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## **Abstract**

The present paper is focussed on the impact of introducing the common European currency on export performance. Our objective is to explore the impact of introducing the common European currency on the export performance of Slovakia in comparison to the Czech Republic and the old EU member states. Our findings suggest that the export performance and other export-related indicators evolved largely in parallel in both countries. Positive trade effects brought about by the introduction of the euro are rather moderate – up to 5%. The results to some extent do confirm the existence of the so called “Rose effect” – the effect that two countries sharing the same currency trade more than they would otherwise.

**Keywords:** competitiveness, euro adoption, export, Czech Republic, Slovakia

**JEL Classification:** F14, F15

## **1. Introduction**

The presented paper focuses on the impact of introducing the common European currency on a country’s export performance. In particular, our objective is to explore the impact of introducing the common European currency on the export performance of Slovakia in comparison to the Czech Republic and the old EU member states. Neither professional studies nor public declarations published in the period before the introduction of the euro dealt with detailed expectations associated with its impact on export of Slovak businesses and the country as a whole. This paper thus aims to contribute to the discussion over the costs and benefits of the Eurozone membership.

The remainder of this work is organized as follows. Section 2 briefly discusses the theoretical background of the impact of currency unions on trade. Section 3 proceeds with analytical framework. Emphasizing the experience of Slovakia and the Czech Republic, it reviews the empirical evidence and achieved results regarding the impact of euro adoption on foreign trade. Finally, Section 4 assesses all the information and arguments presented in the paper and on their basis formulates a conclusion.

## **2. Theoretical Background**

For most of the last hundred years, economists and policymakers thought that exchange rate volatility and multiple currencies depressed trade. However, until relatively recently, economists could not find robust empirical evidence for a negative impact of exchange rates and volatility on trade flows despite increasingly sophisticated empirical methods and larger datasets. The situation changed dramatically when Rose published his finding that

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a currency union is a powerful stimulant to trade (1999). The so called “Rose effects” implied that two countries that share the same currency trade three times as much as they would trade with different currencies. Furthermore, Rose found a negative trade effect of exchange rate volatility, even after controlling for the endogenous nature of the exchange rate regime. Since then, a lot of research has been conducted either to confirm or disprove Rose’s results. The empirical literature on the boost to trade due to the formation of a monetary and currency union is, however, rather ambiguous. Berger and Nitsch, taking a long-run view of European integration, found that the introduction of the euro had had almost no effect on trade (1995). Specifically, there is evidence for a gradual increase (rather than a one-time jump) in trade intensity between countries that later join the EMU over a period of more than fifty years. After controlling for this long-term trend, the introduction of the euro had no additional effect on trade. Pakko and Wall even reported a 40% negative effect of currency unions on trade (2001, pp. 37–46). On the other side of the spectrum lies the paper by Alesina, Barro and Tenreyro estimating that currency union has a positive effect on bilateral trade of as much as 1.388% (2002). According to McKinsey & Company the trade increase within the euro area is an important lever substantially benefiting EMU members (2012). Nonetheless, the study states that the countries benefit to different degrees. Dědek reports of the negative trade effects after the breakup of the common currency area in case of the former Czech and Slovak Federal Republic and the subsequent creation of independent Czech and Slovak Republics in 1993. In the first two years after the split, exports to the other republic declined by 22% and 19% in the Czech Republic, respectively, and by 18% and 8% in Slovakia, respectively. At the same time, export to other countries rose markedly (1996).

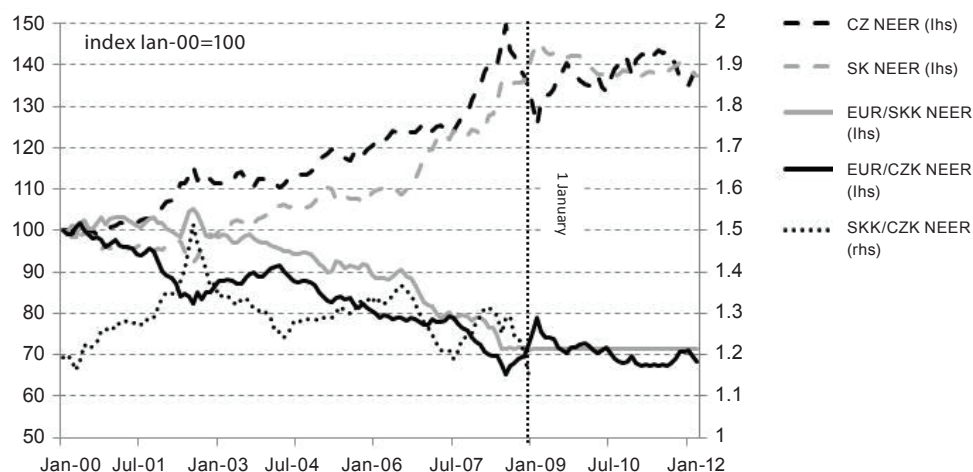
### 3. Export Performance of the Czech Republic and Slovakia

Too little time has passed since the introduction of the euro to make a serious in-depth econometric analysis examining its impact on the Slovak economy, especially if we consider that the euro is generally expected to be beneficial mainly from the long term. The task becomes even harder bearing in mind the fact that the currency changeover coincided with emergence of the economic recession, which severely harmed the country’s small and export-dependent economy. In addition to that, negative effects of the economic downturn were exacerbated by a fortnight-long interruption of industrial production caused by the gas crisis that occurred in January 2009.

Before analysing export performance, a closer look at the development of the exchange rate is desirable. CZK and SKK had evolved broadly in parallel from 2004 until mid-2008. Especially in the second half of the period, both currencies recorded substantial nominal effective appreciation. The exchange rate between the two currencies had remained relatively stable, oscillating around 1.25 SKK/CZK. Fixation of the EUR/SKK<sup>1</sup> exchange rate was confirmed by market development, with trades close to the conversion rate until the end of 2008 in spite of the considerable market instability. Meantime, the Czech koruna, while enjoying full exchange rate flexibility, depreciated sharply against the euro between mid-2008 and early 2009.

1 If this rate goes up, more foreign currency can be obtained for EUR. It therefore becomes more expensive for those who want to exchange foreign currency for euro. In other words, an upward movement of EUR/SKK line means EUR is appreciating and SKK is depreciating.

**Figure 1 | NEER and Bilateral SKK/CZK Exchange Rate**



Source: National central banks, Oanda

**Figure 2 | 3-year % Change of Real Effective Exchange Rate**



Source: DG ECFIN

The real effective exchange rate based on consumer prices is a measure that captures the drivers of changes in price and cost competitiveness of each state relative to its major trading partners<sup>2</sup>. This indicator exemplifies the attractiveness of imports over domestic production and, since it accounts for broader price developments, it casts a more

2 36 industrialized countries: the EU-27 plus Australia, Canada, the United States, Japan, Norway, New Zealand, Mexico, Switzerland, and Turkey.

comprehensive picture of global “price” pressures on domestic producers in a medium-term perspective (EC, 2012).

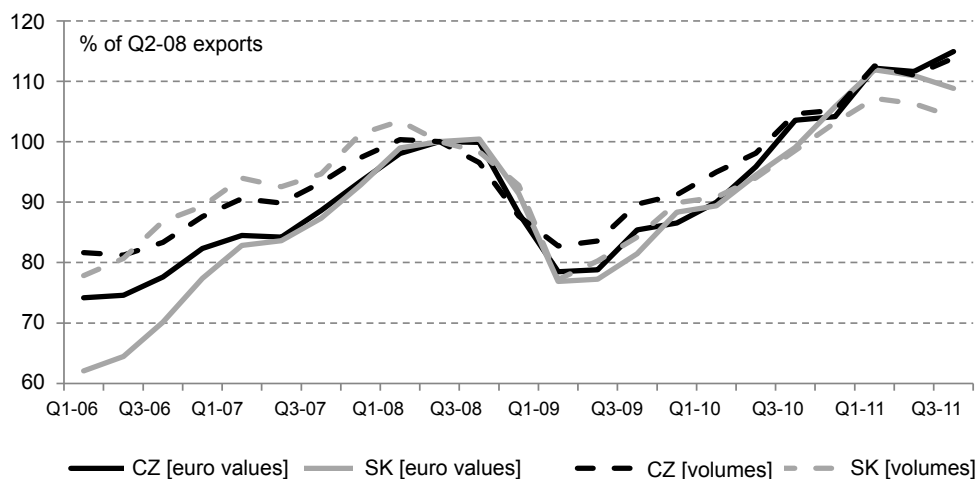
Both economies under observation experienced losses in price competitiveness through strong effective exchange rate appreciation. The growth can most likely be attributed to the nominal exchange rate appreciation in 2008. In 2009, the difference in the exchange rate regimes made a major dissimilarity and, while Slovak REER further increased, CZK with its exchange rate elasticity depreciated. Fidrmuc *et al.* (2013) say it is normal that a rapidly growing economy experiences a real exchange rate appreciation. Nevertheless, they question whether the appreciation “immediately before the crisis would not have been reversed if the nominal exchange rate had not been fixed just at the outbreak of the crisis”. Considering the fact that the Czech Republic had strongly depreciated its currency, it is not far-fetched to argue that “Slovakia entered the euro area with an exchange rate which turned out to be overvalued in the face of the crisis”, the authors conclude.

Taking into account all the above points, export earnings in euro terms evolved largely in parallel in both countries, showing no substantial difference in performance of the two neighbours, as depicted in Figure 3. As of 2007, exports experienced very similar development, with the correlation of 0.98. The euro value of both Czech and Slovak exports dropped sharply by more than 20% during Q4-2008 and Q2-2009, and then gradually recovered back to its original level by mid-2010, *i.e.* exports reached the pre-crisis levels over the period of five quarters.

On the other hand, in terms of volume, a different trend can be observed. While Czech exports fared better, losing around 17% of their Q2-2008 level and then climbing above 100% by Q3-2010, Slovakia’s export volume dropped by 23% between the onset of the crisis and its peak in 2009, and only regained its pre-crisis values by Q4-2010, still lagging behind the Czech Republic. Nominal exchange rate depreciation against the euro witnessed at the beginning of the economic slowdown may have enabled Czech exporters to lower their prices and thus to somewhat mitigate the negative impact of the external demand shock on their sales abroad at the peak of the crisis. At first glance, the difference could be explained by a too strong exchange rate caused by the devaluation of neighbouring currencies. However, the pillars of the Slovak economy, such as automotive and electro-technical industries, are strongly oriented towards exports, their import intensity is also very high and finances are acquired on international markets. The National Bank of Slovakia thus reports that since the monetary policy is not able to influence this sector, its loss does not mean higher exposure of the Slovak economy to shocks in the industry (NBS, 2006). Lalinský points out that comparing the development in Slovakia with other countries allows admitting a possible, though hard to quantify, negative impact which the strengthening of the effective exchange rate could have had on selected services (2010). On the other hand, considering the hypothesis that fixing of the koruna exchange rate and the euro transition had a significant negative impact on the competitiveness of Slovakia, exports would have recovered more slowly in 2009 in comparison with the Czech Republic or other countries with floating exchange rates.

Moreover, as Jevčák explains, “the initial competitiveness boost from the sudden weakening of the Czech koruna at the onset of the crisis might have been partly offset by the fact that a large part of export revenues was at the time hedged” at lower exchange rate levels at which the koruna had traded before the crisis (2011). This is evidenced by the fact that the export performance in nominal euro terms (*i.e.* export earnings) was almost identical for both economies, *i.e.* relatively higher real exports compensated for lower export prices.

**Figure 3 | Exports of Goods and Services**



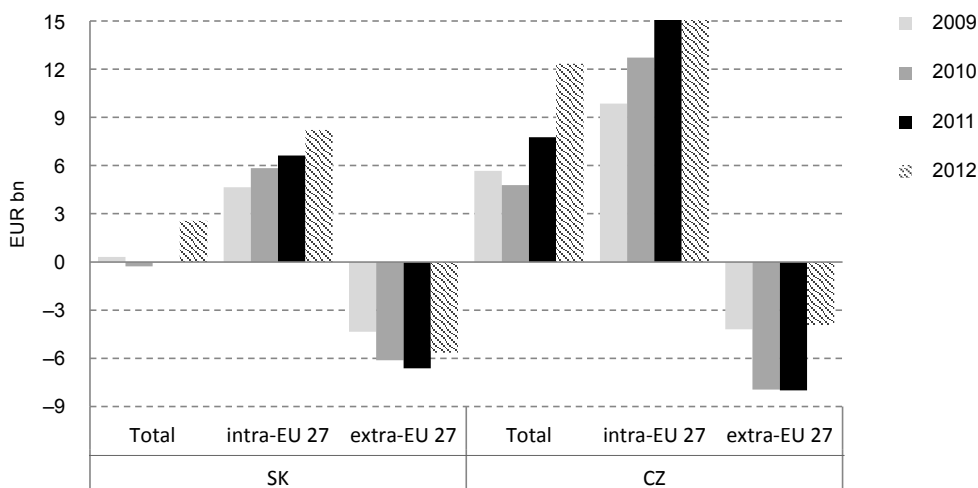
Source: Author's calculations based on Eurostat data

Lalinský suggests the high level of openness of the Slovak economy played a major role in a steeper decline of its exports (2010). Another factor is that value added is created mainly by cyclically sensitive industries. “These factors made the impact of external negative developments on the Slovak economy quicker and stronger”, he concludes. Naturally, tight trade linkages with its main trading partners mean that growth shocks in those countries were transmitted to Slovakia also *via* slower trade growth. Slovakia is particularly sensitive to developments in Germany and in the Eurozone, on which it has almost the highest trade dependence (IMF, 2012).

Figure 4 shows the evolution of trade balance in nominal terms. Overall, the trade balance of the Czech Republic has been gradually improving over the 2009–2012 period, as the crisis-related decline in domestic demand resulted in an expansion of the spread between exports and imports. While the Czech Republic maintains a highly positive balance, Slovakia oscillates around zero. Negative trade balance with extra-EU 27 partners partially offsets the positive intra-EU statistics. This indicator shows a considerable distinction between the two countries. Most likely it is caused by different structure of their respective economies, with more value added being created in the Czech Republic.

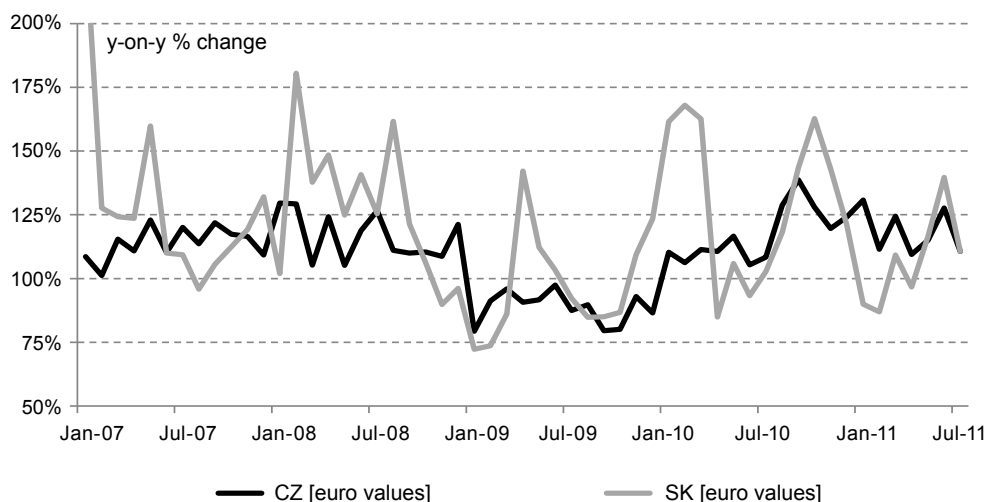
Another meaningful indicator of export performance is export market share. This measure captures structural losses in competitiveness. The logics behind is that countries lose shares of export market not only if exports decline but also if their exports do not rise at the same pace as world exports and their relative position at the global level deteriorates (European Commission, 2012). Looking at the trend of the export market share, no clear influence of the euro can be inferred. Slovakia seems to have witnessed a smaller loss during the peak of the crisis. Relative to the nominal imports of its major trading partners (weighted by their average share in Czech/Slovak exports), the evolution of Slovak exports was relatively favourable throughout 2008 and 2009, apart from a sharp drop in January 2009. Meanwhile, the Czech Republic experienced a decline in its nominal export market share in the course of 2009 and the indicator held relatively steady.

**Figure 4 | Trade Balance Development**



Source: Eurostat

**Figure 5 | Changes in Nominal Export Market Share**

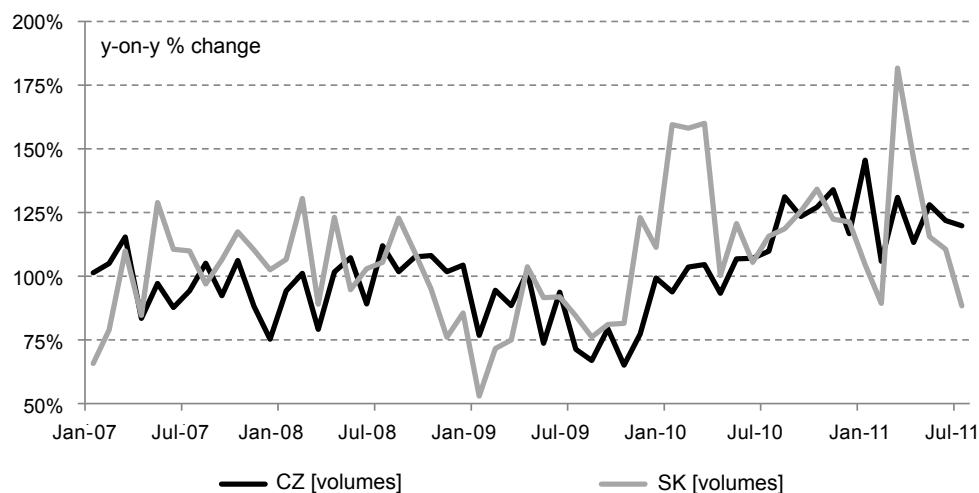


Note: Due to a lack of consistent data, only EU trading partners were taken into consideration when computing the respective market shares.

Source: Author's calculations based on Eurostat data

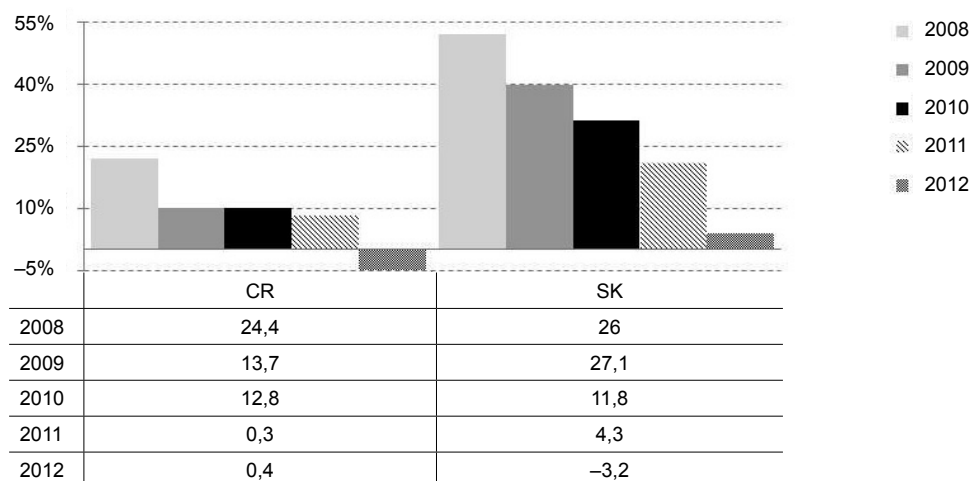
Nevertheless, according to Jevčák (2011), the Czech Republic fared relatively better if the assessment of export performance is based on volumes, which is in line with the more positive trend of its real exports mentioned earlier. But all in all, we can see only minor differences in the evolution of the indicator based on annual changes.

**Figure 6 | Changes in Export Market Share Based on Volumes**



Source: Author's calculations based on Eurostat data

**Figure 7 | 5-year % Change in Export Market Shares**



Source: European Commission

Export market share based on 5-year change shown in Figure 7 reveals that there are gains in export market shares in the Czech Republic as well as in Slovakia over the 2003–2010 period. In Slovakia, the 5-year % change was more than double in comparison with the Czech growth, but with a gradually decreasing trend surrounding the euro adoption. Therefore, neither positive nor negative effect of the euro can be deduced from this indicator.

### 3.1 Simple regression analysis

In order to empirically assess how the euro adoption affected Slovak exports, we first perform a simple regression analysis. The technique used to estimate the euro trade effects is similar to the one used by Lalinský, with the value of Slovak exports being the dependent variable (2010). The novelty of our approach stems from the fact that we introduce a couple of new independent variables and a longer dataset. The GDP variable for the EU-27, Germany and the Czech Republic has been added to increase the explanatory power of the model. Moreover, as opposed to the original dataset that ended in Q3-2009, our estimations are based on quarterly data of selected indicators for the period from Q1-2000 to Q1-2013. We employ a dummy variable to detect the effect of the euro adoption on Slovak export. The dummy variable takes on the value 1 from Q1-2009 onwards and is set to 0 otherwise. A simplified form of the regression equation can be presented as follows:

$$Exports_{SVK} = \beta_0 + \beta_1 Foreign\ demand_W + \beta_2 Foreign\ demand_{GER} + \beta_3 GDP_{EU27} + \beta_4 GDP_{GER} + \beta_5 GDP_{CZE} + \beta_6 Euro_{dummy\ variable} \quad (1)$$

We include columns A-C to show the original results obtained by Lalinský using various variables (2010).<sup>3</sup> Columns D and E represent the findings of the present author.

**Table 1 | Overview of the Results**

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>
<b>Foreign demand - World</b>	0.9 (5.9)	0.6 (4.4)	–	–	–
<b>Foreign demand - Germany</b>	–	–	0.8 (4.4)	–	<b>0.03</b> (4.16)
<b>GDP – EU27</b>	–	–	–	–	<b>0.01</b> (4.75)
<b>GDP – Germany</b>	–	–	<b>0.23</b> (5.12)	–	–
<b>GDP – Czech Republic</b>	–	–	<b>0.48</b> (2.41)	–	–
<b>Euro dummy variable<sup>5</sup></b>	–	–22.3 (5.4)	–25.3 (–3.5)	–	–

Note: Dummy variable equals to 1 in the period after the introduction of euro (or after the fixing of the exchange rate, i.e. Q3 2008, Q4 2008 or Q1 2009), and is set to 0 otherwise.

Source: Lalinský (2010) and own calculations

3 Only coefficients of statistically significant variables are included in the table (t-statistics in the brackets). Several lead or lag variables were significant, but they did not increase the estimation accuracy. In case of Lalinský (2010) growth of wages, employment and prices were significant at some points, but with opposite signs. Unemployment, GDP and gross value added proved insignificant.

A simple regression analysis confirms that export in Slovakia is driven mainly by German and Czech demand. Most of the variables carry the expected signs. As mentioned earlier, the currency changeover in Slovakia was very specific since it coincided with the outbreak of the great global recession. This might be the reason why the euro dummy variable proved statistically insignificant in the present research. This inference is in line with Cieslik *et al.*, who say the lack of statistical significance might result from the fact that the accession of Slovakia took place at the time when world trade flows were depressed (2012). The difference between the present research and the original results regarding the euro dummy variable can be explained by four years longer dataset. The results confirm a significant change in the development of indicators monitored in the given period. As Lalinský explains, this fact makes it extremely difficult to distinguish between the two opposing effects, because a dummy variable can represent a potential impact of the introduction of the euro, but also a negative impact of the crisis (2010). Thus, to answer the research questions, one needs to look at the issue from broader perspective. Employing a well-known concept of gravity equation, the following section proceeds with an empirical analysis of the euro trade effects elaborated on the data from old EU member states.

### 3.2 Analytical framework and methodology

The gravity model has a long history as many authors have noted a relationship between, on the one hand, flows among different locations and, on the other hand, the “weight” of these locations and the inverse of distance. We estimate the gravity model in log-linearized form:

$$\ln Exports_{ij} = \beta_1 \ln GDP_i + \beta_2 \ln GDP_j - \ln Trade Costs_{ij} \quad (2)$$

Anderson suggests to supplement the traditional gravity “with other proxies for trade frictions, such as the effect of political borders and common language” in order to improve the fit (2011). Taking this into consideration, the complete model takes the following form:

$$\begin{aligned} \ln Exports_{ij} = & \beta_{ij} + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln bilateral_{ij} + \beta_4 adjacency \\ & + \beta_5 common\ language + \beta_6 colony + \beta_7 same\ country \\ & + \beta_8 \ln distance_{ij} + \beta_9 landlocked_i + \beta_{10} landlocked_j \\ & + \beta_{11} fromEZ + \beta_{12} toEZ + \beta_{13} withinEZ + \beta_{14} fromSM + \beta_{15} toSM \\ & + \beta_{16} withinSM \end{aligned} \quad (3)$$

Concerning the methodology, two different techniques are employed. The first is Ordinary Least Squared method with time trend. In this case, we do not assume any particular structure of the within-panel error term, except for the presence of the unobserved effect. Standard errors are estimated by using the cluster option and thus calculating standard errors that are robust to within panel serial correlation and heteroscedasticity. The second method is a two-way fixed effects approach, known as the Least Square Dummy Variable (LSDV) regression model, in which the unobserved effect is brought explicitly into the model by a set of dummy variables.

### 3.3 Descriptive data analysis

We use panel data methods to analyse the influence of euro adoption on trade flows between euro area member states. The methodology employed draws upon the one used in Baldwin but with a couple of new variables and a set of data four years longer (Baldwin *et al.*, 2008).

The newly included variables are particularly  $\beta_6$  *colony* and  $\beta_7$  *same country*, both expected to bring additional explanatory power and increase the overall goodness of fit of the model. The country sample consists of 20 countries. Ten of them participate in the currency union and in the single market: Austria, Belgium-Luxembourg, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal and Spain. As in the paper written by Flam and Nordström, Belgium and Luxembourg are treated as a single country since they were treated as such in trade statistics until 1999 (2007). Countries that entered the euro area later are not included due to difficulties with controlling for their late entries and a too short time period spent in the euro area. Four more countries participate in the single market, but not in the currency union: Denmark, Norway, Sweden and the United Kingdom. Six OECD countries with similar levels of development and *per capita* income that are outside both the currency union and single market are also included: Australia, Canada, Japan, New Zealand, Switzerland and the United States. Altogether, this sums up to 380 country pairs with 16 observations (years) for each pair. There were trade data missing for Denmark in 1997, therefore the total number of observations in the sample is 6,061 and the panel is partially unbalanced. The sample period is 1995–2010. The starting year 1995 was chosen because Austria, Finland and Sweden became members of the EU in 1995. By starting in 1995, we do not have to control for the change in their status, nor will there be problems with time series of trade data.

Export data quoted in current U.S. dollars were taken from the United Nations Comtrade database. They were deflated using a producer price index (PPI). As an alternative, a consumer price index was used if the producer price index was unavailable. As mentioned earlier, trade data for Denmark in 1997 were not available. In the model, data are interpreted in a logarithmic form.

Current nominal exchange rates were obtained from Oanda webpage. Real exchange rates between countries  $i$  and  $j$  (an exporting country and an importing country) are also known as the bilateral exchange rate. They have been constructed by dividing the exporting country's producer price index by the importing country's PPI. The PPIs for all countries are expressed in US dollars, *i.e.* the index values are multiplied by the current exchange rate of the dollar to the corresponding currency. Exports from country  $i$  to country  $j$  are expected to decrease with increasing bilateral exchange rate.

Table 2 summarizes all the variables employed with the expected signs obtained from the regression. Trade costs should include geographical distance plus many other factors, such as border contiguity, shared language, common colonial relations *etc.* In other words, they are costs of exporting from  $i$  to  $j$  relative to the cost of exporting from  $i$ 's competitors to  $j$  (Anderson *et al.*, 2001). More relevant to the estimation are the dummy variables for exports to, from, and within the Eurozone as well as a set of dummy variables for exports to, from, and within the single market. The set of both dummies will show the difference in exports between Eurozone/single market countries and outsiders.

The descriptive statistics quantitatively describes the main features of the collected data and provides brief summaries about the sample. As the group in this setup is the country pair, the between-group variation is the variation of variables between country pairs for the considered period and the within-group variation is the variation of the country pair variable over the analysed period (Matei, 2007). Since the between variability is higher than the within variability in all cases, this is an indication of the possible heterogeneity across country pairs (Bellak *et al.*, 2008).

**Table 2 | Variables and Their Expected Signs**

Variable	Description	Source	Exp. sign
<b><math>\ln Exports_{ij}</math></b>	dependent variable; natural logarithm of the direction-specific value of bilateral exports from country $i$ to country $j$	Comtrade database	
<b><math>\ln GDP_i</math></b>	natural logarithm of the importing country's nominal GDP; the bigger the GDP, the greatest the volume of mutual trade	OECD	+
<b><math>\ln GDP_j</math></b>	natural logarithm of the exporting country's nominal GDP	OECD	+
<b><math>\ln bilateral_{ij}</math></b>	natural logarithm of the exchange rate between the exporting and the importing country; the higher the exchange rate, the more expensive the imported products get	Oanda; Eurostat	–
<b><i>adjacency</i></b>	dummy variable set to 1 if a country pair shares a common border; the shorter the distance between countries, the greater the volumes traded	CEPII database	+
<b><i>common language</i></b>	dummy variable set to 1 if a country pair uses a common official language; it is expected that countries that share a common language have less obstacles in mutual trade	CEPII database	+
<b><math>\ln distance_{ij}</math></b>	natural logarithm of the distance between the exporter and the importer based on bilateral distances between the biggest cities of the two countries, weighted by the share of the city in the overall country's population; the shorter the distance, the greater the volumes traded	CEPII database	–
<b><i>landlocked_i</i></b>	dummy variable set to equal 1 if the importing country is landlocked; landlocked countries are typically of smaller size and their trade volumes are smaller too	CEPII database	–
<b><i>landlocked_j</i></b>	dummy variable set to equal 1 if the exporting country is landlocked	CEPII database	–
<b><i>colony</i></b>	dummy variable set to equal 1 if a country pair has ever had a colonial link; it is expected that former colonies trade more with each other	CEPII database	+
<b><i>same country</i></b>	dummy variable set to equal 1 if a country pair has been the same country; similar effect as in case of a colonial link is expected	CEPII database	+
<b><math>EZ_{11}</math></b>	dummy variable for exports within the Eurozone	Own calculation	+
<b><math>EZ_{10}</math></b>	dummy variable for exports from the Eurozone	Own calculation	+
<b><math>EZ_{01}</math></b>	dummy variable for exports to the Eurozone	Own calculation	+
<b><math>SM_{11}</math></b>	dummy variable for exports within the single market	Own calculation	+
<b><math>SM_{10}</math></b>	dummy variable for exports from the single market	Own calculation	+
<b><math>SM_{01}</math></b>	dummy variable for exports to the single market	Own calculation	+

Source: Own elaboration

**Table 3 | Descriptive Statistics**

Variable		Mean	Std. Dev.	Min	Max	Observations
<b>In Exports<sub>ij</sub></b>	overall	21.51095	1.84401	15.2668	26.5920	N = 6,061
	between		1.81043	16.0114	26.1874	n = 380
	within		0.35452	20.1042	23.1559	T-bar = 15.95
<b>common language</b>	overall	0.15311	0.36012	0	1	N = 6,061
	between		0.36011	0	1	n = 380
	within		0	0.15311	0.15311	T-bar = 15.95
<b>colony</b>	overall	0.047517	0.21276	0	1	N = 6,061
	between		0.21271	0	1	n = 380
	within		0	0.04752	0.04752	T-bar = 15.95
<b>same country</b>	overall	0.00528	0.07248	0	1	N = 6,061
	between		0.07245	0	1	n = 380
	within		0	0.00528	0.00528	T-bar = 15.95
<b>In distance<sub>ij</sub></b>	overall	8.008689	1.21491	5.08096	9.88019	N = 6,061
	between		1.21655	5.08096	9.88019	n = 380
	within		0	8.00869	8.00869	T-bar = 15.95
<b>landlocked<sub>i</sub></b>	overall	0.100314	0.30044	0	1	N = 6,061
	between		0.30040	0	1	n = 380
	within		0	0.10031	0.10031	T-bar = 15.95
<b>landlocked<sub>j</sub></b>	overall	0.099984	0.30000	0	1	N = 6,061
	between		0.30040	0	1	n = 380
	within		0	0.09998	0.09998	T-bar = 15.95
<b>adjacency</b>	overall	0.105428	0.30713	0	1	N = 6,061
	between		0.30730	0	1	n = 380
	within		0	0.10543	0.10543	T-bar = 15.95
<b>In GDP<sub>i</sub></b>	overall	27.04428	1.27830	24.8903	30.3111	N = 6,061
	between		1.25818	25.2545	30.0152	n = 380
	within		0.23334	26.3783	27.5335	T-bar = 15.95
<b>In GDP<sub>j</sub></b>	overall	27.04049	1.27870	24.8903	30.3111	N = 6,061
	between		1.25883	25.2545	30.0334	n = 380
	within		0.23311	26.3443	27.5297	T-bar = 15.95
<b>In bilateral<sub>ij</sub></b>	overall	0.004575	1.67557	-4.95333	4.95333	N = 6,061
	between		1.67723	-4.74043	4.74043	n = 380
	within		0.05815	-0.29812	0.30728	T-bar = 15.95

Source: Own elaboration

A *correlation matrix*<sup>4</sup> of the analysed variables is illustrated in Table 4. At a glance, all the correlations are a matter of common sense. The correlation between exports and distance (0.506) is elevated. But, it is expected that the closer countries are the lower the costs of transportation and thus the higher the trade between them. Also, countries with higher GDP import more. Naturally, adjacency is negatively correlated with distance (−0.458) and positively correlated with common official language (0.379). Bilateral exchange rate does not display any high correlation, which is also quite reasonable.

**Table 4 | Correlation Matrix of Main Variables**

<i>Adjacency</i>	<i>Com lang off</i>	<i>Samecountry</i>	<i>ln Distw</i>	<i>Landlock ex</i>	
1.0000	0.3792	0.2122	−0.4583	0.0857	<i>Adjacency</i>
	1.0000	0.1713	−0.0447	0.0776	<i>Com lang off</i>
		1.0000	−0.1756	−0.0243	<i>Samecountry</i>
			1.0000	−0.1309	<i>ln Distw</i>
				1.0000	<i>Landlock ex</i>
<i>Landlock im</i>	<i>ln Exports</i>	<i>ln GDP ex</i>	<i>ln GDP im</i>	<i>ln bilateral</i>	
0.0862	0.3973	0.0399	0.0398	−0.0003	<i>Adjacency</i>
0.0782	0.1584	0.0316	0.0328	−0.0012	<i>Com lang off</i>
−0.0243	0.1059	−0.0170	−0.0168	−0.0002	<i>Samecountry</i>
−0.1301	−0.5044	0.1033	0.1040	−0.0015	<i>ln Distw</i>
−0.0527	−0.0576	−0.2046	0.0105	0.1092	<i>Landlock ex</i>
1.0000	−0.0959	0.0108	−0.2030	−0.1099	<i>Landlock im</i>
	1.0000	0.4547	0.5064	−0.0477	<i>ln Exports</i>
		1.0000	−0.0203	−0.0494	<i>ln GDP ex</i>
			1.0000	0.0456	<i>ln GDP im</i>
				1.0000	<i>ln bilateral</i>

Source: Own elaboration

### 3.4 Results interpretation

Table 5 summarizes the results of the regressions. For sake of comparison, columns A-F show the original results obtained by Baldwin using various techniques (Baldwin *et al.*, 2008).<sup>5</sup> Columns G and H represent the findings of the present author. Almost all the variables carry the expected signs. They suggest the aggregate intra-Eurozone trade was stimulated only slightly, *i.e.* up to 5%. This allows us to conclude that the euro adoption

4 Correlation matrix is a matrix giving the correlations between all pairs of data sets, 5% critical value (two-tailed) = 0.0252 for n = 6,061.

5 Notes: A = OLS in real terms using log-gravity and time dummies; B = OLS in nominal terms using log-gravity and time dummies; C = Importer, Exporter and time dummy (*i.e.* Anderson-Van Wincoop + time dummy) using log-gravity in nominal terms; D = Time-varying importer and exporter using log-gravity in nominal terms; E = Time and pair dummies using log-gravity in nominal terms; F = Time-varying importer and exporter and time invariant pair using log-gravity in nominal terms.

slightly improves trade between member states. Havránek concludes “the trade effect of the euro (at least based on available empirical studies) is probably much lower than we believed, even if “what we believed” was already twentyfold less than what Rose reported in his famous article (2010).” One should also bear in mind that while the overall effect of the euro adoption seems to be positive, the distribution of benefits may vary across member states, even though there is not enough data to firmly establish such differences in a credible fashion (Lalinský, 2010; Baldwin *et al.*, 2008).

**Table 5 | Overview of the Results**

	A	B	C	D	E	F	G	H
<i>EZ<sub>11</sub></i>	0.04 ***	−0	0.01	−0	0.01 ***	0.02 ***	<b>0.0</b>	<b>0.05</b> **
<i>EZ<sub>01</sub></i>	0.06 ***	−0 ***	0	0	0	−0 **	<b>−0.16</b> *	<b>−0.16</b> ***
<i>EZ<sub>10</sub></i>	−0 ***	−0 *	0	−0	0.01 ***	0.03 ***	<b>−0.06</b>	<b>−0.02</b>
<i>ly_o</i>	0.69 ***	0.2 ***	—	—	—	—	<b>0.75</b> ***	<b>0.72</b> ***
<i>ly_d</i>	0.76 ***	0.68 ***	—	—	—	—	<b>0.77</b> ***	<b>0.76</b> ***
<i>ldistw</i>	−1.2 ***	−1.1 ***	−1.2 ***	−1.3 ***	—	—	<b>−1.02</b> ***	<b>−0.99</b> ***
<i>adjacency</i>	0.13 **	0.1 **	0.15 ***	0.22 ***	—	—	<b>0.35</b> ***	<b>0.4</b> ***
<i>comlang_off</i>	0.38 ***	0.42 ***	0.18 ***	0.09	—	—	<b>0.2</b> *	<b>0.15</b> ***
<i>lremot_o</i>	−1.6 ***	−1.7 ***	0	—	—	—	—	—
<i>lremot_d</i>	3.49 ***	2.35 ***	0	—	—	—	—	—
<i>landlock_o</i>	−0.8 ***	−0.7 ***	1.49 ***	—	—	—	<b>−0.33</b> ***	<b>−0.4</b> ***
<i>landlock_d</i>	−0.7 ***	−0.7 ***	0.63 ***	—	—	—	<b>−0.73</b> ***	<b>−0.69</b> ***
<i>lrber</i>	−0.1	0.18 ***	−0	0.39	—	—	<b>−0.09</b> ***	<b>−0.08</b> ***
<i>smp_o</i>	0.04 ***	0.01 ***	−0 **	−0	−0 ***	−0 ***	—	—
<i>smp_d</i>	−0.1 ***	0.01 **	0	−0.1 *	0.01 *	0.02 *	—	—
<i>_cons</i>	−65 **	−29	31 ***	33.3 ***	−1.8	21.5 ***	<b>−10.3</b> ***	<b>−9.6</b>

Source: Baldwin et al. (2008) and own calculations

Astonishingly, the trade flows to Eurozone proved negative. This might indicate that the Eurozone crisis negatively influenced trade with outsiders but the trading activity among the countries of the control group remained stable. Another explanation for the negative results is a general proclivity to display positive effects. Recently, in a meta-analysis of 61 studies, Havránek reports of the striking degree of publication bias present in the Rosean literature applied on the Eurozone, *e.g.* “if there is a top economist among co-authors, the study reports significantly higher (trade) effects (2010, pp. 241–261)”.

Regarding the remaining variables, the impact of the euro on the Eurozone’s exports to non-euro users is also negative, but insignificant and very, very small. GDP size is positive and significant in the case of origin as well as destination. As expected, the impact of distance on trade is negative with the value of around  $-1$ . Border contiguity and shared official language both have a positive impact on mutual trade. Variable is negative proving that the bilateral real exchange rate time series expressed by way of national producer price indices was constructed correctly. The newly added variables including or did not improve the model significantly. The overall goodness-of-fit is satisfactory ( $R^2 = 0.92$ ; adjusted  $R^2 = 0.91$ ).

Several tests have been performed to verify the reliability of the results. *Multicollinearity* is checked by applying the variance inflation factors (VIF) test (Bellak *et al.*, 2008). VIF are a scaled version of the multiple correlation coefficient between variable  $j$  and the rest of the independent variables and is calculated as:  $VIF_j = 1 / (1 - R_j^2)$ , where  $R_j$  is the multiple correlation coefficient (Matei, 2007).

**Table 6 | Variance Inflation Factors Test**

Variable	VIF	1/VIF
<i>withinsm</i>	10.82	0.092396
<i>ln_distw</i>	4.34	0.230498
<i>tosm</i>	4.09	0.244413
<i>fromsm</i>	4.08	0.244941
<i>withinez</i>	2.26	0.443356
<i>toez</i>	2.09	0.478869
<i>fromez</i>	2.09	0.479318
<i>timetrend</i>	1.69	0.591923
<i>adjacency</i>	1.61	0.622654
<i>com_lang_off</i>	1.42	0.705015
<i>landlock_ex</i>	1.35	0.743362
<i>landlock_im</i>	1.34	0.74402
<i>ln_bilateral</i>	1.29	0.775741
<i>ln_gdp_im</i>	1.24	0.805967
<i>ln_gdp_ex</i>	1.24	0.807237
<i>samecountry</i>	1.1	0.911903
Mean VIF	<b>2.63</b>	

Standardly, VIF values are acceptable when lower than 10. The 1/VIF column tells us what proportion of an independent variable's variance is independent of all the other  $x$  variables. A low proportion (e.g. 0.10) indicates potential trouble. In general, there are no problems due to multicollinearity among the independent variables as all the values of 1/VIF are above 0.10 (Matei, 2007).

The heteroscedasticity problem is solved because the estimation method used is clustered Ordinary Least Square that calculates standard errors robust to within panel serial correlation and heteroscedasticity. More specifically, the `cluster(id)` option is added to the regression command, where *id* is the identification number of a particular country pair.

## 4. Conclusion

This paper analysed the trade effects associated with the creation of the Eurozone with a special focus on the export performance of Slovakia in comparison to the Czech Republic, which still uses its own national currency. The evolution of exports during the observed period (2008–2012) was rather specific due to the global market turmoil that coincided with the euro introduction in Slovakia. The crisis radically changed the external environment of the highly open and export-oriented Slovak economy. Taking this into consideration, Czech exports fared relatively better at the onset of the crisis. Nominal exchange rate depreciation against the euro witnessed at the beginning of the economic slowdown may have enabled Czech exporters to lower their prices and thus to somewhat mitigate the negative impact of the external demand shock on their sales abroad at the peak of the crisis. On the other hand, the export earnings evolved largely in parallel confirming the hypothesis that higher real exports were offset by lower prices.

Looking exclusively at Slovakia, a regression analysis estimating the impact of the euro adoption on the country's export development did not lead to statistically significant results. It is a natural consequence of the fact that the accession of Slovakia took place at the time when world trade flows were depressed. This fact makes it extremely difficult to distinguish between the two effects, because a dummy variable can represent a potential impact of the introduction of the euro, but also a negative impact of the crisis.

Thus, to answer our research questions, we had to look at the issue from broader perspective and analyse the trade effects associated with creation of the Eurozone as a whole. Our empirical evidence suggests that positive trade effects brought about by the introduction of the common European currency are rather moderate – around 5%. This result is in line with some of the earlier estimates showing that the euro changeover typically stimulates foreign trade between member states, but to a much lower extent than previously believed. Even though the effect may vary across countries, it can be concluded that the euro adoption has a positive, though hard to quantify, impact on trade. However, our results also confirm that being a member of the Eurozone is in itself no panacea. Although out of the scope of this paper, evaluation of other competitiveness metrics could also contribute to the euro-related policy discussions.

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