The Effect of the Single Currency on Exports: Comparative Firm-Level Evidence*

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We investigate how adopting the euro affects exports using firm-level data. In contrast to previous studies, we focus on two countries, Slovakia and Estonia, which adopted the single currency individually and had different exchange rate regimes. The results highlight the importance of the transaction costs channel related to exchange rate volatility. The euro changeover has a strong pro-exports effect for a country with a floating exchange rate, while it has almost no effect for a country with a fixed exchange rate to the euro. The export effect manifests itself mainly through the intensive margin and is heterogeneous across firms, with more productive firms and smaller exporters benefiting the most.

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1. Introduction

Assessment of the potential benefits of any currency union relies predominantly on the savings that come from eliminating nominal exchange rate volatility and reducing transaction costs. These savings are expected to lead to higher exports, higher gross domestic

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product (GDP), and consequently higher living standards in the economies of the currency union. Introducing currency unions such as the euro area can affect trade through more than one channel. According to Baldwin et al. (2008) we may consider (i) trade prices being reduced as transaction costs from exchange rate volatility and foreign exchange fall; (ii) trade prices being reduced by increased competition; and (iii) opportunities opening up for newly traded goods. However, there is no consensus on which channel has a decisive role for the gains in trade.

The more years that pass since the introduction of the single European currency, the more information there naturally is on the impact of this step on international trade. While there is ample macro-level evidence built on the gravity-type models that show the euro changeover had a positive impact on trade, micro-level analyses remain limited to a small number of countries. The distribution of gains from trade and the mechanism behind this distribution are still unclear. The aim of this paper is to bring more evidence on the topic using firm-level data. The paper contributes to the literature on the effects of common-currency areas on trade, first, by studying two natural experiments where trade costs were reduced but there was no increase in competition from other countries and, second, by testing the heterogeneous effect of the euro on exports.

The data come from two relatively new euro-area members: Slovakia, which joined the common-currency area in 2009, and Estonia, which joined in 2011. The difference-in-differences methodology is applied where the euro adoption effect is identified by firm-level bilateral trade flows to European Union (EU) countries. The treatment group consists of exports to the euro-area countries, while the control group consists of exports to the non-euro-area EU countries. Building on the theoretical models of heterogeneous and multiproduct firms (Melitz 2003 and Bernard, Redding, and Schott 2011), we answer questions about whether adopting the euro has raised the probability of exports to a given destination, has increased the number of products for each destination, or has boosted average or total exports to each destination. This approach is used to examine whether the benefits of euro adoption are manifested mostly through the intensive margin or the extensive margin. The incidence of gains from adopting the euro is tested across productivity and size groups, and across other firm characteristics such as age, foreign ownership,

and financing structure. The unconditional quantile regression technique of Firpo, Fortin, and Lemieux (2009) is applied to study the effect of the euro along the distribution of exports, to test whether the smallest exporters or the largest ones benefited the most.

The Slovakian and Estonian changeovers to the euro are good case studies for a number of reasons. The lion's share of the literature on how the euro affected trade is based on papers that use data from the countries that introduced the euro in 1999. All these countries switched to the euro at the same time, and transaction costs were reduced for all of them. This meant the introduction of the euro affected trade in two ways, with a positive effect from lower transaction costs and a negative effect from increased competition from other euro-area countries. Berthou and Fontagne (2013) control for the competition effect indirectly and find that the euro effect is underestimated when the increased competition is ignored. The advantage of our paper is that we use two cases where the euro was introduced in one country at a time, so that there was no effect of increased competition from other countries.

Our two-country natural experiment study has further advantages. The timing of the effect is concentrated, as the euro was introduced for electronic and cash transactions at the same time, and a much larger control group of EU destination markets is available compared with the situation when the euro was first introduced. Most importantly, the cases analyzed in this paper, Slovakia and Estonia, provide insightful comparative evidence about the channel behind the effects. Estonia had a currency board system with a strict peg to the euro prior to the changeover, while Slovakia had a floating exchange rate against the euro. Although, both countries joined the Exchange Rate Mechanism II (ERM II) with the commitment to maintain their exchange rate within the ± 15 percent fluctuation band around the agreed central parity without severe tensions, in line with the ongoing strong economic convergence Slovakia was two times permitted to revalue its parity. As a result, in contrast to Estonia, Slovakia saw its transaction costs from exchange rate volatility fall significantly in its run up to the euro. We use these similarities and differences to identify the channel behind the gains.[1] To our knowledge, there is only one paper that uses the data of the recent

[1] Please see more in section 2 on the case of the two changeovers.

euro-area members to estimate the effect of euro on trade, Mika and Zymek (2018) at the macro level, but they do not ask which channel contributed to the effect, and they ignore the cross-country variation in exposure to different channels.

There is a lot of research on how common-currency areas affect trade at the macro level, less at the product level, and very little at the micro level. Abundant macroeconomic studies applying different versions of the gravity models typically find that a common currency has a positive effect on trade. Many amendments to the gravity-type estimates, which relate trade performance with the size of engaged economies and various measures of trade costs, have emerged since Rose (2000) published his encouraging results. The main contributions are critically reviewed in Baldwin (2006), who concludes that the euro trade effect varies between 5 percent and 10 percent, and also in Bun and Klaassen (2007), Baldwin et al. (2008), and Polak (2018), who suggest the effect is even smaller. Baldwin and Taglioni (2007) or Head and Mayer (2014) give evidence on more estimates of the euro effect that are frequently disputable. More recently, Glick and Rose (2015) show that the estimates of the currency union effect are sensitive to the exact econometric methodology and conclude that the euro has a smaller trade effect than other currency unions do. A possible reason for the milder effect could be the deep pre-accession integration in the common market.

Using product-level trade data helps to unveil more of the consequences of a currency union. Baldwin and Di Nino (2006) provide supportive evidence for the newly traded goods hypothesis. Flam and Nordström (2007) find a stronger trade effect for products that were not exported continuously and confirm the significant and substantial effects on the extensive margin of trade from the introduction of the Economic and Monetary Union (EMU). Simple stylized facts based on product-level data for the trade of new euro-area countries indicate that the euro promotes exports of intermediate or semi-finished products, as shown by Flam and Nordström (2007) or Rotili (2014).

A microeconomic approach offers even more aspects for study than the aggregate or product-level approach does. The theoretical approaches build on new trade theory and Melitz (2003). In his framework, a fall in export costs allows smaller and less productive firms to start exporting and increases the value of exports for each

firm. Bernard, Redding, and Schott (2011) propose a multiproduct model, where a fall in trade costs leads to firm selection into the export market, with an increase in both the number of destinations for each type of product and the range of products exported by firms to a given destination.

As we have access to detailed firm-level trade data, we contribute to the smaller stream of empirical firm-level literature that uncovers processes that are usually hidden in aggregate trade figures. Baldwin et al. (2008) offer the first unconditional evidence of the euro trade effect for France and Belgium and confirm the newly traded goods hypothesis. However, the conditional estimates with a more rigorous approach are not conclusive. Berthou and Fontagne (2008a, 2008b, 2013) find that the adoption of the euro in France has a statistically significant impact in reducing trade costs. Berthou and Fontagne (2013) show that the euro changeover increased firm-level exports by 5 percent in France and that the intensive margin dominated the effect. Nitsch and Pisu (2008) estimate the euro trade effect on Belgian exporters. They find no statistically significant effect on total firm-level exports, but find that intra-euro-area trade has expanded through new markets and new product margins. De Nardis, Pappalardo, and Vicarelli (2008), employing Italian firm-level data, find that the euro had no statistically significant effect on total firm-level exports, but it had an effect along the extensive margin of new markets.

There is also no consensus on which type of firm saw its exports increase the most from the changeover to the euro. Berthou and Fontagne (2008b) find that firm efficiency and the composition effect play a role in the decision by firms to export, but the newly traded goods hypothesis is not subject to the presence of the composition effect of firm size. There is evidence that the most productive firms started to export more because of the euro changeover (Berthou and Fontagne 2013) or that less productive firms started to export more (Nitsch and Pisu 2008). It has also been found that the exports of the smallest firms increased the most due to the introduction of the euro (Nitsch and Pisu 2008 and Esteve-Pérez et al. 2011).

We find that adopting the euro had a statistically significant and strong economic impact on exports for Slovakia but almost no effect for Estonia. For Slovakia we find that the changeover to the euro increased exports by 18 percent and that the intensive margin

dominated the effect. One possible explanation for this larger effect is that we are studying countries that adopted the euro separately and not in a big group of countries, and so no adverse competition effect from other countries emerges. We claim that the main mechanism behind the effect is the reduction of transaction costs from the exchange rate volatility that exporters were exposed to in Slovakia but not in Estonia.[2] It is also found that the gains in trade from the reduced transaction costs are distributed heterogeneously across firms. More productive firms benefit the most from the reduced transaction costs. These findings provide empirical evidence on theoretical models like that of Melitz (2003), as we confirm the prediction that reduced trade costs contribute to more concentrated distribution of productivity. We also find that the exports of smaller and medium-sized exporters increased the most after the changeover to the euro.

The next section introduces the main facts on the euro changeover in the analyzed countries; section 3 provides a detailed description of the data used in our econometric analyses; section 4 describes our methodology; in section 5 we present the estimation results and robustness tests; and section 6 concludes.

2. The Case of Two Changeovers, Slovakia and Estonia

The sample countries in this study, Slovakia and Estonia, are exposed differently to the reduction of transaction costs caused by the introduction of the euro, as they had different monetary policies before they adopted the euro. Slovakia had a fixed exchange rate system in the 1990s and shifted to a managed floating exchange rate with inflation targeting from 1998. The indicative target inflation was gradually lowered toward 2 percent prior to the accession to the common-currency area (Banerjee et al. 2017). Estonia had a fixed exchange rate system with a currency board from 1992, where the Estonian currency was first strictly pegged to the German mark

[2] Please note that the effect from common currency might have been even larger if the country had joined from a fully free-floating exchange rate compared with the ±15 percent fluctuation band of ERM II. In the same vein, the effect could have been smaller if the country had strictly followed the ERM II without recent revaluations.

and from 2002 onward until the changeover, the Estonian kroon was pegged to the euro (*Kroon & Economy* 2008). Both of the countries joined the ERM II—Slovakia in 2005 and Estonia in 2004. While Slovakian koruna was agreed to float within the 15 percent nominal exchange rate bound and revalued its central parity by 8.5 percent in March 2007 and by 17.6 percent in May 2008, Estonian kroon continued to be fixed to the euro throughout its entire participation in the ERM II.

The variations of monthly exchange rates with euro-area countries and non-euro-area countries were quite similar before the changeover in Slovakia. The coefficient of variation of monthly exchange rates with euro-area trade partners was 2.6 percent before the changeover and dropped to zero afterwards (for more details, see Lalinsky and Meriküll 2018). However, Estonia has not experienced any exchange rate volatility with the euro-area trade partners prior to or after the accession. This implies that the benefits in trade from the removal of exchange rate volatility are different in the two countries and the gains expected in exports should be larger in Slovakia than in Estonia.

Another source of transaction costs is the reduced cost of foreign exchange. The European Commission (1990) estimated that the expected gains from foreign exchange brought by the euro were from 0.1 percent to 1 percent of GDP and were higher for small euro-area countries like our sample countries. The euro was already a dominant currency in extra-euro-area trade before the changeover in Slovakia and Estonia, as around 90 percent of extra-euro exports were invoiced in euros in Slovakia and 50 percent in Estonia one year before the changeover (European Central Bank 2012). Unfortunately, there are no public statistics on currency invoicing for intra-euro-area trade, but it is also likely to have been higher in Slovakia than in Estonia.[3] It can be expected that the gain from reduced foreign exchange transaction costs in exports was larger in Slovakia than in Estonia, though both of the countries gained. The reasoning for this is that the drop in transaction costs from foreign exchange was larger in Slovakia than in

[3]The invoicing information is available in the confidential customs data for Estonia used in this paper. Based on this source, 67 percent of the volume of exports to the euro area has been invoiced in euros before the changeover.

Estonia, as currencies other than the euro played a minor role in the exports of Slovakian firms, while the exports of Estonian firms were more frequently invoiced in other currencies also after the changeover.

The findings on the effects of the introduction of the euro suggest that the gains in trade were different across countries and that countries which were more tightly integrated before adopting the euro gained more. Baldwin and Taglioni (2004) propose a model to explain this regularity. They show that countries which have lower trade barriers before the introduction of a common currency have larger expected gains. This implies that countries with close proximity to other euro-area countries or which trade a lot with other euro-area countries have larger expected gains for exports. Both of the sample countries in this study export the majority of their products to the EU, though Slovakia is more tightly integrated in trade with the EU than Estonia is. Slovakia sent 86 percent of its exports to the EU before adopting the euro (Eurostat indicator ext_lt_intratrd from 2008) and Estonia sent 69 percent of its exports to the EU before it adopted the euro (Eurostat indicator ext_lt_intratrd from 2010). Within the EU, Slovakia is again more tightly connected to the euro area, exporting 56 percent of its EU trade to the euro area, while Estonia exports 46 percent. Slovakia is a neighbor of one euro-area country, Austria, and is close to such large euro-area countries as Germany, France, and Italy. Estonia had one euro-area neighbor, Finland, which is also one of its main trading partners, but the rest of Estonia's main trading partners were not in the euro area at the time of the changeover.

This implies that the potential gains for trade from adopting the euro are larger for Slovakia than those for Estonia, and the main reason for this is that Slovakia had a floating exchange rate before adopting the euro, and Estonia did not. Table 1 summarizes the main channels behind the gains for trade from common-currency areas. The three main channels that can reduce transaction costs all have a positive effect on trade. The increased competition channel has a negative effect on trade as export prices are reduced, export markets become more transparent, and product markups are reduced. Unlike when the euro was introduced in 1999, our sample countries did not face increased competition from other countries because they joined the euro area one country at a time.

Table 1. Expected Gains in Trade from the Euro

Channel of Euro Impact on Trade	Expected Direction of the Effect	Introduction of the Euro in 1999	Changeover to the Euro in Slovakia in 2009	Changeover to the Euro in Estonia in 2011
Transaction Costs from Exchange Rate Volatility	(+)	Strong	Strong	No
Transaction Costs from Foreign Exchange	(+)	Variable	Strong	Medium
Interaction of Transaction Costs and Importance of the Euro Area in Trade Prior to Accession	(+)	Variable	Strong	Medium
Increased Competition from Other Euro-Area Members	(–)	Strong	No	No

Source: Compiled by the authors from related literature.

3. Data

We use detailed firm-level trade and balance sheet data for Slovakia and Estonia. These two countries represent the new Central and Eastern Europe (CEE) and Baltic euro-area countries well in terms of their level of development or trade openness.[4] As with the old euro-area countries, high levels of confidentiality for the detailed transaction data mean that strict data-handling rules are required, and these prevent cross-country combination of data sets.[5]

We use customs data on all exporting firms in Slovakia and Estonia, covering the NC8 codes for products, the ISO codes for destination countries, and the FOB values of the export flows. The data represent fairly exhaustive information on the exports of the countries analyzed, running between 2006 and 2011 for Slovakia and between 2008 and 2013 for Estonia. We aggregate the eight-digit NC codes to actual six-digit HS codes to ensure better comparability of product codes over time. The data are of very high quality, as the same administrative data have been used by national statistical institutions to produce official trade statistics.

The customs and commercial register data set is combined with the balance sheet data. We use real value-added, the real book value of net capital, employment, and material inputs to calculate firm-level total factor productivity (TFP). The TFP is calculated using the GMM-based approach suggested by Wooldridge (2009).[6] The

[4]They both represent small, highly open economies. Cyprus and Malta differ significantly in their trade openness based on trade in goods.

[5]According to Castellani and Koch (2015), firm-level trade data are in general available for all seven new euro-area member states except Cyprus, but their confidential and restrictive accessibility rules make them difficult to access.

[6]We follow Dhyne et al. (2014) and implement the approach as in Wooldridge (2009) and Galuscak and Lizal (2011) that relies on the GMM framework of the specification suggested by Levinsohn and Petrin (2003). Production functions were estimated at the industry level, i.e., all firms in the same industry (and country) were assumed to have the same marginal returns of labor and capital. The industries are defined at the two-digit NACE level. The simultaneity of productivity and production inputs is addressed by introducing the polynomial of capital and material costs and GMM-type instruments for labor. Firm-level TFP was then calculated as the difference between the actual and predicted value-added taking into account the firm's values of labor, capital, and material costs. Given the unavailability of firm-specific price deflators, only industry-level ones, the TFP used in our regressions represents a revenue-based productivity measure.

real values are derived using GDP deflators at the two-digit NACE level. Interest paid and profits are used to derive a debt burden indicator that accounts for a financial situation effect. The balance sheet data are harmonized across countries using an approach that originates from the CompNet microdata project.[7] To ensure better compatibility of Slovakian and Estonian data, we use a sample of firms with 20 or more employees and firm-destination trade flows that are 1,000 euros per year or larger. As exports are highly concentrated, we still cover 99 percent of total exports in Slovakia and 95 percent in Estonia.

Tables 2 and 3 provide descriptive statistics about all the trade margins and explanatory variables analyzed. The descriptive statistics have been provided for the treatment and control group destination countries and for the period before and after the changeover to the euro. There is no evidence that average unconditional trade margins have developed differently for the treatment and control groups, as exports have increased to both of the destination country groups and the increase has been even faster in non-euro-area markets. The sample countries are similar in terms of the probability of a firm being an exporter, firm age, and the share of foreign-owned firms, though Slovakian firms are somewhat larger than Estonian firms and export larger volumes.

Additional aggregate explanatory data on macroeconomic indicators come from publicly available databases published by the International Monetary Fund and Eurostat.

4. Methodology

The aim of this paper is to investigate how joining a common-currency area affects trade. Following the new trade theory, we consider three types of adjustment: firm selection to export; changes in product varieties, which represent extensive margins; and changes in the average value of exports, which represent an intensive

[7]See Dhyne et al. (2014) for more details on the definition of variables and outlier treatments. This source also discusses the methodology for the TFP calculation.

Table 2. Descriptive Statistics of the Main Variables (EU trade), Slovakia 2006–11

	Control Group: EU Non-Euro-Area Countries				Treatment Group: EU Euro-Area Countries			
	Before		After		Before		After	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Share of Exporters in Each Destination (n = 86,332)	0.519	0.500	0.490	0.500	0.486	0.500	0.471	0.499
Share of Exporters in Each Destination × Product (n = 632,223)	0.265	0.441	0.245	0.430	0.266	0.442	0.257	0.437
Number of HS6 Products per Destination (n = 32,991)	5.125	7.200	4.862	7.146	4.963	8.503	4.768	9.289
Average Exports per HS6 Product in Destination (ths. EUR) (n = 32,991)	394.0	2,098.7	539.6	4,137.6	589.5	2,605.0	774.8	6,423.7
Total Exports per Destination (ths. EUR) (n = 32,991)	2,128.4	15,978.5	1,733.4	10,342.1	3,420.7	25,437.0	3,179.7	27,313.1
Firm Age (Years) (n = 32,991)	11.6	4.5	13.0	5.0	11.3	4.6	12.8	5.2
Firm Employment (n = 32,991)	381.2	1,009.0	315.4	719.8	433.0	1,108.4	339.3	779.0
Share of Foreign-Owned Firms (n = 32,991)	0.430	0.495	0.512	0.500	0.486	0.500	0.559	0.497
Firm Log(TFP) (n = 32,991)	−0.049	1.616	−0.023	1.614	−0.282	1.512	−0.214	1.594
Firm Debt Burden (n = 32,991)	0.237	0.246	0.207	0.235	0.237	0.243	0.198	0.232

Source: Authors' calculations from commercial register and customs data.
Notes: Foreign-owned firms are defined as a binary variable where majority foreign-owned firms take the value "1" and the rest "0." The firm debt burden represents interest paid divided by operating profit.

Table 3. Descriptive Statistics of the Main Variables (EU trade), Estonia 2008–13

	Control Group: EU Non-Euro-Area Countries				Treatment Group: EU Euro-Area Countries			
	Before		After		Before		After	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Share of Exporters in Each Destination (n = 12,014)	0.597	0.491	0.634	0.482	0.579	0.494	0.638	0.481
Share of Exporters in Each Destination × Product (n = 73,656)	0.378	0.485	0.450	0.497	0.385	0.487	0.455	0.498
Number of HS6 Products per Destination (n = 5,979)	4.1	6.8	5.0	8.2	4.4	8.5	5.2	10.1
Average Exports per HS6 Product in Destination (ths. EUR) (n = 5,979)	215.6	621.8	268.6	1034.1	372.7	1013.8	498.1	1349.9
Total Exports per Destination (ths. EUR) (n = 5,979)	665.0	2,124.4	2,414.5	37,280.0	1,025.1	2,903.2	1,636.7	5,391.4
Firm Age (Years) (n = 5,979)	13.7	4.1	15.9	5.2	13.5	4.1	15.7	5.2
Firm Employment (n = 5,979)	119.5	193.4	126.1	183.7	123.2	182.5	138.4	210.1
Share of Foreign-Owned Firms (n = 5,979)	0.358	0.480	0.411	0.492	0.375	0.484	0.428	0.494
Firm Log(TFP) (n = 5,979)	−0.061	1.948	0.077	1.855	−0.337	2.004	−0.149	1.906
Firm Debt Burden (n = 5,979)	0.143	0.225	0.078	0.155	0.126	0.218	0.072	0.146

Source: Authors' calculations from commercial register and customs data.
Notes: Foreign-owned firms are defined as a binary variable where majority foreign-owned firms take the value "1" and the rest "0." The firm debt burden represents interest paid divided by operating profit.

margin. The unit of observation is the trade flow to a particular destination country at the firm level, or firm times destination market.

In the baseline estimation strategy, we start with the probability of a firm exporting using a within-fixed-effect estimator.[8] The dependent variable in these regressions takes the value of 1 if the firm exports to a particular destination market and 0 otherwise.

In the next step, we continue by estimating the effect of the euro on the product margin (the number of six-digit HS code products exported for each firm in a destination market), the intensive export margin (the average value of exports of a six-digit HS code product for each firm in a destination market), and the total firm exports in a destination market using a fixed-effect estimator.

We follow the methodology of Berthou and Fontagne (2013), but in addition to their approach we introduce a dynamic specification with lagged dependent variable where the persistence of the export margin is controlled for, and we introduce industry-specific year dummies at the two-digit NACE level. The euro effect is identified by a difference-in-differences style dummy variable that is equal to 1 during the period following the adoption of the euro if the destination country was a member of the euro area, and 0 otherwise. We compare exports to the euro-area countries with exports to the remaining non-euro-area EU countries, so destination markets outside the EU are removed from the control group to ensure better comparability of the treatment and control groups. The number of EU members was 27 during the sample period, so excluding the home country results in 26 countries, of which 15 were euro-area members at the time when Slovakia introduced the euro and 16 at the time when Estonia did so. Only manufacturing firms are used in the estimations, as these are responsible for the majority of trade in goods.

[8]This is in contrast to the logit approach, which estimates the effect of independent variables on the probability of the firm changing its status from nonexporter to exporter, meaning it takes into account only information for the firms that change their status (switchers), while the within-fixed-effect approach keeps all the observations, meaning it takes into account both switchers and nonswitchers. The logit model with only switchers in the sample has been estimated for robustness.

The following dynamic specification is applied:

$$\begin{aligned} TM_{ijt} = {} & \alpha_{ij} + \beta_1 TM_{ijt-1} + \beta_2 Post_t \times EA_{ij} + \beta_3 \log(TFP_{ijt-1}) \\ & + \beta_4 \log(\mathrm{GDP}_{jt}) + \beta_5 \log(\mathrm{REER}_{jt}) + \beta_6 \log(\mathrm{MP}_{jt}) \\ & + \tau_t \times sector_k + e_{ijt}, \end{aligned} \tag{1}$$

where i denotes the firm, j is the destination country, t is the year, and k is the industry at the two-digit NACE level. TM_{ijt} stands for the trade margin. Two types of trade margin are used, one of which is a binary variable capturing the whether the firm exports or not. The estimation of equation (1) for this type of trade margin covers firms that have exported at least once during the sample period. Trade margins of the other type are continuous variables and are defined only for positive firm-destination-level trade flows. As these trade margins have values larger than zero, logarithm has been taken of these margins. We prefer this two-part approach over the selection model, as it is proven to be robust to endogenous selection and avoids an often fruitless search for instruments that affect the decision to export but not the value of exports (see Drukker 2017 for the formal presentation and Nitsch and Pisu 2008 for the discussion of these issues). The firm-destination fixed effects are controlled for and are denoted by α_{ij}.

$Post_t \times EA_{ij}$ represents a combination of two dummy variables: $Post_t$ is equal to 1 after the home country joined the euro area (for the period 2009–11 for Slovakia and 2011–13 for Estonia), and 0 otherwise; and EA_{ij} is equal to 1 if the destination country was a member of the euro area at the time of the changeover, and 0 otherwise. The difference-in-differences effect of adopting the euro is captured by the coefficient β_2 and has a statistically significant positive value if the common-currency area increases the export margin.

The lagged TFP at the firm level controls for the dynamics of firm-level productivity as more productive firms are expected to enter export markets more likely by new trade theory (Melitz 2003). In order to isolate the effect of the euro from other economic factors, we control for a number of macrovariables in the destination country: gross domestic product $log(GDP_{jt})$, the real effective exchange rate $log(REER_{jt})$, and import prices $log(MP_{jt})$. GDP is expected to control for demand in the destination country, the real effective exchange rate for price competitiveness in the destination

country, and import prices for the potential effect of imports from third countries.[9] Here we follow Berthou and Fontagne (2013), who used the same set of macro controls and lagged TFP. To control for the remaining industry-level developments in export markets, the industry-specific year dummies $\tau_t \times sector_k$ are added. The industry-specific year dummies also capture possible developments in the domestic economy that can induce firms to export. The standard errors e_{ijt} are clustered at the firm and destination levels and are expected to have conventional properties.

Our empirical specification builds on theoretical models of heterogeneous and multiproduct exporters. We analyze the effect of reduced trade costs on various trade margins that allows testing for predictions of models with multiproduct exporters (Bernard, Redding, and Schott 2011). These models predict that introduction of the euro and reduction of transaction costs leads to new entries to euro-area destination markets and a larger number of products exported to euro-area markets, but not necessarily larger exports per firm. Our empirical specification follows the structural gravity model and we control for the time-invariant inward multilateral resistance terms by introducing firm-destination fixed effects.[10]

We apply the decomposition of Berthou and Fontagne (2013) to disentangle the euro effect into that from the product-intensive and product-extensive margins. This approach allows to test the role of the product margin or the newly traded goods channel (Baldwin and Taglioni 2004) in the effect of the common-currency area on trade. First, three separate regressions are estimated for continuous trade margins as the logarithm of total exports for each destination, the logarithm of the number of products exported to each destination, and the logarithm of the average value of exports for each product in

[9]The role of industry-level import prices at the two-digit NACE level in the destination country has also been tested, but as the results were similar to the ones with country-level import prices, the latter have been used throughout the paper.

[10]For a full control in the panel setting, a proxy for the time-varying multilateral resistance term would be needed. However, in the time span of our analysis these resistance terms change very rarely and only little. Unlike in the aggregate country- or product-level specification, we cannot control for outward multilateral resistance terms, as the database covers only one exporting country at the time.

destinations. The total effect on the value of exports is decomposed as follows:

$$\frac{\partial \log(X_{ijt})}{\partial Post_t \times EA_{ij}} = \frac{\partial \log(N_{ijt})}{\partial Post_t \times EA_{ij}} + \frac{\partial \log(\bar{x}_{ijt})}{\partial Post_t \times EA_{ij}}, \qquad (2)$$

where X_{ijt} denotes total exports to each destination, N_{ijt} the number of products for each destination, and $\bar{x}_{ijt}$ the average value of exports in destinations. The first term on the right-hand side of equation (2) captures the effect from the new products exported, or the product-extensive margin, and the second term captures that from the average value of exports per product, or the product-intensive margin.

5. Results

5.1 Baseline Results and Intensive vs. Extensive Margin

The estimation results for equation (1) on all the trade margins are presented in tables 4 and 5. Our results show that the euro has a positive trade effect across all the margins except number of products for Slovakia, but only for the probability of exporting for Estonia. The finding that the euro has no statistically significant effect on overall firm-level trade in Estonia but that the decision to export to new destination markets is affected can be related to experimentation in new markets with little export value that does not stand out in the total exports of firms. The euro increased the probability of exporting into euro-area destination markets by 1.8 percent in Slovakia and by 4.7 percent in Estonia.[11] We interpret the long-run effects and not the short-run effects of our dynamic specification, which provides better reference to the related literature that usually does not use dynamic specification. These effects are in line with

[11] Given our dynamic specification, the coefficients-on-treatment variable, β_2, refers to the short-run effect, and the long-run effect is calculated as $\beta_2/(1-\beta_1)$; see equation (1) for notation. The relatively low persistence of trade margins implies that usually the long-term effects are quite close to the short-term effects.

Table 4. The Euro Effect on Firm-Level Exports, Slovakia 2006–11, Manufacturing Firms, Within-Group Estimation

	Export Decision in Each Destination	Number of Products per Destination, N_{ijt}	Average Export Value per Product in Destination, $\bar{x}_{ijt}$	Total Exports per Destination, X_{ijt}
Lagged Dependent	0.045***	0.133***	0.177***	0.228***
	(0.005)	(0.010)	(0.010)	(0.011)
$Post_t \times EA_{ij}$	0.017**	0.020	0.111***	0.130***
	(0.007)	(0.014)	(0.030)	(0.032)
$\text{Log}(\text{TFP}_{ijt-1})$	−0.005	0.003	0.029	0.020
	(0.005)	(0.010)	(0.023)	(0.024)
$\text{Log}(\text{GDP}_{jt})$	0.197***	0.124	0.677***	0.742***
	(0.038)	(0.086)	(0.186)	(0.193)
$\text{Log}(\text{MP}_{jt})$	0.073	0.098	−0.427*	−0.336
	(0.054)	(0.119)	(0.255)	(0.264)
$\text{Log}(\text{REER}_{jt})$	−0.185***	−0.158	−0.639**	−0.740***
	(0.054)	(0.118)	(0.254)	(0.267)
Year × Sector FE	Yes	Yes	Yes	Yes
Firm × Destination FE	Yes	Yes	Yes	Yes
Observations	86,332	32,991	32,991	32,991
No. of Objects	20,535	10,523	10,523	10,523
Within R^2	0.014	0.0437	0.0849	0.1140

Source: Authors' calculations from the commercial register and customs data.
Notes: *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively. Clustered standard errors are in parentheses.

Table 5. The Euro Effect on Firm-Level Exports, Estonia 2008–13, Manufacturing Firms, Within-Group Estimation

	Export Decision in Each Destination	**Number of Products per Destination, N_{ijt}**	**Average Export Value per Product in Destination, $\bar{x}_{ijt}$**	**Total Exports per Destination, X_{ijt}**
Lagged Dependent	0.108***	0.183***	0.234***	0.250***
	(0.014)	(0.025)	(0.022)	(0.024)
$Post_t \times EA_{ij}$	0.042**	0.005	0.002	0.004
	(0.020)	(0.034)	(0.066)	(0.067)
$\text{Log}(\text{TFP}_{ijt-1})$	−0.000	−0.020	0.055	0.032
	(0.009)	(0.016)	(0.038)	(0.038)
$\text{Log}(\text{GDP}_{jt})$	0.006	0.126	1.328***	1.433***
	(0.094)	(0.162)	(0.394)	(0.390)
$\text{Log}(\text{MP}_{jt})$	0.384**	0.341	−0.817	−0.471
	(0.160)	(0.318)	(0.642)	(0.642)
$\text{Log}(\text{REER}_{jt})$	0.477***	0.269	−1.552**	−1.279**
	(0.180)	(0.350)	(0.730)	(0.736)
Year × Sector FE	Yes	Yes	Yes	Yes
Firm × Destination FE	Yes	Yes	Yes	Yes
Observations	12,014	5,979	5,979	5,979
No. of Objects	3,542	2,262	2,262	2,262
Within R^2	0.045	0.111	0.129	0.150

Source: Authors' calculations from the commercial register and customs data.
Notes: *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively. Clustered standard errors are in parentheses.

previous findings, such as the increase of a couple of percent from Belgian data (Nitsch and Pisu 2008).[12]

For total exports, we find that adopting the euro had a statistically significant and relatively strong economic impact in Slovakia, but no effect in Estonia. The euro increased the exports of Slovakian manufacturing by 18 percent ($\exp(0.13/(1 - 0.228)) - 1$), which is a large effect in comparison with results published on the introduction of the euro in 1999. For example, Baldwin (2006) concludes that the feasible macro-level euro trade effect findings based on gravity-type models are between 5 percent and 10 percent, while from microdata, Berthou and Fontagne (2008a) find that the euro increased exports by 5 percent, but Nitsch and Pisu (2008) and de Nardis, Pappalardo, and Vicarelli (2008) find there to be no effect. Our results from the Slovakian data are clearly from the upper bound of feasible effects. The main reason for the large effect in Slovakia is that this country benefited strongly along all the channels that have potential for positive gain, while it did not face increased competition from the other countries.

Our results indicate that the euro effect mainly manifested itself via the intensive margin and only partially via the decision to export new products. The euro effect on the average export per products is 14 percent ($\exp(0.111/(1 - 0.177)) - 1$) in Slovakia, and it accounts for almost 80 percent of the total increase in exports. This result is in line with the findings of Berthou and Fontagne (2008a), who also find the effect of newly traded goods to be less than 20 percent, while it is in contrast to the findings of Nitsch and Pisu (2008), who find that the euro increased newly traded goods but that there was no statistically significant effect on overall firm-level trade.

The micro-level control variables have the expected signs, all the export margins tend to have some persistence, and the lagged TFP, if statistically significant, has a positive effect on the trade margin. This gives support to our dynamic specification. Among the

[12]The panel fixed effects logit model with only the export decision of switchers in the sample shows an even stronger effect of the euro changeover to trade, but the statistical significance is unchanged. In this model the probability of exporting to a new euro-area destination increased by 11.3 percent in Slovakia and 5.7 percent in Estonia.

macro-level control variables, destination market GDP has a positive effect on the trade margin, while the price competitiveness proxy (REER) and import prices (MP) have varying effects depending on the country and specification.

The introduction of the euro reduced exchange rate volatility in Slovakia but not in Estonia, which suggests that the transaction costs channel from exchange rate volatility is important in the manifestation of gains from common currencies. In sum, our findings suggest that the transaction costs channel, both from exchange rate volatility and from foreign exchange, was an important mechanism behind the gains from trade due to adoption of the euro. This is not something that has been confirmed so far. Baldwin et al. (2008), who summarize the previous literature, conclude that non-euro-area countries in the EU did not face trade diversion after the introduction of the euro and use it as evidence that the transaction costs channel was not the main one. They claim that the main mechanism was increased competition and improved market transparency in euro-area countries, and that the newly traded goods hypothesis had a potentially important role. We find that the newly traded goods hypothesis accounted for only 20 percent of the total increase in trade, while we can exclude the increased competition channel from our empirical setup and confirm the strong effect from reduced transaction costs.

5.2 Results over Firm Characteristics

It was shown that the intensive margin has dominated the effect of the euro on exports in our sample countries. This subsection tests whether the effects have been heterogeneous over firm productivity and size, and also over age, ownership, and debt. The heterogeneity of the effects has been tested by interacting the treatment dummy with firm characteristics before the euro was adopted. We start with the total factor productivity (TFP), which in theory has been the most important determinant of entry to export markets. The firms have been divided into four TFP quartiles based on their average TFP three years prior to accession. In contrast to our baseline specification, this approach helps us to address possible nonlinearity.

The results are shown in table 6, where only the interaction terms with treatment are presented, as the rest of the coefficients do not

Table 6. The Euro Effect over Firm Characteristics, Slovakia 2006–11 and Estonia 2008–13, Manufacturing Firms, Within-Group Estimation

	Slovakia		Estonia	
	Export Decision in Each Destination	**Total Exports per Destination, X_{ijt}**	**Export Decision in Each Destination**	**Total Exports per Destination, X_{ijt}**
Regression with TFP Quartiles				
$Post_t \times EA_{ij} \times TFP\_q1_i$	−0.001	0.035	−0.011	−0.207**
	(0.011)	(0.056)	(0.029)	(0.087)
$Post_t \times EA_{ij} \times TFP\_q2_i$	0.022**	0.095**	0.111***	0.114
	(0.010)	(0.044)	(0.029)	(0.098)
$Post_t \times EA_{ij} \times TFP\_q3_i$	0.017*	0.148***	0.056**	0.034
	(0.010)	(0.045)	(0.029)	(0.096)
$Post_t \times EA_{ij} \times TFP\_q4_i$	0.026***	0.191***	−0.016	0.096
	(0.010)	(0.048)	(0.033)	(0.097)
Regression with Size Groups				
$Post_t \times EA_{ij} \times Size\_1_i$	0.029**	0.103	0.051*	0.007
	(0.011)	(0.064)	(0.027)	(0.083)
$Post_t \times EA_{ij} \times Size\_2_i$	0.023***	0.157***	0.036	−0.005
	(0.008)	(0.037)	(0.023)	(0.073)
$Post_t \times EA_{ij} \times Size\_3_i$	−0.006	0.100**	0.043	0.054
	(0.010)	(0.043)	(0.040)	(0.167)
Regression with Age				
$Post_t \times EA_{ij}$	0.017***	0.125***	0.046**	−0.012
	(0.007)	(0.032)	(0.020)	(0.067)
$Post_t \times EA_{ij} \times Young_i$	−0.018	0.126	−0.050	0.194
	(0.023)	(0.113)	(0.074)	(0.266)
Regression with FDI				
$Post_t \times EA_{ij}$	0.006	0.118***	0.059***	−0.021
	(0.008)	(0.038)	(0.023)	(0.074)
$Post_t \times EA_{ij} \times FDI_i$	0.024***	0.020	−0.040	0.037
	(0.009)	(0.043)	(0.028)	(0.081)
Regression with Debt				
$Post_t \times EA_{ij}$	0.020**	0.178***	0.030	−0.010
	(0.009)	(0.045)	(0.022)	(0.071)
$Post_t \times EA_{ij} \times Debt_i$	−0.005	−0.186*	0.133**	0.089
	(0.021)	(0.106)	(0.067)	(0.221)

Source: Authors' calculations from the commercial register and customs data.
Notes: The table presents only the coefficients of the interaction terms with the treatment variable and productivity or size. The rest of the control variables, not presented, are the same as in the baseline estimations or in equation (1). Separate regressions are estimated for each trade margin, and for each firm characteristic and its interaction. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively. Clustered standard errors are in parentheses.

differ much from the baseline estimates and are not shown. The results for Slovakia show some nonlinearity of the effect in terms of the decision to export, as firms from the second and fourth productivity quartiles have gained the most. The overall effect on the value of exports is strongest for the most productive firms, while the effect is already statistically significant in the second productivity quartile. The results for Estonia show that it was firms from the second productivity quartile that started to export to new destinations after the euro was adopted. This also explains why the effect does not show up in total exports, as it was rather less productive firms that started to export.

Our results indicate that the gains from adopting the euro were more equally distributed than in previous studies. Berthou and Fontagne (2013) find that the effects were concentrated in the most productive firms from the fourth productivity quartile, while Nitsch and Pisu (2008) find that less productive firms gained the most. Our results show that firms from the second to the fourth productivity quartile gained and that the effect was the strongest for the most productive firms. In this sense our findings are in line with the theory of Melitz (2003), which predicts that a reduction in trade costs allows a wider set of more productive firms to start exporting.

A similar exercise is to test whether the effect differed across firm size. Esteve-Perez et al. (2011) claim that only small firms experienced trade gains from the introduction of the euro, a finding that Nitsch and Pisu (2008) confirm. In this paper the firms are divided into three size groups: small firms with 20 to 49 employees, medium firms with 50 to 249 employees, and large firms with 250 or more employees. As in the exercise with productivity, the average firm size three years prior to adoption of the euro is calculated, and from this firms are allocated into three size groups. The results are presented in table 6. For Slovakia, where we find the euro has a strong effect on trade, we confirm the previous findings for new destination markets, where smaller firms started to export to new markets after the introduction of the euro. However, the gains over export volumes are quite equally distributed across firm size. The results from the Estonian sample are statistically insignificant, as in the baseline estimation.

Lastly, we test whether the gains from the euro have been distributed equally over other firm characteristics such as firm age,

ownership, and debt burden. There is no theoretical evidence that the reduction in trade costs has a varying effect over these firm characteristics. It is rather that these estimates indicate whether trade costs differ across firms with different characteristics. The interaction terms with the treatment dummy are mostly statistically significant.

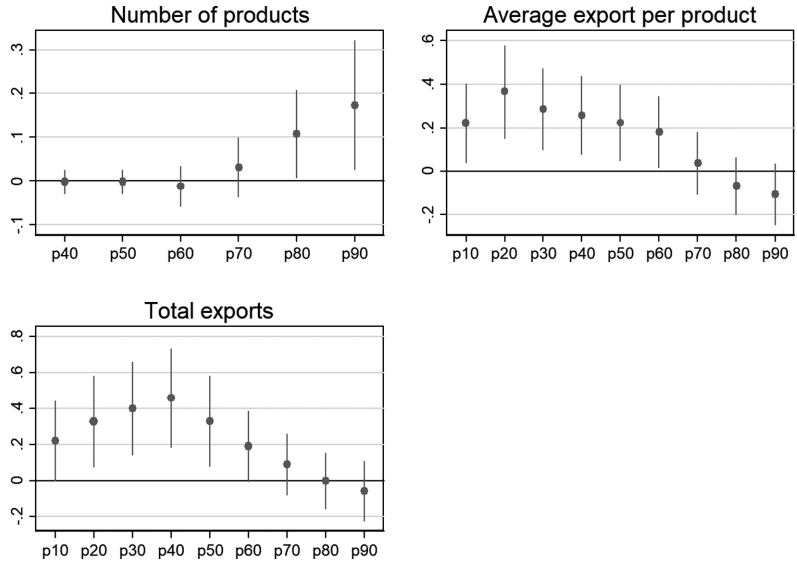
5.3 Effects over the Distribution of Exports

This subsection, like the previous one, tests the heterogeneity of gains in trade from the introduction of the euro. Here we test whether the gains in trade from the reduction of transaction costs differ across the outcome variable, which is exports. As the effects on the distribution of the outcome variable are estimated, the data with positive trade flows are used and the binary variables such as the decision to export are not analyzed.

The unconditional quantile regression by Firpo, Fortin, and Lemieux (2009) is applied and the xtrifreg command by Borgen (2016) is used to implement the panel estimations with fixed effects in Stata. This method allows us to estimate how the explanatory variables affect the unconditional distribution of the outcome variable by using the recentered influence function technique. The advantage of this method is that unlike the conventional quantile regression, where the results are interpreted in terms of the conditional distribution of the outcome variable, this approach allows much more intuitive interpretation of the results in terms of the unconditional distribution of the outcome variable. The unit of observation is firm-level exports to a destination country, as in the previous sections. The same specification as in equation (1) has been used and the estimations have been run for nine quantiles.

Figures 1 and 2 present the results for Slovakia and Estonia, respectively. Only the effects of the treatment dummy on the export margin are presented, and the rest of the coefficients are not shown. The results confirm the finding that the euro had strong effects on trade in Slovakia and no effect in Estonia. Most importantly, the distribution of effects for Slovakia is cardinally different along the extensive margin and the intensive margin. On the extensive margin it is shown that those firms that already exported a large number of products to a market started to export new products following the introduction of the euro. The newly traded goods hypothesis

Figure 1. The Distribution of the Euro Effect on Exports, Slovakia 2006–11, Manufacturing Firms



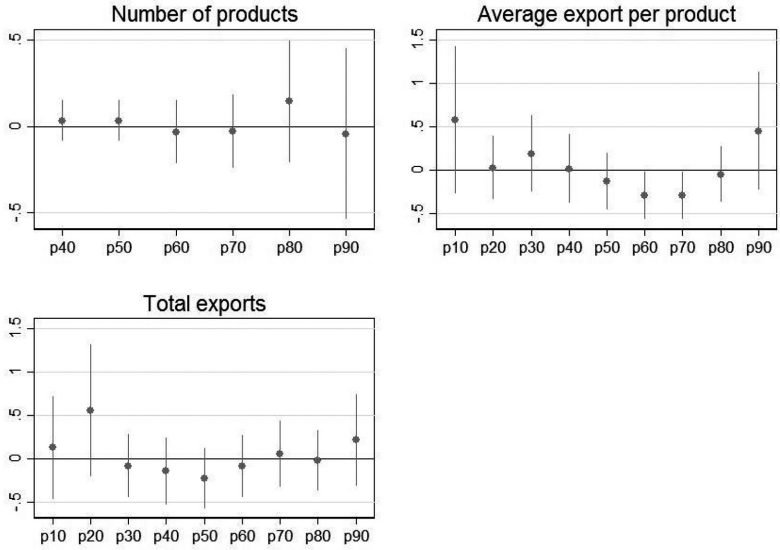
Source: Authors' calculations from the commercial register and customs data.
Notes: Each coefficient on the figure represents one regression for the particular percentile, e.g., p10 shows the effect of the euro on exports at the 10th percentile of firm-destination export flows. The confidence intervals reflect statistical significance at 10 percent. The figure presents the long-term effects, i.e., $(\exp(\beta_2/(1-\beta_1))-1)$ according to specification (1).

seems to be an important channel for benefits for firms that already export a lot of products or for destinations which are already served by many products.[13]

In contrast to the case of the extensive margin, it was rather smaller exporters or markets where small amounts were exported that gained most from the euro along the intensive margin. The effects are statistically significant up to the 60th percentile for

[13]It may be noted that the recentered influence function of the decile cannot be defined for this part of the distribution where there is no variation in the dependent variable, so the graph only starts from the 40th percentile for the product margin where only one product was exported.

Figure 2. The Distribution of the Euro Effect on Exports, Estonia 2008–13, Manufacturing Firms



Source: Authors' calculations from the commercial register and customs data.
Notes: Please refer to the notes of figure 1.

Slovakia. In the overall effect on trade, the intensive margin dominates over the extensive margin, so total exports also increased for smaller exporters or in destination markets where exports were small. The overall effect on exports is large and statistically significant up to the 50th percentile of firm-destination trade flows in Slovakia. Our results are in line with the predictions of the multiproduct models that a decline in transaction costs is related to an increase in the number of products exported, but not necessarily to an increase in the average export per product, as new products are traded in smaller volume (Bernard, Redding, and Schott 2011). We find that the total export did not increase for the largest exporters, which are usually exporting many products, but it increased for smaller exporters. The overall effect on trade is the strongest around mid-size exporters from the 40th percentile, where the effect is as large as 40 percent.

5.4 Effects over Sectors and Product Groups

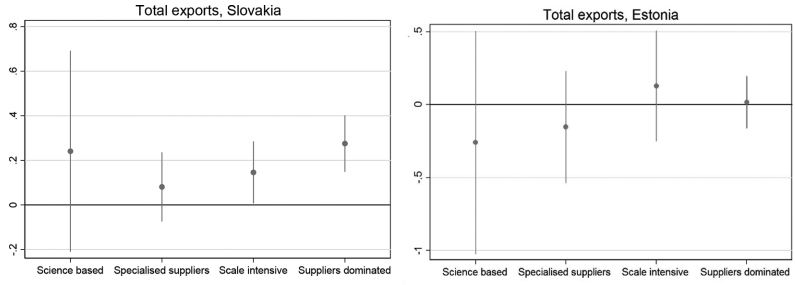
Several studies suggest that the gains from trade differ across sectors or macrosectors. Baldwin and Taglioni (2004) note that the exports of industries that are characterized by imperfect competition and increasing returns to scale increased more following the introduction of the euro than did the exports of industries working with natural resources or producing raw materials. Baldwin et al. (2008) summarize the macro-level sectoral findings by stating that the gains from trade from adopting the euro have been concentrated in a few industries, and most industries did not experience any increase in trade from the introduction of the euro. They take this argument as evidence against the transaction costs being an important channel behind the gains in trade from common currency. There is also evidence that the euro has enhanced vertical specialization and especially increased the trade in intermediate and final goods (Flam and Nordström 2007 and Martinez-Zarzoso and Johannsen 2017).

The firm-level studies do not provide much information on the sectoral distribution of the euro effects. De Nardis, Pappalardo, and Vicarelli (2008) find from Italian microdata that it was indeed the scale-intensive industries dominated by traditional goods or suppliers that experienced a boost to exports from the introduction of the euro. They use Pavitt's (1984) taxonomy to divide sectors into four groups and find that there was no effect in science-based industries and industries of specialized suppliers that produce specialized technology or inputs for other firms.

Our findings support the results of Baldwin and Taglioni (2004) and De Nardis, Pappalardo, and Vicarelli (2008). We find that scale-intensive and traditional sectors producing highly differentiated goods benefited the most from the introduction of the euro. The results for the total exports are presented in figure 3. We contribute to this discussion also by testing whether there are different euro effects for firms from different NACE two-digit industries. We observe that the euro effects on total exports are large and positive in the majority of industries for Slovakia, but are always statistically insignificant for Estonia (the results are available from the authors upon request).

In order to fully exploit the granularity of our trade data, we divide manufacturing firms into groups based on type of product

Figure 3. The Effect of the Euro on Sector Defined According to Pavitt's (1984) Taxonomy, Slovakia 2006–11 (LHS) and Estonia 2008–13 (RHS), Manufacturing Firms



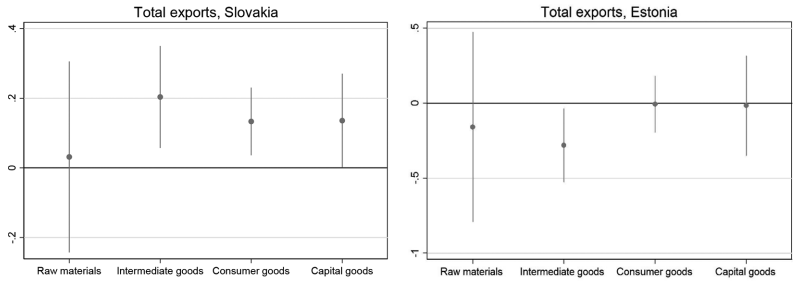
Source: Authors' calculations from the commercial register and customs data.
Notes: Each coefficient in the table represents one regression for the particular sector and trade margin. The confidence intervals reflect statistical significance at 10 percent. The figure presents the long-term effects, i.e., $(\exp(\beta_2/(1-\beta_1))-1)$ according to specification (1).

exported rather than sector of activity. We use the standard end-use product group categories of HS six-digit goods, which divide products into raw materials, intermediate goods, consumer goods, and capital goods.[14]

Figure 4 shows the results. The euro effect on total firm exports other than for raw materials is quite equally distributed across intermediate, consumer, and capital goods in Slovakia, but the effect on intermediate goods is the largest. These estimates confirm our previous findings that quite a broad range of industries benefited from the introduction of the euro, which supports our main argument that transaction costs from exchange rate volatility were driving the gains. Our results also support the macro-level findings that the trade in intermediate goods increased the most and the trade in raw materials did not increase following the introduction of the euro. This implies that the euro further increased the vertical specialization of trade in Slovakia. Both of our sample countries have among

[14]HS Standard Product Groups following UNCTAD statistical classifications of products (UNCTAD-SoP1, SoP2, SoP3, SoP4) were used. See https://wits.worldbank.org/referencedata.html for the reference

Figure 4. The Effect of the Euro on Different Goods, Slovakia 2006–11 (LHS) and Estonia 2008–13 (RHS), Manufacturing Firms



Source: Authors' calculations from the commercial register and customs data.
Notes: Each coefficient in the table represents one regression for the particular sector and trade margin. The confidence intervals reflect statistical significance at 10 percent. The figure presents the long-term effects, i.e., $(\exp(\beta_2/(1-\beta_1))-1)$ according to specification (1).

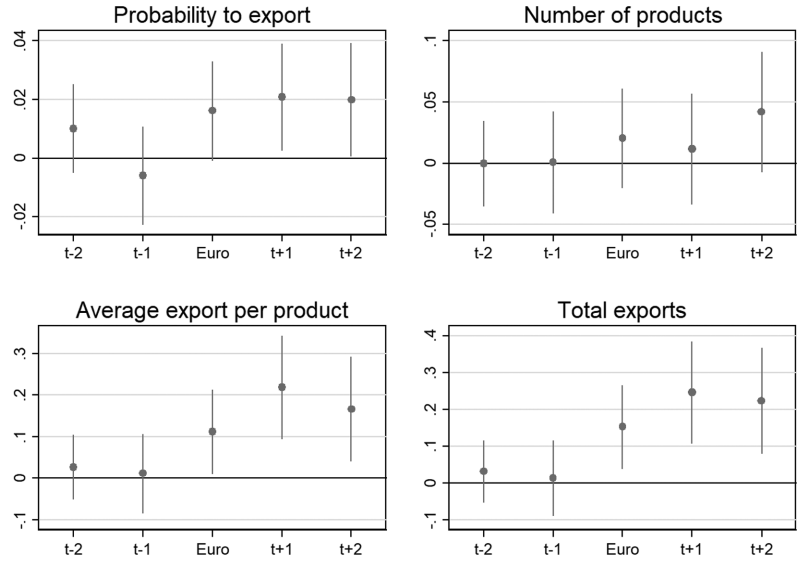
the highest degrees of vertical integration in the Organisation for Economic Co-operation and Development (OECD 2009).

5.5 Robustness Tests

In addition to the presented results over firm characteristics and distribution of exports, we run a number of robustness tests to validate the results. First, we perform the placebo tests over the time and the cross-section. Second, we test for the role of the estimation method and control for the Nickell's bias in our dynamic specification by GMM estimation.

Figures 5 and 6 present the placebo tests over time, i.e., the coefficients of the interaction of the euro-area dummy with year dummies. The placebo year effects are expected to be statistically insignificant before the euro was adopted, and they should become statistically significant after the adoption of the euro in order to support the causal interpretation of the results. The yearly effects allow also testing for the common trend assumption before the changeover. If the yearly effects are statistically insignificant before the changeover, it shows that the conditional trends in dependent variable are similar

Figure 5. Timing of the Effect of the Adoption of the Euro, Slovakia 2006–11, Manufacturing Firms

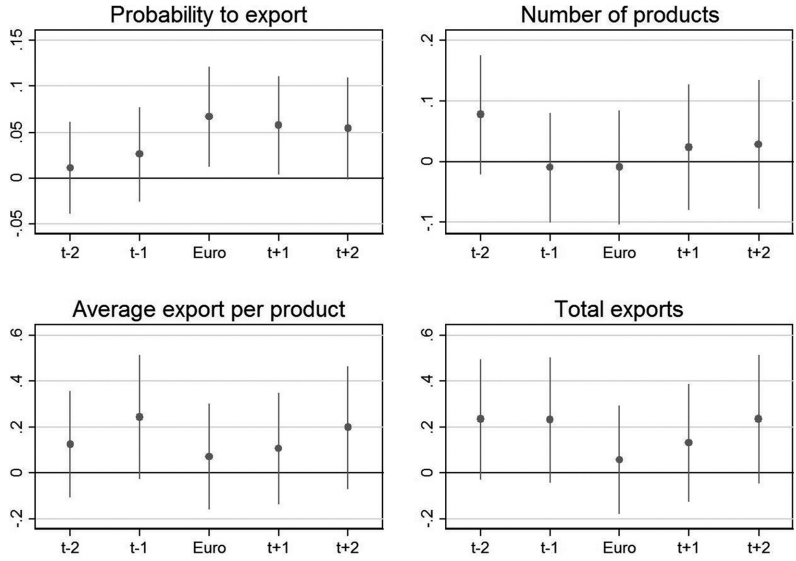


Source: Authors' calculations from the commercial register and customs data.
Notes: Each graph represents the results from one regression, where instead of one treatment dummy in equation (1), five treatment dummies have been used: the year two years before the accession time EA_{ij}; the year one year before the accession time EA_{ij}, and so on. The year three years before the accession has been used as a reference period, and this dummy is omitted from the regressions. The confidence intervals reflect statistical significance at 10 percent. The figure presents the long-term effects, i.e., $(\exp(\beta_2/(1-\beta_1))-1)$ according to specification (1).

for the treatment and control group prior to the changeover. These yearly effects also show the timing of the effect.

The results for Slovakia show that there were no differences between exporting to euro-area and non-euro-area countries before the changeover, while there was more export to euro-area countries after the changeover. The strongest effect along the intensive margin appears one year after the adoption of the euro, while the strongest effect for the number of products appears somewhat later at two years after the adoption of the euro. The results for the longer time span over five years show that the maximum effect along the product margin appeared three years after the euro was adopted. The effects

Figure 6. Timing of the Effect of the Adoption of the Euro, Estonia 2008–13, Manufacturing Firms



Source: Authors' calculations from the commercial register and customs data.
Note: Please refer to the notes of figure 3.

for all the trade margins remained in the same magnitude for five years after the euro changeover (these results are available from authors upon request). The effect is persistent for all the statistically significant cases, so it is not an on-off effect from the temporary experimentation but persists over the treatment period of three or five years. The results for Estonia are clearly statistically insignificant for the volume of trade, while like for Slovakia, the probability of exporting to new destinations increases immediately after the euro is introduced.

The placebo treatment over the cross-section is defined so that the sample is limited to non-euro-area export destinations and the treatment and control groups have been assigned randomly. The effect of this placebo treatment is expected to be statistically insignificant. Table 7 presents the results: the placebo treatment over the cross-section shows no statistically significant treatment effects.

Table 7. The Euro Effect on Total Firm-Level Exports per Destination, Manufacturing, Robustness Tests

	Slovakia			Estonia		
	Placebo Treatment, Non-Euro-Area Countries Only[a]	**Alternative Estimation Method, System GMM**	**Alternative Estimation Method, OLS**	**Placebo Treatment, Non-Euro-Area Countries Only**	**Alternative Estimation Method, System GMM**	**Alternative Estimation Method, OLS**
Lagged Dependent	0.225***	0.325***	0.859***	0.136***	0.288***	0.868***
	(0.016)	(0.017)	(0.003)	(0.031)	(0.043)	(0.007)
$Post_t \times Treatment_{ij}$	0.065	0.109***	0.016	0.020	−0.048	0.053
	(0.053)	(0.036)	(0.019)	(0.095)	(0.042)	(0.040)
$\text{Log}(\text{TFP}_{ijt-1})$	0.041	−0.086***	0.124***	0.054	−0.062	0.058**
	(0.036)	(0.024)	(0.011)	(0.058)	(0.049)	(0.027)
$\text{Log}(\text{GDP}_{jt})$	0.666***	0.479**	0.061***	0.703	1.683***	0.033***
	(0.256)	(0.216)	(0.006)	(0.472)	(0.392)	(0.011)
$\text{Log}(\text{MP}_{jt})$	−0.122	0.131	0.341	−0.289	−0.733	−0.738
	(0.364)	(0.300)	(0.217)	(0.843)	(0.755)	(0.454)
$\text{Log}(\text{REER}_{jt})$	−0.329	−0.170	−0.359*	−0.867	−0.513	−0.021
	(0.346)	(0.305)	(0.197)	(1.017)	(0.749)	(0.589)
Year × Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm × Destination FE	Yes	No	No	Yes	No	No
Observations	15,550	32,991	32,991	2,966	5,979	5,979
No. of Objects	4,922	10,523		1,140	2,262	
R^2	0.124		0.761	0.183		0.772
Sargan Test		5.526			1.651	
No. of Instruments		123			119	

Source: Authors' calculations from the commercial register and customs data.
Notes: [a]The treatment group consists of Denmark, Hungary, Lithuania, Sweden, and Romania; the control group consists of Bulgaria, Czechia, Latvia, Poland, and the United Kingdom. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively. Clustered standard errors are in parentheses.

This raises confidence that our specification is able to control for destination country-specific shocks to trade which occurred during the changeover but were not related to the changeover. This demonstrates that the euro effect is not just some residual trend in the data, but that it disappears when the treatment group is "wrongly" assigned.

The robustness of the estimation method has been tested by estimating the specification in equation (1) by ordinary least squares (OLS) and system GMM; the latter method addresses the Nickell's bias in our baseline fixed-effects estimates. Table 7 reports that the persistence of trade margins is underestimated with our default fixed-effects estimator, as expected, but the statistical significance and the size of the long-run effect, 18 percent ($\exp(0.109/(1-0.325))-1$) for Slovakia, are unchanged.

6. Conclusion

This paper studies the effect of adopting the euro on firm-level exports using data from two recent euro changeovers in Slovakia and Estonia. It is the first paper to test the firm-level trade effects of the euro in countries that were not initial members of euro area. The contribution of the paper is twofold. First, the paper provides evidence of the effect of the euro on exports by studying two cases of changeovers where the trade costs of a new member were reduced, while the competition in the euro area was unaffected. By doing this we can point to the exact channel in action much better than previous studies based on the standard gravity model. Second, the paper provides new evidence for the scarce and inconclusive findings about the heterogeneous effect of the euro on exports.

Our findings for new euro-area countries using microdata show a relatively large positive trade effect from the adoption of the euro in Slovakia that has manifested itself mainly through the intensive margin, and almost no effect in Estonia. We find that joining the euro area increased Slovakian exports to the euro area by 18 percent. In contrast to the previous studies, we have the advantage of studying countries that adopted the euro separately, so we can abstract away from the effect of increased competition and consider only the

channels of foreign exchange transaction costs or transaction costs related to exchange rate volatility. Taking into account the differences in the pre-euro exchange rate regimes in the countries analyzed, where Slovakia had a floating exchange rate with the euro and Estonia had a fixed rate, our results indicate the important point that the major part of the euro trade effect can be assigned to savings from the reduction in exchange rate volatility. This result, however, does not imply that countries with a fixed exchange rate to the common currency are not subject to gains from it. The gains from the transaction costs channel can arise much earlier at the time when exchange rate was fixed and the net gains during the changeover can be positive as the costs from giving up country-specific monetary policy are also lower.

The analysis of the heterogeneity of effects shows that the positive overall effect on the value of exports was the strongest for the most productive firms, but in contrast to previous studies we find gains to be more equally distributed across firm size. The euro changeover does not have a robust interaction effect with other firm characteristics such as firm age, foreign ownership, or debt burden. The results of the unconditional quantile analysis show that it was smaller and medium-sized exporters that increased their exports as a result of the changeover to the euro and they benefited mostly from the intensive margin. Our results indicate that scale-intensive and traditional sectors producing highly differentiated goods and exports of intermediate goods benefited the most from the introduction of the euro, while quite a broad range of industries and products benefited from the introduction of the euro. These results suggest that small and already very open economies can experience a wider distribution of gains and a wider distribution of exports from the reduction in trade costs. Various robustness tests, including estimation of the placebo effects along the time and cross-sectional dimension or using different estimation methods, confirm our baseline results.

Our results are encouraging for small open economies with floating exchange rates that are planning to join the euro area or any other currency union. If the reduction in trade costs is substantial, it can lead to a substantial increase in trade. The differences in the scale and the heterogeneity of the trade effect are an interesting space for further research.

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