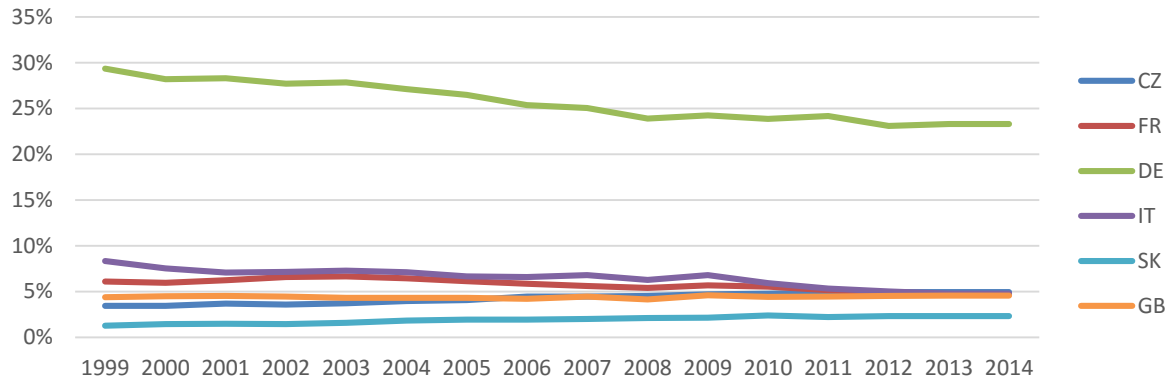
Figure 1: Territorial Structure of Czech Foreign Trade



Source: authors´ calculations based on OECD statistics

Figure 1 and 2 show the shares of major trading partners of the Czech Republic and Poland on their total foreign trade turnover. It can be seen that the selected countries focus on the similar export markets and their regional similarity of consumer behavior translates also to their mutual trade. Bilateral trade between these two countries is based on the long-term economic ties. Czechia and Poland implement foreign trade even thanks to barrier-free trade within EU.

Figure 2: Territorial Structure of Polish Foreign Trade

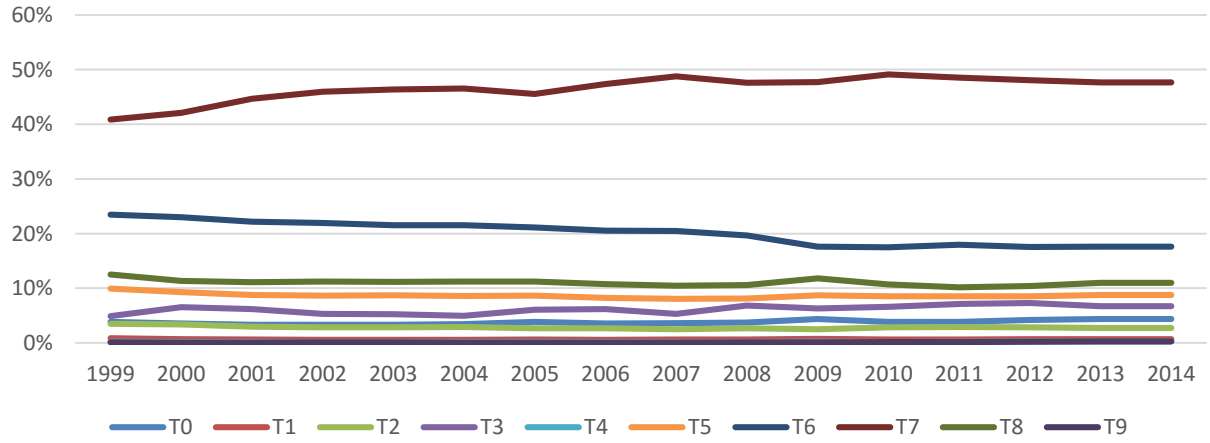


Source: authors´ calculations based on OECD statistics

The product groups used in estimations are determined on the basis of SITC classification:

- T0: Food and live animals;
- T1: Beverages and tobacco;
- T2: Crude materials, inedible, except fuels;
- T3: Mineral fuels, lubricants and related materials;
- T4: Animal and vegetable oils, fats and waxes;
- T5: Chemicals and related products;
- T6: Manufactured goods;
- T7: Machinery and transport equipment;
- T8: Miscellaneous manufactured articles; and
- T9: Commodities and transactions not classified elsewhere in the SITC.

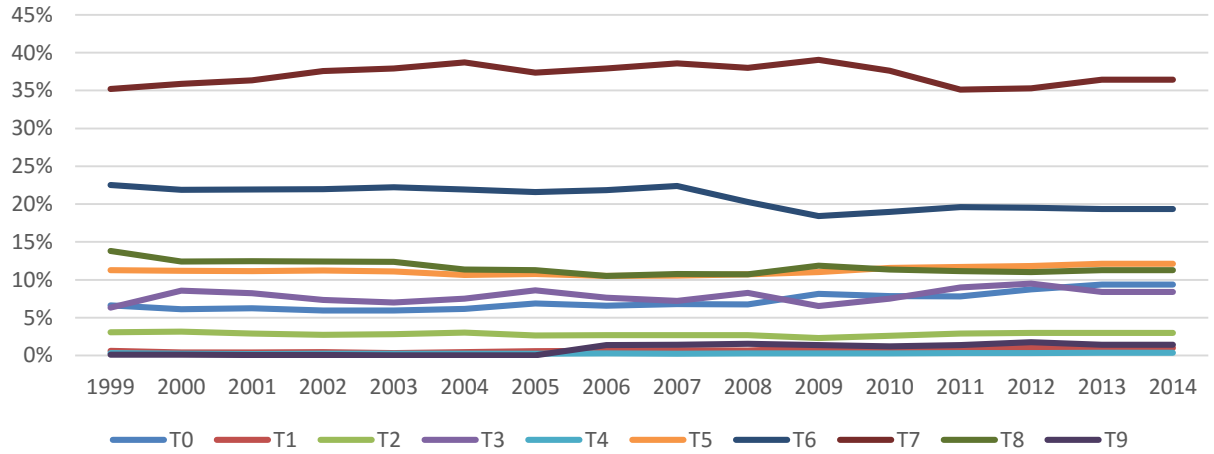
Figure 3: Development of Commodity Structure of Czech Foreign Trade (share on total foreign trade of the country in %)



Source: authors´ calculations based on OECD statistics

Figure 3 and 4 show the average share of individual product categories on Czechia's and Poland's total international trade during the period 1999 – 2014. Almost half of total trade falls into product category T7, and two more product groups (T6 and T8) represent an additional 20 % and 10 % of international trade, respectively.

Figure 4: Development of Commodity Structure of Polish Foreign Trade (share on total foreign trade of the country in %)



Source: authors´ calculations based on OECD statistics

4. Empirical Analysis

To examine the effects of exchange rates level on the bilateral trade balance is used model based on Bahmani-Oskooee and Kutan (2009). In equation (1) is variable *TB* calculated as the proportion of exports to import within the bilateral trade flows between Poland and the Czech Republic. The paper assumes different influence of foreign currency fluctuations on individual partial trade balances. The variable TB_p from equation (2) is therefore calculated as a share of export to import in individual product categories SITC in every trade flow. Incomes of countries Y_d and Y_f, are represented by GDP in current prices, and are converted into an index form, to achieve unitless value, as recommended by the Bahmani-Oskooee (1991). Exchange rates *ER* are calculated as a quarterly average of monthly nominal exchange rate in direct quotations. Each equation is estimated in two directions. In first direction, Czechia represents domestic country and Poland is its foreign trading partner, in the second direction it is vice versa.

Data sample covers the period 1999:Q1 – 2014:Q3, which represents 63 observations on quarterly frequency. All time series are adjusted by logarithmic transformation and subjected to ADF stationarity testing. ADF test results confirmed the integration of I(1), which is the basic precondition for the Johansen cointegration analysis testing the long-term relationships and subsequent modeling of short-term effects with the VECM model. The presence of tendency to long-term equilibrium between the variables is assessed on the basis Trace and Maximum eigenvalue test.

Since the choice of lag orders of the variables in the vector error correction model specification can have a significant effect on the inference drawn from the model, we sequentially determined the appropriate lag length for each variable. The literature typically shows lags centered around two years for many countries, but the exact number can differ across the trading partners due to different character and elasticity of trading goods and time lags in the consumers search for acceptable, cheaper alternatives (Auboin and Ruta, 2013).

The optimal lags given by maximizing of Schwarz information criterion for each estimated trading partner within different product groups are reported in Table 1. In the same table, one can see results of the Johansen cointegration test, where *r* states for number of cointegration equations.

Table 1: Number of Lags and Cointegration Equations

		TT	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9
CZ	*lag*	2	2	2	2	2	2	3	2	3	4	4
	r	1	2	1	2	1	0	1	1	1	1	0
PL	*lag*	4	4	4	4	4	4	4	4	4	6	5
	r	1	1	1	1	1	0	2	1	1	1	0

Source: authors´ calculations

From the perspective of Czechia, the optimum lag calculated for each trading flow in individual product categories shows that the average delay in the product groups from T0 to T4 is lower than in other monitored categories. This confirms the assumption of Auboin and Ruta (2013) that lower lags in these product categories are caused by the higher substitution. Johansen cointegration test results says that the aggregate bilateral trade balance with Poland is in long term relationship with CZK/PLN exchange rate, but on the product level, we can find exceptions. Neither cointegrating vector is found in the product category T4 and T9. T4 product category is characterized by a substantially smaller share of the total foreign trade. For the Czech Republic it is for the sample less than 0.1%. The share of category T9 is even lower and, moreover, it is clear that this is an inconsistent product category for which it is not possible to find common characteristics.

The optimum lags calculated from Polish perspective shows that delays are except the categories T8 and T9 constant and represent one year. Johansen cointegration test confirms the existing cointegration on the aggregate bilateral level. Nor for this case, product categories T4 and T9 do not show long-term relationship in estimated equations. The non-cointegrated categories represents less than 1%, therefore it can be concluded that the tested trade balances are characterized by long-term mutual development of Czech GDP, Polish GDP, as well as CZK/PLN exchange rate, regardless of the direction of monitored trade flows.

We run 20 cointegration estimations, but did not reveal cointegration equations in all cases. No long-term relationship with exchange rate development was found, particularly for product groups T4 and T9 as was already mentioned. As a next step, we proceeded with assessing the long-term coefficient estimates for the models with evidence of a cointegrating relationship. Detailed results can be observed in Table 2.

Table 2: Estimated Long Run Coefficients of Trade Models

		TT	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9
CZ	*Yd*	1.29	-	-0.07	-	1.04	-	-3.14	0.93	-2.49	0.13	-
	Yf	1.02	-0.39	0.9	1.32	0.84	-	1.76	-0.96	0.44	0.53	-
	ER	3.55	2.63	0.65	1.71	0.56	-	-2.81	0.22	-0.82	0.71	-
PL	*Yd*	0.55	-0.23	-0.34	3.08	-0.41	-	-	1.25	-1.47	0.14	-
	Yf	0.17	0.87	2.18	-4.26	0.38	-	1.8	-0.77	2.71	-0.67	-
	ER	0.32	0.73	-1.51	0.21	0.57	-	-1.52	0.62	-0.74	2.23	-

Source: authors´ calculations

Analysis of long-term coefficients for the Czech Republic shows that domestic GDP has significant differences across effects on tested product categories. Cointegration analysis on the total bilateral trade confirmed the opposite relationship with domestic GDP. However, partial analyzes of this effect do not support the overall coefficient. Identical conclusion for total and partial trade balances with Poland represents 36% of their bilateral foreign trade. The results thus clearly show the possible bias resulting from aggregation of data. The estimated coefficients of foreign GDP provide clearer conclusions. GDP of Poland (foreign income in model) has a positive effect on overall bilateral trade balance. The increase in income in foreign economy can thus be approximated with an increase in the purchasing power of foreign investors, increase of foreign demand of domestic goods and thus increase of the export. Contrary, on the product level can be also find the opposite effect, what represents the 37% share of bilateral foreign trade. The results presented in Table 2 show that trade flows between Czechia and Poland are positively affected by variable of exchange rate on total bilateral level. These estimates support the expected positive effect of the depreciation of the Czech koruna to their trade flows. The expected effect of depreciation on product-level trade balance can be observed in estimations representing 77% share of total trade flows.

From estimations for Poland can be seen that its domestic income has the same effect as for the Czechia. Parameter of Czech GDP representing the foreign trading partner shows again a little clearer conclusions. The depreciation of the Polish zloty is connected with an improvement of total bilateral trade balance. Although the depreciation of the Polish zloty against Czech koruna demonstrates a

positive effect on 60% of the total foreign trade product categories with Czechia, the results again confirm the problem of smoothing some effects while aggregating data of different kinds of goods.

As indicated before, the short-run effects of depreciation are reflected in the coefficient estimates obtained for the lagged value of the first differenced exchange rate variable. The J-curve approach allows us to distinguish the short-run effects from the long-run effects. The traditional J-curve is confirmed if the estimate of the coefficient for the exchange rate is significantly negative at lower lags and is followed by a significantly positive coefficient at longer lags. Simultaneously, the J-curve can be represented as negative short-run coefficients, followed by a positive long-run coefficient. In this study, only some short-term coefficients based on VECM model are statistically significant. In case of Czechia can be found negative coefficients for product categories T0, T3, T7 and T8. Contrary the positive coefficient are revealed in case of trade flows in T2. The negative coefficients followed by positive ones what confirm the presence of J-curve is estimated only in case of T0, T3 and T6. In case of Poland, coefficients show a positive short-term relationship between exchange rate and trade balance in T0, T2 and T3 product group. On the contrary, significantly negative coefficients can be found for product group T7.

5. Conclusion

Paper was focused on the relationship between exchange rate level and foreign trade. The aim of this paper was to evaluate the impact of CZK/PLN development on trade flows between the Czech Republic and Poland in the context of disaggregated data on product-level trade balances. Results confirm assumption that tested trade balances between Czechia and Poland are characterized by long-term mutual development of Czech GDP, Polish GDP, as well as CZK/PLN exchange rate, regardless of the direction of monitored trade flows. Product-level analysis shows that the impact of exchange rate level across the tested product categories can differ. Results show disunity with economic theory in some ways and can not be clearly generalized.

Ambiguous exchange rate effect on foreign trade which do not verified the economic theory can be explained by several characteristics of participation in mutual commodity movements. Both countries has a significant presence of foreign direct investment. Many foreign companies with subsidiary branches include multinational corporations operating on different territories. This fact implies their strong involvement in export and import transactions within multinational companies. World economic environment is constantly changing and the current trend of global supply chains and multinational companies is also accompanied by an expansion of the total international trade flows due to intermediate crossing national borders several times during production. In this situation, the relationship between the exchange rate and trade flows can vary significantly. Kiss and Schuszter (2014) also discuss the implications of corporate financing through loans in foreign currencies. All these attributes result in the fact that the bulk of international trade is related to the natural hedging. Čadek et al. (2011) provided such analysis of hedging in case of Czech companies and found that the majority of exports are realized through the euro. The incoming and outgoing payments of foreign trade are carried out without the use of local currency. The paper states that in 2009, almost 60% of Czech exports used natural hedging and the rest was covered mainly by financial derivatives. Similar conclusions can also be found for the Poland in the study by Égert-Zumaquera and Morales (2008). According to Abrams (1980) is a determinant of the relationship and potential export capacity of the country, its structure and consumption, which affects the elasticity of the demand for export and import and, therefore, the effect of exchange rate volatility on trade flows. An important factor in the characteristics of foreign trade between Czechia and Poland is the degree of integration of trading partners. According to Martinez-Zarzoso and Ramos (2008), with the higher integration of economies, the volume of trade between them is increasing and exchange rates as one of the determinants and act to a lower extent. Economic relation between Czechia and Poland clearly shows the importance of integrity for the implementation of foreign trade and for trade within the EU.

Acknowledgement

This paper was supported by the Ministry of Education, Youth and Sports within the Institutional Support for Long-term Development of a Research Organization in 2015.

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