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Trade effects of the euro adoption by the EU new member states

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Abstract

In this paper we estimate the trade effects of the euro adoption in countries that joined the European Union in 2004. We employ a generalized gravity model that controls for an extended set of trade theory and policy variables. Trade theory variables include both the country size and factor proportion variables. Trade policy variables include the membership in GATT/WTO, CEFTA, OECD, EU and Europe agreements. The gravity model is estimated for the sample consisting of over 20 thousand country-pairs during the period 1990–2010 using the fixed effects estimator. It seems that elimination of exchange rate volatility resulted in trade expansion for the new member states but the accession to the Eurozone did not have positive effects on the volume of exports of the analyzed countries.

Keywords: EU new member states, trade effects of euro, panel gravity model

JEL: F14, F15, F33, F42

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1. Introduction

During the two waves of the so-called Eastern enlargement in 2004 and 2007 twelve new countries became the members of the European Union (EU). The accession to the EU is associated with the adoption of the common currency. The NMS are obliged to eventually join the European Monetary Union (EMU), however the final date has not been set. The accession to the EMU requires fulfillment of the Maastricht convergence criteria. One of them is related to the accession to the exchange rate mechanism (ERM II) with the aim of reducing the exchange rate variability.

This is in line with theoretical arguments in favor of the common currency adoption is that the elimination of the exchange rate risk stimulates exports of existing firms and encourages previously non-exporting firm to start exporting (Baldwin et al. 2005). This effect can be important for countries where forward foreign exchange markets are not well developed. In addition, a reduction of the transaction cost associated with elimination of the exchange rate risk is argued to be important for countries that are characterized by the strong concentration of their trade with one large trading partner or a group of countries that share a common currency. This is the case for many EU new member states (NMS) for which Germany is the main trading partner, and more than 50% of their trade takes place with the members of the Eurozone.

Estonia, Lithuania and Slovenia joined the ERM II already in June 2004, Cyprus, Latvia and Malta in May 2005, while Slovakia in November 2005. Slovenia was the first country to join the EMU in January 2007. Cyprus and Malta joined the EMU in January 2008, Slovakia in January 2009, Estonia in January 2011, Latvia in January 2014, and Lithuania is expected to join the Eurozone in 2015. Other larger countries from the region, such as Bulgaria, the Czech Republic, Hungary, Poland and Romania, that joined the EU, despite their declarations to adopt the euro have not joined the ERM II so far.[1]

The effects of the adoption of a common currency in the old EMU members have already received a great deal of attention in the empirical literature. In particular, the trade effects of the common currency have been one of the most controversial and extensively studied issues in international economics and the economics of the European integration. Although, there seems to be a widespread consensus that there are non-negligible effects of the currency unions on trade the results of empirical studies differ greatly depending on the methodology used. Moreover, the evidence for the new EMU members still remains scarce.

The main aim of this paper is to evaluate the *ex post* effects of NMS accession to the European Economic and Monetary Union on their trade flows. In contrast to the majority of other studies in this area we distinguish between the old and the new EMU members and analyze the *ex post* trade effects of the Eurozone accession for four new EU member states: Cyprus, Malta, Slovakia and Slovenia.[2] Moreover, to evaluate the overall effect of the euro adoption in our study we distinguish the effects on trade with both the EMU members and non-members. In other words, this study is intended to help in understanding whether and by how much the adoption of the euro could contribute to the development of trade not only between the NMS that adopted the euro and the members of the EMU but also with third countries that remain outside the Eurozone. To evaluate these effects we estimate a generalized gravity model for the sample consisting of over 20 thousand country-pairs during the period 1990–2010 using the fixed effects estimator.

[1] Bulgaria, although it did not officially enter the ERM II, pegged its currency to the euro since its creation in 1999 (before the Bulgarian lev was pegged to the German mark).

[2] Unfortunately, we cannot extend our analysis to include Estonia and Latvia due to the lack of data covering the period after the Eurozone accession.

The contribution of our paper is several-fold. First, in contrast to the previous studies, that were devoted to the evaluation of the effects of the creation of the Eurozone, we study the implications of accession of the new EU member countries into the already existing and functioning EMU. Second, we complement the results of previous studies by taking into account the latest EMU enlargements and the impact of 2008–2009 world economic crisis on the trade flows of the new Eurozone countries.[3] Third, we control for the trade policy changes in the new EU member countries that may affect bilateral trade. In particular, Central and Eastern European countries since the beginning of their economic transformation in the early 1990s have drastically liberalized their trade regimes and became the members of the multilateral as well as various regional trading agreements. These include the WTO membership and the Europe agreement with the EU. Fourth, we take into account the specificity of the NMS that still have lower incomes *per capita* and are less developed than the founding members of the Eurozone. Therefore, to underpin our analytical framework we use the extended gravity model that assumes incomplete specialization in production and takes into account the role of factor proportions and technology differences captured by their GDPs *per capita*.

The structure of this paper is as follows. In the next section we survey the previous studies on the impact of the euro adoption with the particular attention devoted to the new EU member states. Then, we describe the analytical framework and discuss data sources. Finally, we present estimation results on the *ex post* impact of the euro on trade in four new EU member countries that have already adopted the common currency. The last section summarizes and concludes with policy guidelines for countries that so far have not adopted the euro and for which it was not possible to analyze *ex post* direct effects of the euro adoption for their trade flows.

2. Literature review

The *ex post* trade effects of the euro adoption in the old EMU members have already received substantial attention in the literature while the empirical evidence for the new EMU members still remains relatively scarce. One of the first attempts to estimate the *ex post* trade effects of the monetary union was made by Rose (2000; 2001). He identified two main effects of the adoption of a common currency: the effect associated with the elimination of the exchange rate volatility and the pure monetary effect associated with the use of a single currency. His results suggested that the participation in the monetary union may increase trade even threefold.

Since then a large number of studies on these effects have emerged and summarizing this huge literature goes beyond the scope of this paper. In subsequent studies their authors suggested several reasons for overestimation of trade effects associated with the adoption of a common currency, such as a sample selection bias or the endogeneity of the monetary union.[4] The comprehensive survey of the literature on the trade consequences of joining the monetary union by the old EMU members has

[3] There is already a bulk of literature on the Great Trade Collapse that occurred during the crisis. For example, recently, Śledziewska and Witkowski (2012) studied the effects of economic crises in the context of the old EU member states. However, the evidence for the new EU member states still remains scarce.

[4] For example, endogeneity can be associated with central bank policies and colonial ties. In particular, exchange rate volatility may not be exogenous if central banks want to decrease the range of exchange rate fluctuations with respect to the currencies of their main trading partners. The main trading partners for developing countries are often former colonizers with respect to which former colonies stabilize their exchange rates.

been complied by Baldwin (2006). In general this literature shows that there are non-negligible effects of the euro adoption on trade but the results of empirical studies differ greatly depending on the methodology used.[5]

In the context of EU new member states two main strands in the empirical literature employing the gravity models to study the trade effects of the euro adoption can be distinguished. The first strand that emerged in the early 2000s concentrated on estimating the *ex ante* trade effects of the euro adoption by the NMS while the second strand that emerged in the late 2000s focused on evaluating the *ex post* effects of the euro adoption on their trade. Several attempts were made to estimate *ex ante* trade effects of the euro adoption by the new EU member countries. However, the literature dealing with the *ex post* evaluation of the trade effects of euro adoption in the NMS is much less abundant.

One of the first attempts to evaluate the *ex ante* effects of the euro adoption in the NMS was made by Maliszewska (2004). She studied bilateral trade flows between the EU and the Central European countries during the period 1992–2002 using a simple gravity model estimated by the simple OLS method. She found that the estimated parameter on the EMU dummy variable was positive and statistically significant. According to her estimates the euro adoption would increase trade on average by 23%. Then she used this estimate to make a forecast for the Central and East European countries assuming that these countries would reach the same level of trade openness as the old EMU members. Her forecast suggested that as the result of the euro adoption the less open countries such as Poland, Latvia and Lithuania would experience a significant increase in trade, while already open countries such as the Czech Republic, Estonia and Slovakia should rather expect a decrease in trade.

In the follow up study, Belke and Spies (2008) arrived at the opposite conclusion. They included in their analysis all the OECD and the CEE countries during the period 1992–2004 and estimated a gravity model using the Hausman-Taylor approach. In their study the estimated parameter on the EMU variable also turned out to be positive and statistically significant. However, in contrast to Maliszewska (2004) their forecast showed that relatively closed economies such as Poland, Latvia and Lithuania would experience a decrease in their exports while more open economies such as the Czech Republic, Estonia and Slovakia would experience an increase in their exports.

In another study on the *ex ante* effects of the EMU enlargement Brouwer, Paap and Viaene (2008) studied the impact of the exchange rate volatility on trade and FDI using the fixed effects estimator and unbalanced panel data for 29 countries, including both the old and the new EU members as well as four major non-EU countries: Canada, Japan, Switzerland and the US, during the period 1980–2005. Although their main results focused mainly on FDI they also reported that the direct export effect of joining the EMU for all countries which was positive and varied depending on the level of volatility and trade balance from 0.84% for Lithuania to 13.3% for Malta.

Further attempts to study the *ex ante* trade effects of the CEE countries joining the Eurozone were made by Cieślik, Michałek and Mycielski (2009; 2012a) using the Hausman and Taylor approach for the old EMU members and almost 100 other countries trading with the Eurozone countries. Their forecasts consisted of two elements. First, they estimated the effect of exchange rate stabilization against the euro, making use of data for the group of CEE countries which pegged their currency to the euro. The second component of their forecast concerned the impact of joining the Eurozone. According to their results Polish exports after joining the Eurozone, would increase by about 12%, but this positive effect would gradually disappear over time.

[5] More recently, Berger and Nitsch (2008) argued that the euro's impact on trade disappears if the positive trend in the institutional integration is controlled for.

The existing literature on the *ex post* evaluation of the effects of euro for the new EMU members has concentrated so far on the fulfillment of the Maastricht criteria for the euro adoption, growth and business cycle synchronization.[6] In one of the earliest studies on the *ex post* trade effects of the EMU creation, Aristovnik and Meze (2009) employed a time series approach and Slovenian trade data to argue that the trade benefits of the entry of new countries into the EMU would not be the same as the benefits of the initial formation of the EMU in the nineties. According to the results of their time series regression analysis there had been a positive effect on Slovenia's exports into and a negative effect on its imports from the Eurozone precisely at the time of the creation of the EMU in 1999. However, in their study they did not investigate the actual *ex post* trade effects of 2007 Slovenia accession to the Eurozone.

This issue was taken up in the empirical study by Cieślik, Michałek and Mycielski (2012b) who studied the *ex post* trade effects of accession of two Central European countries: Slovenia and Slovakia to the already existing and functioning EMU. They employed a gravity model that controlled for an extended set of trade theory and policy variables. The trade theory variables included both the country size and factor proportion variables while the trade policy variables included the membership in GATT/WTO, CEFTA, OECD, EU and the Europe agreements. The gravity model was estimated using the panel data approach on a sample of CEE countries trading with the rest of the world during the period 1992–2009 using the fixed effects, random effects and Hausman-Taylor estimators. According to their results elimination of exchange rate volatility resulted in trade expansion for these countries but the actual accession to the Eurozone did not have any significant effects on exports of Slovakia and Slovenia.[7]

The previous *ex post* results for two NMS: Slovenia and Slovakia, reported in Cieślik, Michałek and Mycielski (2012b), demonstrated that the accession to the EMU did not contribute to an increase in their exports. Their estimations were based on gravity model estimated separately and jointly for these two Central European countries. This result was not in line with their expectations. In the present study we extend the scope of their analysis to include two other new members of the Eurozone: Cyprus and Malta. Moreover, we also extend the geographical coverage of the reporter countries to include all larger countries for which data were available which increases the number of country pairs to over 20 thousand and the total number of observations to over 250 thousand.

3. Analytical framework and data sources

The analytical framework used in this study is based on the generalized gravity equation derived from the trade theory models that assume incomplete specialization in production. The gravity equation is one of the most popular empirical equations that has been successfully used to study the whole range of spatial interactions in economics during the last fifty years. In particular, it has been most often applied to study the determinants of bilateral trade flows and to assess the impact of various forms of regional economic integration, such as the creation of a customs union or the adoption of a common currency, on the volume of bilateral trade between integrating countries.

In the context of international trade, the gravity equation in its most basic form postulates that the amount of trade between two countries increases in their sizes, as measured by their national

[6] The examples of studies that belong to this strand in the literature include Fidrmuc and Korhonen (2006), De Grauwe and Schnabl (2008), Frankel (2008), Feuerstein and Grimm (2007), and Sivak (2011).

[7] These results do not seem surprising given the fact that some of the studies for the old EU member states do not find any positive trade effect of the Eurozone creation.

incomes, and decreases in the cost of transport between them, as measured by the distance between their economic centers. This relationship closely resembles Newton's (1687) law of universal gravitation which states that every particle in the universe attracts every other particle with a force that is proportional to the product of their masses and inversely proportional to the square of the distance between the particles.

Although the gravity equation in its basic form does a pretty good job at explaining bilateral trade with just the size of trading partners and distances between them, however, there is still a huge variation in trade it is unable to explain. Therefore, in order to improve the performance of the gravity equation in empirical studies of bilateral trade flows it has been also common to specify it in a more general form that takes into account also the impact of other factors that may affect trade. One of the most frequently used variables to augment the baseline gravity equation is *per capita* income. The general idea behind the inclusion of this variable is that higher-income countries trade more in general (Head 2000).

The first formal justification for the inclusion of the *per capita* income variables was provided by Bergstrand (1989) who concentrated on the demand-side. He assumed complete specialization in production and in order to provide the theoretical justification for the use of *per capita* incomes in his estimating equations he had to depart from the standard assumption of homothetic and identical preferences across countries. More recently, Cieślik (2009) demonstrated how the augmented gravity equation can be derived from a variety of models based on both neoclassical and monopolistic competition approaches that assume incomplete specialization in production and provided a supply--side justification for the inclusion of *per capita* income variables. According to him, income *per capita* variables can proxy for the differences in relative factor endowments between trading partners.

In addition to the standard set of gravity variables in our equation we used a set of control variables, that includes trade policy variables. Trade policy variables include various institutional arrangements facilitating development of international trade at the global or regional scale. World trade facilitating arrangements include GATT/WTO and OECD memberships. The main regional agreement affecting trade is the European Union. In addition to this we included also the variables describing participation in free trade areas concluded by Central European countries among themselves (CEFTA) and with the EU (Europe Agreements). These agreements can be seen as intermediates steps proceeding full EU membership. The aim of these agreements was to gradually liberalize trade and approximate legislation of Central European countries to EU standards.

In this study we focus our attention mainly on the institutional variables related to European monetary integration. In particular, we distinguish between the situation in which two countries of the country-pair participate in the EMU or ERM from the situation when only one of them is a member these agreements and the second is not. In addition we control for other exchange rate arrangements.

Our estimating equation used to study the determinants of bilateral trade flows is as follows:

$$\ln EX_{ijt} = \alpha + \beta' X_{ijt} + \gamma' Y_{ijt} + \zeta' Z_{ijt} + c_{ij} + \theta_t + \varepsilon_{ijt}$$

where:

EX_{ijt} – bilateral exports between country i and j in year t; export data are expressed in the current US dollars for exports (gross exports), which comes from the WITS (World Integrated Trade Solution) database, complied jointly by the World Bank, WTO and UNCTAD;

X – the set of standard gravity variables expressed in logarithms;
Y – the set of trade policy dummy variables;
Z – the set of variables related to the European monetary integration.

The countries providing export data were treated as reporters, while importing countries were treated as partners.[8] The detailed list of partner and reporter countries is provided in Table 3. Our dependent variable is the volume of bilateral exports from the reporter to the partner country. This can also be interpreted as the volume of bilateral imports from the partner to the reporter country.[9] The sample covers the period 1990–2010 which yields over 250 thousand observations. The detailed definitions of explanatory variables are given in Table 1.

The generalized gravity equation was estimated using the fixed effects estimator. Our empirical specification includes an individual country-pair effect c_{ij} which can be correlated with explanatory variables and varies over countries pairs but not over time. This pair specific effect are related to barriers to bilateral trade which can not be directly observed but which are constant over time. The joint error term can be defined as $v_{ijt} = c_{ij} + e_{ijt}$. In the case when the individual effect c_{ij} is correlated with the explanatory variables, the estimation with OLS will suffer from simultaneity bias due to the correlation between the joint error term and explanatory variables. The standard solution to this problem is to use fixed effects (FE) for particular country pairs.

In our study we used bilateral trade flows of all countries with population exceeding 200ths. This means that we exclude mainly small island economies having very limited trade relations with other countries. This strategy allows us to obtain a more balance panel with limited number of zero observations. Moreover, we assumed that the lack of bilateral observations means no trade for a given country pair in a given year.

4. Estimation results

In this section we present estimation results on the *ex post* impact of the euro on bilateral exports on the NMS that have already adopted the common currency. In our study we hypothesize that the lack of significance of the EMU variable in the previous studies for the NMS described in the literature review section may result from the fact that the accession to the already functioning monetary union is different from the simultaneous foundation of the union by several large countries that decided to adopt the common currency. In the latter case the synergy effect of the common currency for the founding countries should be stronger compared to the former case when only one small country joins the monetary union. Second, the lack of statistical significance of the parameter on the EMU variable for the new member countries might result from the coincidence of the accession of Slovenia and Slovakia with the world crisis that depressed the world trade flows. Therefore, in our study we control for the effects of the world crisis. The estimation results obtained using the fixed effects estimator are reported in Table 2.

[8] The smallest economies with the population less than 200 thousand inhabitants were excluded from our sample.
[9] This interpretation should, however, be treated with caution due to asymmetry of the countries included in the groups of reporter and partner countries.

In column (1) we present our benchmark results based on the gravity model the augmented with the additional dummy variable indicating the EMU membership (*EMU*) of both reporter and partner countries. The estimated parameter on this variable is statistically significant already at the 1% level but displays a counterintuitive negative sign. Moreover, it can be noted that the estimated parameter on the *exchange_sd* variable is negative and statistically significant at the 1% level. This means that the lower level of exchange rate volatility positively affect exports. The estimated parameters on the *ERM2*, *rep_ERM2* and *part_ERM2* are not statistically significant. In other words, the countries that stabilized their exchange rates with some degree of volatility by accessing to the ERM II such as Estonia, Latvia and Lithuania did not experience an increase in their bilateral trade flows.

The majority of our control variables are statistically significant and display the expected signs. In particular, the GDP variables for both reporting and partner countries display positive signs and are statistically significant already at the 1% level. However, none of the GDP *per capita* variables are statistically significant. Also trade policy variables indicating membership in preferential trade agreements such GATT-WTO, OECD, EU and the Europe agreement are statistically significant at the 1% level and display positive signs. This means that multilateral and regional trade liberalization positively affected trade flows of analyzed countries. In particular, the Europe agreements concluded between the new and old EU member states increased their bilateral trade flows.

In column (2) we present estimation results obtained from the specification in which we distinguished between the new and the old EMU members to test the hypothesis that the accession to the already existing monetary union might have differed from the foundation of the union. The *new_EMU* variable means that either a reporter or a partner country is a new EMU member trading with all other EMU members (old and new) while the *old_EMU* variable describes the situation when both countries are the old EMU members. The estimated parameters on both EMU variables are negative and statistically significant, although at different levels of statistical significance. The estimated parameter for the new EMU members is statistically significant at the 5% level, while the estimated parameter for the old EMU members is statistically significant at the 1% level. Moreover, the magnitude of the estimated parameter for the new EMU members is smaller than the magnitude of the estimated parameter for the old EMU members. The statistical significance of the other variables remained unchanged.

The counterintuitive negative signs on both EMU variables might be related to the economic crisis 2008–2009 and the resulting great trade collapse that occurred during this period. Therefore, in column (3) we control for the economic crisis by including the dummy variable *crisis* indicating whether both trading countries faced a drop in real GDP in 2008–2009. This variable displays a negative sign and is statistically significant at the 5% level. The inclusion of this variable made the estimated parameter on the *new_EMU* variable not statistically significant. This means that the drop in trade flows of the new EMU members resulted mainly from the economic crisis in Europe and not from the accession to the Eurozone. However, the estimated parameter on the *old_EMU* variable still remains statistically significant at the 1% level and displays a negative sign. Similarly, the statistical significance of the other control variables did not change.

In column (4) we explore the trade effects of the Eurozone in a more detailed way having controlled for the effects of the crisis. In particular, we include the set of variables describing the separate trade effects of the Eurozone for both the reporter and partner countries as well as their cumulative effects. The inclusion of these variables does not affect the statistical significance of the majority of

other variables with exception of the *crisis* and *rep_ERM* variables. The estimated parameter on the *crisis* loses completely its statistical significance while the *rep_ERM* variable becomes statistically significant at the 1% level and displays a negative sign. On the other hand, the estimated parameter on the *central_to_EMU* variable displays a positive sign and is statistically significant already at the 1% level. This means that the decision of some NMS to peg their currencies to the euro strongly contributed to the expansion of their exports. This results is similar to the results reported by Cieślik, Michałek, Mycielski (2009) for the pre-crisis period.

Moreover, many other variables related to the functioning of the Eurozone (*part_old_EMU, old_EMU_cum, rep_old_EMU_cum, part_old_EMU_cum, rep_new_EMU*) also turned out to be statistically significant. In particular, the *part_old_EMU* variable displays a positive sign and is statistically significant at the 5% level. This may mean that the exports of the non-EMU countries to the Eurozone were positively affected due to the relative appreciation of the euro against the majority of national currencies. The *old_EMU_cum, rep_old_EMU_cum* and *part_old_EMU_cum* variables display negative signs and are statistically significant at the 1% level while the estimated parameter on the *old_EMU* variable loses completely its previous statistical significance. This may mean that the long-run effects of the functioning of the EMU for the old member states are negative. In the case of the NMS we observe that the estimated parameter on the *rep_new_EMU* variable displays a negative sign and is statistically significant at the 5% level. This result may mean that the exports of the NMS to the other countries decreased due to the relative appreciation of the euro.

Therefore, in column (5) we control for the changes in the level of real exchange rates for the partner and reporter countries. The increase in the real exchange rate for the reporter (partner) country means real appreciation, i.e. the higher prices of goods produced in the reporter (partner) country in terms of goods produced in the partner (reporter) country. The estimated coefficients on the real exchange rates for both countries are statistically significant already at the 1% level and display expected opposite signs. This means that in the case of the reporter country real appreciation decreases its exports. The inclusion of the real exchange variables does not affect our previous estimation results with the exception of the exchange rate volatility variables which loses its previous statistical significance.

5. Conclusions

The main goal of this paper was to investigate the *ex post* trade effects of the euro adoption by the NMS that have so far adopted the euro and to draw lessons for the other countries in the region that are to join the Eurozone in accordance with the EU accession treaties. Our overall results show that the EMU accession of the NMS did not stimulate their bilateral exports. These results are in sharp contrast to the majority of older studies analyzing *ex post* trade implications of the Eurozone membership for the old member states which demonstrated that the participation in the Eurozone increased their trade. Moreover, these results are also in contrast to the *ex ante* studies aiming at estimation of the euro adoption by the Central European EU member states.

In our estimations we distinguished between the old and the new EMU members. The estimation results obtained without controlling for crisis showed that the parameters on both EMU variables were negative and statistically significant, although at different levels of statistical significance. However, when we controlled for the crisis the results obtained for NMS were different from the results obtained

for the founding members of the Eurozone. In particular, the estimation results revealed that exports of NMS that joined the Eurozone to the other members of the Eurozone did not increase while the exports of old members of the Eurozone decreased. Moreover, the results obtained from a more detailed specification revealed that the exports of the NMS to the third countries decreased. This means that the overall effect of the EMU accession on bilateral trade of the EMU members is negative. Therefore, it should not be expected that the euro adoption by the remaining NMS, such as the Czech Republic, Hungary, Poland and Romania, will increase their trade in the nearest future.

Our estimations revealed also that the reduction in the exchange rate volatility has a positive impact on exports. In addition, the NMS that stabilized their exchange rates with respect to euro experienced a relative increase in their exports. We also showed that the changes in the real exchange rates were also important for the determination of exports. The NMS that did not join the Eurozone or pegged their currencies to the euro faced depreciation of their currencies against the euro in reaction to the business cycle downturn in 2008–2009.[10] This has temporarily lowered their relative prices and have improved trade balances of those countries in the short run. Thus, the EU new member states with the flexible exchange rates were in a relatively better position.

Our empirical results, in particular the role of exchange rate flexibility, should be verified for the longer period of time and a broader sample of countries. Moreover, the analysis of *ex post* trade consequences of the euro adoption should be extended to include also other countries: Estonia and Latvia which were not taken into account in our study due to the lack of data covering the period after the Eurozone accession.

Alternatively, it would be useful to study the trade consequences of the euro adoption at the firm level by looking at the propensity of particular firms to export. However, this approach would require the use of individual firm level data which are not widely for a large number of countries. This would complement the existing studies on the impact of accession to EMU conducted at the macroeconomic level using aggregated trade data by micro-analysis based on the firm-level data.

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[10] See Figure1 illustrating the changes in the exchange rate levels of CEECs.

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Appendix

Table 1
Definitions of explanatory variables

X: gravity variables	rep_GDP_{it}: in country i in year t; GDP variable is measured in current US dollars. GDP data comes from World Development Indicators database complied by the World Bank. GDP variable measures the economic size of trading countries. $part\_GDP_{jt}$: GDP in country j in year t; GDP variable is measured in current US dollars. GDP data comes from World Development Indicators database complied by the World Bank. GDP variable measures the economic size of trading countries. $rep\_GDP\_pc_{it}$: in country i in year t; GDP *per capita* variable is measured in current US dollars. GDP data comes from World Development Indicators database complied by the World Bank. *GDP_pc* variable measures the level of development of reporter country. $part\_GDP\_pc_{jt}$: GDP in country j in year t; GDP *per capita* variable is measured in current US dollars. GDP data comes from World Development Indicators database complied by the World Bank. *GDP_pc* variable measures the level of development of partner country. $crisis_{ijt}$: the dummy variable indicating that both trading countries faced a drop in real GDP in 2008–2009.
Y: trade policy variables	EU_{ijt}: dummy variable that takes value 1 if both countries are the members of the European Union in year t and 0 otherwise; rep_EU_j: dummy variable that takes value 1 if reporter country is the EU member country and partner is not and 0 otherwise; $part\_EU_j$: dummy variable that takes value 1 if partner country is the EU member country and reporter is not and 0 otherwise; $CEFTA_{ijt}$ (Central Free Trade Area): dummy variable indicating whether both trading countries in year t were the members of the CEFTA; $OECD_{ijt}$: dummy variable indicating whether in year t both trading countries are the OECD members; $GATT\_WTO_{ijt}$: dummy variable indicating whether in year t both countries are the GATT/WTO members. $Europe\_agreement_{ijt}$: dummy variable that takes value 1 if CEE country was the member of the European Agreement in year t with the European Union and 0 otherwise.

Z: variables related to monetary integration	EMU_{ijt}: dummy variable that takes value 1 if both countries are the members of the European Monetary Union in year t and 0 otherwise; rep_EMU_j: dummy variable that takes value 1 if reporter country is the EMU member country and partner is not and 0 otherwise; $part\_EMU_j$: dummy variable that takes value 1 if partner country is the EMU member country and reporter is not and 0 otherwise; EMU_cum_{ijt}: minimum number of years in EMU for two members of EMU; $rep\_EMU\_cum_{it}$: the number of years in the EMU for the reporting country; $part\_EMU\_cum_{jt}$: the number of years in the EMU for the partner country; *new_EMU*: dummy variable that takes value 1 if either partner (reporter) country is the new EMU member country and reporter (partner) is old EMU or both countries are the new EMU members and 0 otherwise *old_EMU*: dummy variable that takes value 1 if both countries are the old EMU members and 0 otherwise $ERM2_{ijt}$: dummy variable that takes value 1 if both countries are the members of ERM2 in year t and 0 otherwise; rep_ERM2_{ijt}: dummy variable that takes value 1 if reporter country is the member of ERM2 in year t and partner is not and 0 otherwise; $part\_ERM2_{ijt}$: dummy variable that takes value 1 if partner country is the member of ERM2 in year t and reporter is not and 0 otherwise; $new\_EMU_t\_cum$: variable indicating the number of years of membership of four NMS in the EMU; new_EMU_t: dummy variable indicating the membership of four NMS in the EMU; $central\_to\_EMU_{ijt}$: dummy variable that takes value 1 if both countries decided to stabilize their exchange rates by pegging their national currencies to the euro in year t and 0 otherwise; *rep_real exchange rate:* nominal exchange rate times the consumer price index (CPI) of the reporter divided by the CPI of the partner country[1] *part_real exchange rate:* nominal exchange rate times the consumer price index (CPI) of the partner divided by the CPI of the reporter country $exchange\_sd_{ijt}$: exchange rate volatility between country i and country j in year t; bilateral exchange rates and their volatility were calculated using data from International Financial Statistics database compiled by the International Monetary Fund, where the exchange rates were expressed in relation to the SDR of particular countries at the end of the month.[2]
	c_{ij}: individual country-pair fixed effect θ_t: time specific effect in the period t, affecting all observations in the same way. ε_{ijt}: error term.

[1] The nominal effective exchange rate of the country under study, is the geometrically weighted average of nominal exchange rates. The nominal bilateral exchange rate between the country under study and its trading partner i is measured as the foreign currency price of one unit of domestic currency.

[2] Following earlier studies exchange rate volatility was measured using the standard deviation of first differences of logs. These differences are equal to zero when the exchange rate does not change.

Table 2
Estimation results for the period 1990–2010

Variable	1	2	3	4	5
exchange_sd	-0.0785***	-0.0785***	-0.0785***	-0.0817***	0.0753
	(0.014)	(0.014)	(0.014)	(0.014)	(0.046)
EU	0.1316***	0.1296***	0.1291***	0.2062***	0.2009***
	(0.037)	(0.037)	(0.037)	(0.039)	(0.039)
rep_eu	0.0064	0.0062	0.0060	0.0255	0.0285
	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)
part_eu	-0.0657***	-0.0659***	-0.0660***	-0.0837***	-0.0921***
	(0.022)	(0.022)	(0.022)	(0.023)	(0.023)
erm_2	-0.0069	-0.0046	-0.0044	-0.1155	-0.1158
	(0.106)	(0.106)	(0.106)	(0.107)	(0.107)
rep_erm2	0.0090	0.0094	0.0096	-0.0681***	-0.0669***
	(0.024)	(0.024)	(0.024)	(0.025)	(0.025)
part_erm2	0.0414	0.0420	0.0422	0.0172	0.0147
	(0.029)	(0.029)	(0.029)	(0.030)	(0.030)
CEFTA	-0.0263	-0.0267	-0.0270	-0.0123	-0.0118
	(0.080)	(0.080)	(0.080)	(0.080)	(0.080)
OECD	0.2061***	0.2063***	0.2057***	0.2288***	0.2238***
	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)
GATT_WTO	0.2547***	0.2546***	0.2546***	0.2451***	0.2405***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Europe_agreement	0.0879***	0.0882***	0.0882***	0.0996***	0.0990***
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
lrep_GDP	0.4154***	0.4155***	0.4153***	0.3888***	0.3998***
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
lpart_GDP	0.5946***	0.5947***	0.5944***	0.5957***	0.6006***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.025)
lrep_GDP_pc	0.0257	0.0256	0.0257	0.0109	0.0135
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
lpart_GDP_pc	0.0256	0.0255	0.0256	0.0186	0.0121
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
EMU	-0.2059***				
	(0.050)				
new_EMU		-0.1789**	-0.1098	-0.2846	-0.2849
		(0.086)	(0.092)	(0.185)	(0.185)
old_EMU		-0.2189***	-0.2014***	0.0457	0.0438
		(0.060)	(0.061)	(0.088)	(0.088)
crisis			-0.1845**	-0.0365	-0.0351
			(0.092)	(0.098)	(0.098)

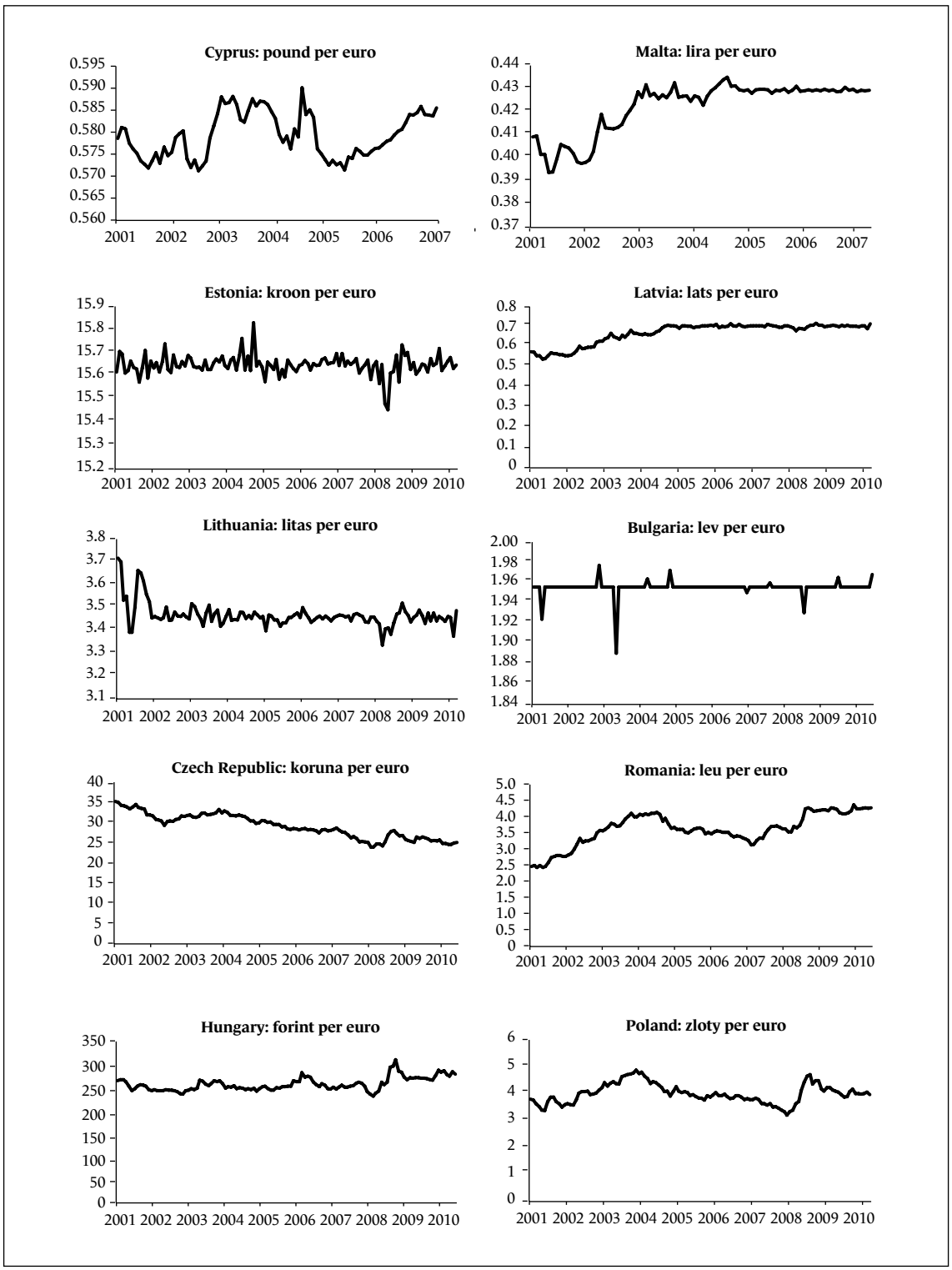
central_to_EMU				0.2013*** (0.063)	0.2039*** (0.063)
rep_old_EMU				-0.0114 (0.025)	-0.0118 (0.025)
part_old_EMU				0.0689** (0.029)	0.0677** (0.029)
old_EMU_cum				-0.0550*** (0.011)	-0.0550*** (0.011)
rep_old_EMU_cum				-0.0418*** (0.003)	-0.0414*** (0.003)
part_old_EMU_cum				-0.0251*** (0.003)	-0.0257*** (0.003)
rep_new_EMU				-0.2021** (0.084)	-0.2048** (0.084)
part_new_EMU				0.0233 (0.107)	0.0285 (0.107)
new_EMU_cum				-0.0516 (0.082)	-0.0503 (0.082)
rep_new_EMU_cum				-0.0198 (0.037)	-0.0190 (0.037)
part_new_EMU_cum				-0.0762 (0.048)	-0.0774 (0.048)
rep_reer					-0.0003*** (0.000)
part_reer					0.0003*** (0.000)
_cons	3.7183*** (0.076)	3.7186*** (0.076)	3.7195*** (0.076)	3.9156*** (0.077)	3.8683*** (0.077)
Time effects	yes	yes	yes	yes	yes
Number of observations	256 215	256 215	256 215	256 215	255 380
Number of country pairs	20 673	20 673	20 673	20 673	20 416
R^2 overall	0.458	0.458	0.458	0.434	0.442
R^2 between	0.476	0.476	0.476	0.447	0.457
R^2 within	0.197	0.197	0.197	0.198	0.199

Notes:
*** denotes statistical significance at the 1% level, ** denotes statistical significance at the 5% level, *** denotes statistical significance at the 10% level;
standard errors in parentheses.

Table 3
Summary statistics

Variable	Observations	Mean	Standard deviation	Min	Max
EX	255 380	499916.1	4501276	0.001	3.51e+08
exchange_sd	255 380	0.0352405	0.0603968	0	1.539174
new_EMU	255 380	0.0011395	0.033737	0	1
old_EMU	255 380	0.0057522	0.075625	0	1
central_to_EMU	255 380	0.0043543	0.0658434	0	1
rep_old_EMU	255 380	0.0767327	0.2661674	0	1
part_old_EMU	255 380	0.0579724	0.2336918	0	1
old_EMU_cum	255 380	0.0366591	0.5418108	0	12
rep_old_EMU_cum	255 380	0.4891182	1.927827	0	12
part_old_EMU_cum	255 380	0.3589905	1.644787	0	12
rep_new_EMU	255 380	0.0054233	0.0734432	0	1
part_new_EMU	255 380	0.0034341	0.0585006	0	1
new_EMU_cum	255 380	0.0022476	0.073529	0	4
rep_new_EMU_cum	255 380	0.0108779	0.1632474	0	4
part_new_EMU_cum	255 380	0.0067781	0.1278031	0	4
crisis	255 380	0.0017621	0.0419402	0	1
rep_reer	255 380	98.85325	32.80096	32.07726	2339.494
part_reer	255 380	101.7499	53.84892	3.193981	2339.494

Figure 1
The exchange rate levels in Cyprus, Malta and CEE countries that are not members of Eurozone



List of countries analyzed in our sample. Partners and reporters: countries with population over 200 thousand inhabitants

Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Central African Republic, Chad, Chile, China, Colombia, Comoros, Democratic Republik of Congo, Kongo, Costa Rica, Cote d'Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Djibouti, Dominican Republic, Ecuador, Egypt Arab Rep., El Salvador, Equatorial Guinea, Eritrea, Estonia, Ethiopia (excludes Eritrea), Fiji, Finland, France, Gabon, Gambia, Georgia, Germany, Ghana, Greece, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, Iceland, India, Indonesia, Iran Islamic Rep., Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Korea Republic, Kuwait, Kyrgyz Republic, Lao PDR, Latvia, Lebanon, Lesotho, Liberia, Libya, Lithuania, Luxembourg, Macedonia FYR, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russian Federation, Rwanda, Saudi Arabia, Senegal, Sierra Leone, Singapore, Slovak Republic, Solomon Islands, South Africa, Spain, Sri Lanka, Sudan, Suriname, Swaziland, Sweden, Switzerland, Syrian Arab Republic, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Vanuatu, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe.