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ARE EXCHANGE RATES LESS IMPORTANT FOR TRADE IN A MORE GLOBALIZED WORLD? EVIDENCE FOR THE NEW EU MEMBER POLICY

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IES Working Paper 10/2020

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Bibliographic information:
Fisera B. and Horvath R. (2020): "Are Exchange Rates Less Important for Trade in a More Globalized World? Evidence for the New EU Members" IES Working Papers 10/2020. IES FSV. Charles University.

Are Exchange Rates Less Important for Trade in a More Globalized World? Evidence for the New EU Members

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April 2020

Abstract:
We evaluate the effect of exchange rate misalignments on the balance of trade and the role that global value chain participation plays in this effect for 11 new European Union member states. Using heterogeneous panel cointegration methods, we first estimate the real equilibrium exchange rate and detect episodes of currency misalignment. We find asymmetric effects of real currency misalignments: overvaluation has a negative effect, but undervaluation has no effect on the trade balance. Additionally, we find that global value chain participation weakens the effect of currency misalignments on the balance of trade. Therefore, our results suggest that globalization reduces the role of exchange rates in stimulating the domestic economy.

JEL: F31, F32
Keywords: Balance of trade, Exchange rates, Global value chains, Export sophistication, Panel cointegration

Acknowledgments: We thank Maria Siranova and Juraj Sipko for helpful comments. Fisera acknowledges that this paper is the partial result of the project VEGA (2/0158/18) Prediction of Economic and Financial Crises in the Wake of the Recession in the European Union.

1 Introduction

The relationship between exchange rate movements and economic performance constitutes an important part of textbook international macroeconomics. In the short and medium term, domestic exchange rate depreciation is supposed to make domestic production more competitive, improve net exports and, as a consequence, contribute to higher economic growth (Eichengreen and Gupta, 2013). Currency depreciations (or undervaluations when referring to the equilibrium exchange rate concept) have been considered to have played a key role in the export-driven economic growth of Japan and West Germany in the postwar era as well as of China and other East Asian economies over the past three decades (Dooley et al., 2004).

Recently, some studies, such as Ahmed et al. (2017), show that the increasing share of global value chains (GVCs) in world trade reduces the strength of the relationship between exchange rates and trade balance (and economic performance). In other words, as production chains are located in numerous countries, countries need to increasingly import more to be able to export. Under such conditions, a currency depreciation still makes exports more competitive but very likely with more limited competitiveness gains because of higher prices of imported intermediate products used in the production of exported goods. Accordingly, currency appreciation would not only make exports more expensive abroad but also make imported intermediate products cheaper, thus lowering the domestic production costs of exports and therefore reducing the exchange rate elasticity of exports. Consequently, the increased globalization of production, characterized by an increasing share of global value chains, is likely to significantly affect the relationship between exchange rates and the real economy. Therefore, somewhat paradoxically, exchange rates become less important for trade in a more globalized world. This phenomenon, i.e., the greater importance of GVCs, may help explain the experience of several of the new EU member states of export-led growth without currency depreciations.

We focus in this paper on the new European Union (EU) members states—the former transition economies. These countries are characterized by two interesting features. First, they typically experienced high rates of economic growth, often driven by strong export dynamics despite a significant trend of appreciation of domestic exchange rates.[1] Second, these new EU member states have often exhibited some of the world's highest shares of participation in the GVCs and therefore highest shares of reexports (or, alternatively, lowest shares of domestic value added) in their total exports.[2]

The contribution of this paper is threefold. First, we reestimate the exchange rate elas-

[1] Real appreciation was driven by rapidly growing productivity in the trading sector, which was associated with the Balassa-Samuelson effect (Egert et al., 2003), and nominal appreciation was primarily caused by increasing inflows of foreign investment.

[2] According to the OECD, the share of domestic value added in gross exports in 2016 was only 55.5% in Slovakia, 55.9% in Hungary, 62.3% in the Czech Republic and 65.5% in Estonia. These values are well below the OECD average and much lower than, for example, Japan and the US (88.6% and 91%, respectively).

ticity of exports. Therefore, we extend the previous evidence on the role of exchange rate in the economies of new EU member states by Cuestas et al. (2020). While these authors examine the effect of the exchange rate on economic growth, we evaluate the effects on the trade balance. An undervalued exchange rate is unlikely to lead to an overall positive effect on the real economy unless it first improves the trade balance. Additionally, the transition economies are expected to experience trade balance deficits in the early stages of the transition process, with the eventual trade balance surpluses often being considered to be the key macroeconomic preconditions for successful completion of the transition process. Consequently, our paper not only helps improve our knowledge on the modalities of the relationship between the exchange rate and the real economy in the new EU member states but also contributes to understanding the role played by real over-/undervaluation in the successful conclusion of the transition process. This study is also relevant to the new EU member states with the plans to join the euro area (EA). If the exchange rate elasticity of exports is high, the benefits of conducting one's own monetary policy increase. In such a case, policies focusing on maintaining an undervalued currency can aid in economic recovery or address persistent current account imbalances. However, our results, obtained using heterogeneous panel cointegration techniques, do not indicate that an exchange rate undervaluation improves the trade balance.

Second, we examine the possibility of nonlinearity in the effects of currency misalignments; specifically, we separately investigate the effects of real overvaluation and real undervaluation on the trade balance. Some authors examine the periods of over- and undervaluation separately and evaluate the impact on economic growth, showing mixed evidence on whether currency undervaluation stimulates growth (Nouira and Sekkat, 2012; Rodrik, 2012). We contribute to this body of literature by providing evidence on the new EU members. We find that real overvaluation has a negative effect on the balance of trade. On the other hand, we fail to find evidence of a positive effect of real undervaluation on the balance of trade. Therefore, our results suggest that real overvaluation adversely affects the successful completion of the transition process by preventing the trade balance from improving. Moreover, undervaluation does not seem to be able to stimulate trade balance improvement, suggesting that the advantages of an independent monetary policy may be more limited in this group of countries.

Finally, the third contribution of this paper is an investigation of the role played by GVCs in the relationship between currency misalignments and the trade balance. We find that increased GVC participation reduces the effect of currency misalignments on the balance of trade. This is especially the case for backward GVC participation (i.e., a higher share of foreign value added in domestic exports). For forward GVC linkages (i.e., a higher share of domestic value added in third-country exports), our results are somewhat mixed. In addition, we examine whether export sophistication reduces the exchange rate elasticity of exports. Indeed, some authors, such as Thorbecke and Salike (2018), have argued that more sophisticated export products are also less

likely to be affected by exchange rate movements. However, the results vary across specifications, and we provide several arguments as to why this may be so.

The rest of the paper is organized as follows. Section 2 discusses the related literature. Section 3 presents the empirical methodology, while Section 4 outlines our dataset. Section 5 contains our results, and Section 6 concludes the paper. Additional results of the robustness tests are available in the Appendix.

2 Related Literature

In this paper, we follow two main strands of literature. The first includes studies that investigate the effects of exchange rate movements on the trade balance. The second group of articles studies the effects of currency misalignments on the real economy.

The role played by the exchange rate in affecting the balance of trade has been acknowledged by international finance theory for decades. Real depreciation makes domestic production more competitive; thus, it likely leads to an increase in exports and to a decrease in imports, which, as a result, improves the trade balance. Conversely, real appreciations make domestic producers more expensive in the international context and are thus likely to have an adverse effect on the balance of trade. Nominal exchange rate movements are likely to affect the trade balance by affecting the real exchange rate.

A number of empirical studies have investigated the relationship between the exchange rate and the trade balance, but they have not reached a consensus. An early example of such an empirical study is Miles (1979), who find no evidence of the existence of the expected positive effect of devaluation on the trade balance. On the other hand, later studies (Haynes and Stone, 1982; Himarios, 1985; Bahmani-Oskooee, 1991; Arize, 1994) observe a positive effect of a weaker currency on the balance of trade. Nonetheless, even after the start of the new millennium, the empirical literature has not come to a consensus. Bahmani-Oskooee (2001), Singh (2002) and Sun and Chiu (2010) represent studies that find a positive relationship between the real exchange rate and trade balance (i.e., an exchange rate depreciation improves the trade balance and *vice versa*). However, Wilson and Tat (2001) and Hatemi and Irandoust (2005) find no statistically significant relationship between the exchange rate and trade balance. In addition, Arize et al. (2017) show some nonlinear effects of the real exchange rate on the balance of trade, with depreciation having a larger effect than appreciation (in absolute terms).

The empirical evidence is also mixed for the new EU member states. Bahmani-Oskooee and Kutan (2009) examine the relationship in a group of Central and Eastern European economies, but they find a long-run relationship between the real exchange rate and balance of trade in only 3 out of the 11 studied countries. However, Begovic and Kreso (2017) obtain the opposite finding: Real depreciation worsens the trade balance in a group of European former transition economies.

The authors attribute this finding to the high import dependence and low export capacity of the European transition economies.

The second strand of literature investigates the effect of currency misalignments on the real economy.[3] Lee and Chinn (1998) and Arghyrou and Chortareas (2008) find the theoretically expected effect of misalignments on the current account balance. Aguirre and Calderon (2005) find that exchange rate misalignment has an effect on economic performance and that the magnitude of this effect increases with the size of the misalignment. The authors emphasize the role of the trade channel in the transmission of the effects of real misalignments. Razin and Collins (1997) find that overvaluation causes a negative effect on economic growth, while undervaluation has a positive effect. However, Razin and Collins (1997) also observe certain nonlinearities in the effect of exchange rate misalignment on economic performance. They find that only very large overvaluations exhibit a negative effect on economic growth, while both moderate and high undervaluations boost the rate of growth.

Similarly, other studies also find evidence of nonlinearity between real misalignments and economic performance. For example, Aguirre and Calderon (2005) show that small and moderate undervaluations are conducive to growth, while very large undervaluations are harmful to growth. However, Nouira and Sekkat (2012) argue that overvaluations are more common; therefore, the results of previous research may be driven by overvaluation episodes. To address this issue, Nouira and Sekkat (2012) use a separate measure for undervaluation and overvaluation, and they fail to find positive effects of undervaluation on economic performance. Similarly, using a panel of new EU member states, Cuestas et al. (2020) show that overvaluations hurt growth, while the effect of undervaluations is weak. Gnimassoun and Mignon (2015) find that large real overvaluations cause persistent current account imbalances, while real undervaluations had no such effects. Interestingly, the results of Gnimassoun and Mignon (2015) suggest that even relatively small overvaluations translate into persistent current account imbalances for the euro area countries. These results highlight the absence of an exchange-rate adjustment mechanism in the euro area. Finally, Schroder (2013) find that any deviations of the actual exchange rate from the equilibrium exchange rate have harmful effects on the real economy.

3 Empirical Methodology

First, we describe our estimation framework for the equilibrium exchange rates. Second, we present the methodology to estimate the effect of exchange rate misalignments on the trade balance.

[3]Misalignments are defined as deviations of the actual exchange rate from its equilibrium level, leading to either overvaluations or undervaluations.

3.1 Estimation of Equilibrium Exchange Rates

There is a large body of literature on estimating equilibrium exchange rates, and a variety of equilibrium exchange rate models are used. We opt for the commonly used behavioral equilibrium exchange rate (BEER) model (Aguirre and Calderon, 2005; Gnimassoun and Mignon, 2015; Cuestas et al., 2020) because this single-equation approach entails simple and straightforward applications. The BEER model was developed by MacDonald (1998) and Clark and MacDonald (1998). The model assumes the validity of the uncovered interest rate parity (UIP). As a result, the equilibrium real exchange rate is associated with the expected real exchange rate, real interest rate differential and risk premium. The risk premium is typically proxied by the ratio of foreign debt, while the expected real exchange rate is assumed to depend on macroeconomic fundamentals. Therefore, empirical studies applying the BEER approach typically include the following explanatory variables to estimate the equilibrium real exchange rate: Balassa-Samuelson effect, net foreign assets (NFA), ratio of domestic to foreign government debt, real interest rate or terms of trade (ToT). The measure of the exchange rate[4] is regressed on these variables. The fitted value obtained from the estimation is assumed to represent the equilibrium exchange rate (Horvath and Komarek, 2007).

In addition, MacDonald and Dias (2007) distinguish the long-term, medium-term and short-term fundamentals that drive the equilibrium exchange rate:

$$q_t = \beta_1 Z_{1t} + \beta_2 Z_{2t} + \beta_3 T_t + \varepsilon_t \tag{1}$$

where q_t is the real exchange rate at time t, Z_{1t} is a vector that represents the variables that affect the exchange rate over the long run (i.e., NFAs, relative productivity or ToT), and Z_{1t} represents the medium-term determinants (i.e., real interest rate differential). These economic fundamentals are supposed to determine the equilibrium exchange rate, $q_t^{'}$. However, the current exchange rate may deviate from its equilibrium value, and the short-term or transitory determinants of the exchange rate, T, and random errors, ε_t are then assumed to be the determinants of these deviations, which are often referred to as currency misalignments, cm:

$$q_t^{'} = \beta_1 Z_{1t} + \beta_2 Z_{2t} \tag{2}$$

$$cm = \beta_3 T_t + \varepsilon_t = q_t - q_t^{'} \tag{3}$$

In this paper, we follow the literature and estimate currency misalignments as deviations of the current exchange rate from the equilibrium exchange rate. Therefore, the first step in our analysis is the estimation of the equilibrium exchange rate. We estimate the equilibrium exchange rate in a panel setting, as this approach enables us to increase the sample size and furthermore, we

[4]Typically, the real effective exchange rate (REER).

also argue that the 11 former transition economies included in our analysis represent a rather homogeneous sample.[5] Thus, assuming that the equilibrium exchange rate determinants among the new EU member states are broadly similar over the long run, the panel approach reduces the influence of temporary country-specific shocks on our equilibrium exchange rate estimates. As a result, we specify the following model of the equilibrium exchange rate, where we regress a measure of exchange rate on its determinants:

$$q_{it} = \beta_0 + \beta_1 BS_{it} + \beta_2 ToT_{it} + \beta_3 IRDif_{it} + \varepsilon_{it} \tag{4}$$

where q_{it} represents the REER for country i in time t, BS stands for the Balassa-Samuelson effect, which we proxy as the ratio of the consumer price index (CPI) to the producer price index (PPI). In doing so, we follow the approach taken by Cuaresma et al. (2005), who argue that since the CPI covers developments in both the tradable and nontradable sectors and the PPI reflects developments in the tradable sector, the increase in this ratio reflects the higher growth of prices in the nontradable sector relative to the tradable sector. ToT represents the terms of trade, which we define as the ratio of export and import unit value indices. Finally, $IRDif$ represents the real interest rate differential. Calculating real interest rates for the group of new EU member states is somewhat complicated by the unavailability of comparable data for the entire period of the past 20 years. Therefore, we proxy real interest rates using the 3-month interbank interest rates adjusted by the inflation rate.[6] We express the real interest rate differential as the differential between the domestic real interest rate and the international real interest rate; we use the German real interest rate as a proxy for the international real interest rate.

While it is tempting to include more explanatory variables in equation (4), we restrict the number of regressors included in our equilibrium exchange rate model to prevent overfitting of the model (Horvath and Komarek, 2007). Consequently, we only include the measures described above, as they represent the key theoretical determinants of the equilibrium exchange rate from the BEER literature (i.e., a measure of relative productivity, a measure of the interest rate differential and a measure controlling for international trade participation).[7]

[5] An alternative approach would be to estimate the equilibrium exchange rate on a country-by-country basis. However, Maeso-Fernandez et al. (2004) argue that the small sample size renders the results of statistical tests less reliable and that the equilibrium exchange rate estimates would be biased if the initial undervaluation during the transition process is not accounted for.

[6] While the selection of short-term interest rates is primarily driven by data availability, we argue that short-term interest rates are important for international investors' decision-making and that typically, the short-term market is the most liquid and largest relative to other maturities. Additionally, we assume that there is a nearly complete passthrough of short-term interest rate developments to long-term interest rates—an assumption that is generally confirmed by empirical studies (Gregora et al., 2019)—with the differences between short-term and long-term interest rates being mostly driven by liquidity and term premiums. Furthermore, we also assume backward-looking inflation expectations (Lyziak, 2012), and thus we adjust the nominal interest rate by the current rate of inflation.

[7] Interestingly, our choice of variables coincides with those suggested by the approach of Belloni et al. (2012), who use the lasso selection approach to address regression model uncertainty and choose the regressors.

Due to the nonstationarity of macroeconomic time series, we opt for a cointegration approach to estimate equation (4). We use two cointegration methods: dynamic OLS (DOLS) and fully modified OLS (FMOLS). The DOLS method was initially introduced by Saikkonen (1992) and Stock and Watson (1993) and later extended to the panel setting by Kao and Chiang (2001) and Mark and Sul (2003). The method relies on including the leads and lags of explanatory variables in the regression to control for nonstationarity. The FMOLS estimator uses a semiparametric correction to address the issues posed by the long-run correlation between the cointegrating equation and stochastic regression innovations. The FMOLS method was developed by Phillips and Hansen (1990). The panel version of the FMOLS estimator, which we use in this paper, was proposed by Phillips and Moon (1999) and Pedroni (2001). Both DOLS and FMOLS are commonly used to estimate currency misalignment because the effects of the medium-term determinants of equilibrium exchange rates are assumed to be homogeneous across countries.

3.2 Currency Misalignments and the Balance of Trade

In the following subsection, we outline the methodology used to investigate the primary research question of this paper. We use the pooled mean group (PMG) estimator by Pesaran and Smith (1995) and Pesaran et al. (1999) to examine the effects of currency misalignments on the balance of trade. We estimate the following model:

$$\begin{aligned}\Delta tb_{i,t} = \sum_{j=1}^{p-1} \Phi_{i,j} \Delta tb_{i,t-j} + \sum_{j=0}^{q-1} \Pi_{i,j} \Delta cm_{i,t-j} + \sum_{j=0}^{r-1} \Theta_{i,j} \Delta Z_{i,t-j} + \\ \beta_{0,i}(tb_{i,t-1} - \beta_1 cm_{i,t} - \sum_{j=0}^{u} \beta_j Z_{i,t} - \mu) + \epsilon_{i,t}\end{aligned} \tag{5}$$

where tb represents our measure of the trade balance in country i, which is expressed as the ratio of exports to imports (i.e., when the value of this measure is greater than unity, a country is running a trade surplus), cm is a measure of currency misalignments, as described in equation (4), while Z is a vector of control variables to account for other factors affecting the balance of trade.

In equation (5), $\sum_{j=0}^{q-1} \Pi_j$ represents the short-term response of the trade balance to changes in real currency misalignments, the coefficient β_1 describes the long-term relationship between misalignments and the trade balance, while the coefficient β_0 is the error correction term (ECT) (i.e., the coefficient denotes the speed of adjustment towards long-term equilibrium). The PMG estimator enables the short-term coefficients as well as the coefficient of the ECT to be country-specific (i.e., heterogeneous), while the long-term coefficients are assumed to be homogeneous across all the countries. This is in line with our assumptions—namely, that over the short term, the heterogeneity of the new EU member states enables different reactions of the trade balance to

changes in real misalignments, while over the long term, the relationship between the two variables will be similar across these states, as all the new EU member states have at some point experienced the transition process and are currently undergoing the process of economic convergence towards the old EU member states.

In the next step, we aim to investigate the hypothesis that the relationship between exchange rates and the real economy may have changed due to increasing GVC participation (Ahmed et al., 2017). To do so, we introduce an interaction term between the measure of currency misalignments and the measure of GVC participation in equation (5); specifically, we estimate the interacted PMG estimator as used by Leroy and Lucotte (2016). As GVC participation does not change dramatically from quarter to quarter, we only introduce the interaction term in the long-term equation:

$$\begin{aligned} \Delta tb_{i,t} = \sum_{j=1}^{p-1} \Phi_{i,j} \Delta tb_{i,t-j} + \sum_{j=0}^{q-1} \Pi_{i,j} \Delta cm_{i,t-j} + \sum_{j=0}^{r-1} \Theta_{i,j} \Delta Z_{i,t-j} + \\ \beta_{0,i}(tb_{i,t-1} - \beta_1 cm_{i,t} - \beta_2 gvc_{i,t} - \beta_3 cm_{i,t} * gvc_{i,t} - \sum_{j=0}^{u} \beta_j Z_{i,t} - \mu) + \epsilon_{i,t} \end{aligned} \tag{6}$$

where *gvc* represents a measure of GVC participation. In equation (6), the coefficient β_3 is of particular interest; it shows whether the effect of exchange rate misalignment on the trade balance is weaker in countries with greater GVC participation.

We also introduce several control variables in our balance of trade regressions to control for other factors that may have affected the balance of trade. In general, the literature assumes that apart from the real exchange rate (which we replace with our measure of real misalignments), the main long-term determinants of the trade balance are domestic income and foreign income (Arize et al., 2017; Bahmani-Oskooee, 2001; Miles, 1979; Rose and Yellen, 1989). We also include the government budget balance as a control variable, as some studies argue that the government budget balance and the trade balance also exhibit a long-run relationship (Bachman, 1992; Darrat, 1988). Following Bahmani-Oskooee (1992), we also control for nominal interest rates and the terms of trade.

Before proceeding with the analysis using the PMG estimator, we conduct the panel cointegration test introduced by Westerlund (2007). The results of this test indicate the presence of cointegration and are reported in Table A5 in the Appendix.

4 Data

We use quarterly data for the period 2001-2018 for the new EU member states. This time span enables us to study both the era before the 2007-2009 crisis—a period characterized by the rapid

catchup process for most of the countries in our sample—and the era after the crisis. The countries included in our sample are Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. That is, our sample exclusively covers the former transition economies that joined the EU after 2004.

In line with Aguirre and Calderon (2005), Gnimassoun and Mignon (2015), Comunale (2017), and Cuestas et al. (2020), we use the REER as our primary measure of the exchange rate. We use the REER data (the broad indices) from the Bank for International Settlements (BIS). The REERs are expressed in indirect quotation (i.e., an increase in the value of the REER indicates real appreciation) and indexed to 1 for the year 2010. For our measure of the trade balance, we use the ratio of exports to imports of goods and services from the International Monetary Fund (IMF) dataset. We use the 3-month interbank rates to capture nominal interest rates. As a measure of domestic income, we use GDP per capita (at purchasing power parity [PPP]). As a measure of foreign income, we use the weighted GDP per capita (PPP) of the main trading partners of each country in our sample. As weights, we use the shares of the foreign trade partners of each country in international trade; these shares are also used by the BIS to calculate REERs. As our measures of GVC participation, we use the share of foreign value added in total exports (backward GVC linkages) and the share of domestic value added in third countries' exports to total domestic exports (forward GVC linkages) from the OECD's Trade in Value Added (TiVA) database. As our measure of export sophistication, we use the Export Sophistication Index from the World Bank's WITS Database, which is based on the methodology proposed by Hausman et al. (2007). Due to the unavailability of quarterly data for some of the variables (GDP per capita, terms of trade and GVC participation), we use a linear interpolation of annual to quarterly data. A detailed description of the variables and the data sources used is included in Table A1 in the Appendix.

We report the summary statistics in Table 1. The summary statistics indicate large heterogeneity among the countries in our sample with regard to REERs. On the other hand, the measure of currency misalignments does not indicate sizeable misalignments. On average, the new EU member states have lower GDP per capita than their trading partners, have slightly higher real interest rates and experience both trade and government deficits. Furthermore, foreign value added makes up approximately one-third of the value of total exports, while domestic value added in third-country exports is less than one-fifth of the value of domestic total exports. Table A2 in the Appendix reports the correlation between the variables.

Table 1: Summary Statistics

Variable	Unit	Obs	Mean	St. Dev.	Min	Max
REER	Index	792	0.949	0.086	0.585	1.189
Balassa-Samuelson	Index	792	1.001	0.082	0.728	1.363
Terms of Trade	Index	792	1.308	0.195	0.942	1.700
Real Interest Rate Differential	%	790	0.371	2.676	-13.377	12.228
Trade Balance	Index	792	0.955	0.114	0.620	1.144
Currency Misalignment	Deviation	790	-0.000	0.056	-0.183	0.203
Currency Misalignment (Couharde et al., 2017)	Deviation	792	0.059	0.092	-0.195	0.337
Domestic Income	PPP, USD	792	22,152	6,564	8,196	38,460
Foreign Income	PPP, USD	792	33,777	4,567	24,796	44,247
Government Deficit	%	792	-2.783	2.692	-14.600	2.900
Interest Rate	%	790	3.909	4.762	-0.330	51.140
Relative Productivity	Index	792	0.645	0.129	0.312	0.889
Backward GVC Linkages	%	495	32.493	8.462	18.750	47.830
Forward GVC Linkages	%	451	17.026	2.668	10.450	21.900
Export Sophistication	Index	792	19,439	1,430	16,482	21.807

5 Results

In the following section, we present the results of our empirical analysis. First, we estimate the size of exchange rate misalignments. Second, we examine the consequences of misalignments for the trade balance. Third, we investigate to what extent GVC participation reduces the effect of misalignments on the trade balance. Fourth, we analyze whether export sophistication plays a similar role, i.e., whether it reduces the effect of misalignments on the trade balance, as well.

5.1 Real Currency Misalignment Estimates

First, we estimate the equilibrium exchange rate. Stationarity tests indicate that both our measure of the exchange rate (*REER*) and our equilibrium exchange rate determinants (*Balassa-Samuelson, Real interest rate differential* and *Terms of trade*) are I(1)—integrated of order one (i.e., nonstationary).[8] As a result, we proceed to the test of cointegration. First, we conduct the Johansen-Fisher panel cointegration test by Maddala and Wu (1999).[9] This test indicates that there exists one cointegrating relationship among the variables included in our equilibrium exchange rate model. As a result, we estimate this relationship using the single equation cointegrating models, first by DOLS and then by FMOLS. As a robustness check, we also conduct the Kao cointegration test, which is an Engle-Granger-based test of cointegration (Kao, 1999). This test also indicates the

[8] To save space, we do not report the results of our stationarity tests here, but they are available from the authors upon request.

[9] The number of lags is selected using the Schwarz information criterion.

existence of a cointegrating relationship. The results of the two cointegration tests are reported in Tables A3 and A4 in the Appendix.

Having found evidence of cointegration, we proceed with the estimation of equation (4). We report the results in Table 2 and show the coefficients obtained using both the DOLS and FMOLS estimators. These results indicate that all our selected equilibrium exchange rate determinants exhibit a statistically significant effect on the REER. All the variables show a positive effect on the REER—as the REER is expressed in indirect quotation, this means that an increase in the value of the REER indicates appreciation. Consequently, our results suggest that the growing productivity and associated Balassa-Samuelson effect contribute to a long-term appreciation of the exchange rate. The positive real interest rate differential and improving terms of trade have similar effects. Based on the coefficients obtained in Table 2, we fit the equilibrium exchange rate.[10] Subsequently, based on equation (3), we calculate the currency misalignments as the deviation of the actual REER from the estimated equilibrium REER. Thus, positive values of our measure of currency misalignments indicate overvaluation, while negative values indicate undervaluation. Figure A1 in the Appendix compares our measure of the equilibrium REER with the actual REER, while Figure A2 displays our measure of currency misalignments for the individual countries in the sample.

Table 2: Equilibrium Exchange Rate Estimates

Variables	(1) REER	(2) REER
Balassa-Samuelson	0.502***	0.537***
	(0.062)	(0.008)
Terms of Trade	0.326***	0.349***
	(0.022)	(0.006)
Real Interest Rate Differential	0.293*	0.290***
	(0.169)	(0.018)
Observations	785	790
R-squared	0.635	0.573
Estimator	DOLS	FMOLS

Notes: Standard errors are in parentheses. * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

According to our results, real currency misalignments observed in the new EU member states are somewhat persistent. If misalignment occurs, it often lasts for several quarters. Most of the countries in our sample experienced a real appreciation of both actual REER and equilibrium

[10] Our two fitted measures of equilibrium exchange rates using the coefficients from DOLS and FMOLS are very similar. Consequently, we calculate our final measure of the equilibrium exchange rate as the average of the DOLS and FMOLS estimates.

REER during the period prior to the GFC. During this period, most countries progressed from initial real undervaluation towards real overvaluation during the onset of the GFC, with the overvaluation being most significant in the Czech Republic, Hungary, Poland and Romania. During the postcrisis era, the equilibrium REER remained broadly stable for the new EU member states, with the actual REERs following a similar pattern. In 2018, we find evidence for real overvaluation in Bulgaria, the Czech Republic, Estonia, Latvia, Lithuania, Romania and Slovakia and evidence for real undervaluation in Hungary and Poland, while the actual REER remained close to the equilibrium REER in Croatia and Slovenia. The currency misalignments are typically modest (up to +/- 10%).

5.2 Effects of Real Misalignments

In the following subsection, we use the estimated measure of real currency misalignments to evaluate the effects of over-/undervaluation on the real economy, namely, on the trade balance. We present the results in Table 3. The results show that real currency misalignments have a negative effect on the trade balance in new EU member states. The coefficient of the currency misalignments is negative and statistically significant across all the specifications. Additionally, the size of the coefficient remains rather stable.

In line with economic theory, we consider domestic income (as a key determinant of imports) and foreign income (as a key driver of exports) to represent the main control variables. However, due to the high correlation between these two variables, in specifications (1) and (2), we initially include the measures of domestic and foreign income in our regressions separately. For foreign income, we find the expected positive effect on the balance of trade, while for domestic income, we fail to observe the expected effect. In specification (3), we include both our measures of income; this inclusion does not seem to affect our main findings. In specifications (4)-(6), we consecutively add three more control variables. Nonetheless, we do not find a statistically significant effect of any of these control variables on the balance of trade. Our measure of misalignments and the measure of domestic income are the only two variables that consistently maintain their statistical significance. We hypothesize that the positive effect of domestic income on the trade balance could be explained by the transition process and growing productivity, which not only improved economic performance but also contributed to higher exports.[11] To test this hypothesis, we replace the domestic and foreign income variables with a variable capturing relative productivity (expressed as the ratio of domestic and foreign income) in specification (7). The coefficient of this new variable is positive

[11] Early in the transition process, the countries typically exhibited a negative trade balance. Later, following the inflows of foreign investments, the countries were generally able to improve their trade balance: due to higher productivity, they were able to export more and to substitute some of the imports. This improvement of productivity and export competitiveness is typically associated with higher economic growth. Thus, a positive relationship between domestic income and the balance of trade may emerge.

and statistically significant, while the currency misalignments continue to exhibit a negative and significant coefficient.

Even though we estimate the real misalignments over a period of almost 20 years, our measure of misalignments does not necessarily capture possible initial undervaluations at the beginning of the transition process.[12] Therefore, to address the issue, our robustness check runs all our baseline regressions with an alternative measure of currency misalignments. We use the measure by Couharde et al. (2017). This measure of the equilibrium exchange rate is also estimated using the BEER methodology; however, Couharde et al. (2017) use the out-of-sample approach, as they estimate their measure of the equilibrium exchange rate on a panel covering 186 world economies (i.e., a wider group of countries, not a rather homogeneous group of transition economies). As a result, their estimate of currency misalignments captures more long-term deviations of the actual REERs from the estimated equilibrium REERs (while our approach is more medium-term oriented). Indeed, this measure of long-term misalignments indicates an undervaluation for most of the countries in our sample during the precrisis era. The variability of the real misalignments measure calculated by Couharde et al. (2017) across countries and time is therefore much lower than for our measure of misalignments. For most of the countries, this undervaluation eventually turned into overvaluation during the postcrisis era. Table A6 in the Appendix reports the results of our baseline regressions with the Couharde et al. (2017) measure of misalignments. Even with this alternative measure, we find a negative relationship between real currency misalignments and the balance of trade, even though in this case, the coefficient on the misalignments variable is statistically significant only in specifications (6) and (7). Therefore, these findings indicate that long-term deviations from the equilibrium REERs do not have as significant an effect on the balance of trade as do medium-term deviations.

While our results suggest the existence of a negative relationship between the measure of currency misalignments and the balance of trade, we acknowledge the concerns of Nouira and Sekkat (2012) that the results of studies investigating the effects of currency misalignments are often driven by overvaluation episodes. Nouira and Sekkat (2012) argue that if currency misalignments do not treat undervaluation and overvaluation separately, the interpretation of the obtained coefficient hinges on an assumption that the effect of misalignments is linear. To investigate possible nonlinearity in the effects of currency misalignments, we replace our single measure of misalignments with two separate measures: one for undervaluation and the other for overvaluation. The measure of overvaluation takes the values of our original measure of misalignments when the currency exhibits real overvaluation and zero otherwise. We define the undervaluation analogously. However, we take the absolute value of this measure to ease interpretation.

We provide the results in Table 4. In line with Nouira and Sekkat (2012), we find that over-

[12] Halpern and Wyplosz (1997) argue that the currencies of transition economies were undervalued at the outset of the transition process—that is, in the early 1990s, which our dataset does not cover due to missing data for this period.

Table 3: Effect of Real Currency Misalignments on the Trade Balance

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Balance of trade						
Long-run equation							
Currency Misalign.	-0.268***	-0.191*	-0.243***	-0.258***	-0.228**	-0.228**	-0.240**
	(0.100)	(0.106)	(0.094)	(0.094)	(0.096)	(0.098)	(0.098)
Domestic Income	0.174***		0.070	0.094	0.189***	0.191***	
	(0.018)		(0.058)	(0.058)	(0.063)	(0.071)	
Foreign Income		0.323***	0.191*	0.125	-0.009	0.004	
		(0.038)	(0.108)	(0.122)	(0.112)	(0.125)	
Government Deficit				0.156	-0.033	-0.119	-0.131
				(0.271)	(0.256)	(0.258)	(0.260)
Interest Rate					-0.321	-0.239	-0.411*
					(0.250)	(0.244)	(0.216)
Terms of Trade						0.003	-0.010
						(0.026)	(0.027)
Rel. Productivity							0.493***
							(0.083)
Constant	-0.701***	-2.308***	-1.638***	-1.196	-0.760	-0.933	0.684***
	(0.185)	(0.396)	(0.599)	(0.777)	(0.723)	(0.779)	(0.068)
Short-run equation							
Error Correction	-0.144***	-0.111***	-0.151***	-0.153***	-0.167***	-0.176***	-0.158***
	(0.022)	(0.025)	(0.026)	(0.026)	(0.030)	(0.028)	(0.026)
D.Currency Misalign.	0.020	0.007	0.029	0.039	-0.006	-0.005	0.000
	(0.080)	(0.077)	(0.076)	(0.077)	(0.097)	(0.109)	(0.106)
D.Domestic Income	-0.485***		-0.645***	-0.678***	-0.475***	-0.463**	
	(0.085)		(0.181)	(0.180)	(0.174)	(0.183)	
D.Foreign Income		-0.676***	0.018	0.026	-0.124	-0.164	
		(0.174)	(0.275)	(0.272)	(0.244)	(0.285)	
D.Government Deficit				0.235	0.322	0.339	0.263
				(0.294)	(0.301)	(0.295)	(0.273)
D.Interest Rate					-0.417*	-0.381	-0.297
					(0.247)	(0.253)	(0.265)
D.Terms of Trade						0.133	0.091
						(0.188)	(0.134)
D.Rel. Productivity							-0.691**
							(0.277)
Observations	790	790	790	789	789	789	789

Notes: Standard errors are in parentheses. * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

valuation episodes are indeed important. Our results suggest that overvaluation has a negative and statistically significant effect on the balance of trade. While we also find the expected coefficient on undervaluation, the coefficient is not statistically significant. Therefore, real overvaluation leads to a deterioration of the trade balance in the new EU member states and may prevent an improvement in the balance of trade—and may even lay the foundations for persistent trade deficits. On the other hand, we do not find evidence that real undervaluation helps improve the trade balance.[13]

5.3 Role of GVC Participation

The results outlined in the previous subsection indicate that real overvaluation exhibits a negative effect on the balance of trade, while real undervaluation has a statistically nonsignificant positive impact on the balance of trade in the new EU member states. In the following subsection, we evaluate the impact of increasing GVC participation on the relationship between misalignments and the balance of trade.

Our hypothesis is that higher GVC participation is likely to reduce the strength of the relationship between the exchange rate (and currency misalignments) and the trade balance. To address the hypothesis, we introduce an interaction of a measure of GVC participation and our measure of real currency misalignments in our baseline regression. We use several measures of GVC participation as suggested by Koopman et al. (2010) and later used by Ahmed et al. (2017). Our first measure of GVC participation represents *backward GVC linkages*, defined as the share of foreign value added in gross exports. The second measure of GVC participation represents *forward GVC linkages*, defined as domestic value added in third-country exports (expressed as the share of gross domestic exports). Finally, we construct an index of GVC participation, which equals the sum of our backward and forward GVC linkages. Nonetheless, in this analysis, we are limited by the availability of data on GVC participation, and consequently, we cannot run the regressions with the measures of GVC participation over the entire period 2001-2018. We use the data on GVC participation from the OECD's Trade in Value Added (TiVA) database. The 2018 edition of the TiVA database provides data from 2005 until 2016. An earlier 2016 edition of the TiVA database covers the years 2000-2011. Due to methodological differences between these two additions, we perform our analysis using the 2016 and 2018 editions separately.

We report the results of the baseline regressions with the GVC participation interaction terms in Table 5. First, we show the results for the interactions with backward GVC linkages.[14] In

[13] As a robustness check, we include only the measure of undervaluation in the regressions. Once again, the coefficient on undervaluation is positive. Nevertheless, the coefficient on undervaluation is only statistically significant in the first two specifications; when we introduce other controls, the statistical significance disappears. We present the results in Table A7 in the Appendix.

[14] Arguably, this is our main measure of GVC participation, as the new EU member states are characterized by a comparatively high share of foreign value added in their gross exports (i.e., backward GVC linkages). On the other hand, the share of domestic value added in third-country exports (i.e., forward GVC linkages) is somewhat lower in the case of these countries—and corresponds to the average for the advanced economies.

Table 4: Effect of Undervaluation and Overvaluation on Trade Balance

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Balance of trade						
Long-run equation							
Undervaluation	0.182	0.163	0.167	0.112	0.093	0.081	0.094
	(0.178)	(0.194)	(0.170)	(0.171)	(0.146)	(0.147)	(0.177)
Overvaluation	-0.300*	-0.163	-0.287*	-0.394**	-0.298**	-0.305**	-0.330**
	(0.156)	(0.188)	(0.151)	(0.160)	(0.147)	(0.147)	(0.157)
Domestic Income	0.172***		0.062	0.079	0.177***	0.156**	
	(0.018)		(0.058)	(0.059)	(0.061)	(0.073)	
Foreign Income		0.320***	0.200*	0.130	0.004	0.065	
		(0.038)	(0.107)	(0.123)	(0.108)	(0.125)	
Government Deficit				0.234	-0.058	-0.155	-0.061
				(0.281)	(0.247)	(0.249)	(0.254)
Interest Rate					-0.335	-0.247	-0.392*
					(0.249)	(0.250)	(0.228)
Terms of Trade						0.017	-0.003
						(0.024)	(0.027)
Rel. Productivity							0.459***
							(0.085)
Constant	-0.680***	-2.275***	-1.645***	-1.078	-0.784	-1.229	0.709***
	(0.189)	(0.391)	(0.587)	(0.798)	(0.701)	(0.766)	(0.069)
Short-run equation							
Error Correction	-0.146***	-0.112***	-0.151***	-0.152***	-0.170***	-0.179***	-0.156***
	(0.024)	(0.026)	(0.027)	(0.027)	(0.033)	(0.033)	(0.027)
D.Undervaluation	-0.146	-0.131	-0.150	-0.154	-0.107	-0.110	-0.117
	(0.105)	(0.109)	(0.101)	(0.096)	(0.104)	(0.115)	(0.116)
D.Overvaluation	-0.113	-0.124	-0.095	-0.073	-0.117	-0.098	-0.102
	(0.128)	(0.121)	(0.124)	(0.131)	(0.144)	(0.159)	(0.154)
D.Domestic Income	-0.477***		-0.664***	-0.720***	-0.483***	-0.481**	
	(0.082)		(0.178)	(0.185)	(0.175)	(0.187)	
D.Foreign Income		-0.645***	0.055	0.067	-0.120	-0.163	
		(0.160)	(0.255)	(0.254)	(0.225)	(0.263)	
D.Government Deficit				0.220	0.316	0.337	0.255
				(0.302)	(0.315)	(0.308)	(0.274)
D.Interest Rate					-0.399	-0.379	-0.280
					(0.244)	(0.243)	(0.254)
D.Terms of Trade						0.157	0.111
						(0.200)	(0.146)
D.Rel. Productivity							-0.761***
							(0.277)
Observations	790	790	790	789	789	789	789

Notes: Standard errors are in parentheses. * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

columns (1) and (2), we report the results obtained by using the data on GVC participation from the 2016 and 2018 editions of the TiVA database, respectively. Thus, we estimate the coefficients in column (1) on a subsample covering the years 2001-2011, while column (2) covers the years 2005-2016.

Our results suggest that increased GVC participation does indeed lower the responsiveness of the trade balance to currency misalignments. First, once we include the measure of backward GVC participation, the coefficient on currency misalignment becomes more negative than that in Table 3. This result suggests that the effects of misalignments become larger when controlling for GVC participation. Second, the coefficient on the interaction term is positive and statistically significant. This result indicates that higher GVC participation positively affects the impact of misalignments on the trade balance (i.e., limiting the negative effects of overvaluation).

For forward GVC linkages, our findings are rather mixed. For the 2001-2011 subsample, the coefficient on the interaction term is negative, while for the second subsample (2005-2016), the coefficient is positive and statistically significant. Nonetheless, forward GVC linkages do not play a decisive role for the new EU member states, and the effect of increased participation in these linkages on the relationship between misalignments and the balance of trade is rather ambiguous. Columns (5)-(6) present the results obtained from the regressions with the GVC Participation Index used as a measure of GVC participation. Here, we once again find a positive coefficient on the interaction term, indicating that higher GVC participation reduces the viability of the exchange rate in affecting the trade balance—albeit only for the 2005-2016 subsample.

Overall, across the different specifications and subsamples, we find that increased GVC participation has a negative impact on the balance of trade. In addition, our results also provide some evidence that the role of GVCs in limiting the negative effects of real overvaluation increased over time, as the coefficients on the interaction terms are larger for the 2005-2016 subsample than for the 2001-2011 subsample.

5.4 Role of Export Sophistication

Finally, we investigate the role of export sophistication in the relationship between currency misalignments and the trade balance. Increased GVC participation is likely to improve a country's export sophistication. For economies undergoing the transition process, the inflow of foreign investments generally provides more advanced technologies leading to higher productivity and sophistication of final products, with many of these foreign investors being multinational corporations with their supply chains spread across a large number of countries. Indeed, Figure A6 in the Appendix demonstrates that all the countries in the sample experienced an increase in the sophistication of their exports over time.

Some empirical studies, notably Thorbecke and Salike (2018), have found that more tech-

Table 5: Effect of Real Currency Misalignments on the Trade Balance: Role of GVC Participation

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Balance of trade					
Long-run equation						
Currency Misalignment	-0.705**	-1.629*	1.649**	-1.897	-0.639	-2.982**
	(0.302)	(0.876)	(0.768)	(1.400)	(0.537)	(1.269)
Domestic Income	0.328***	0.189**	0.422***	0.028	0.454***	0.067
	(0.065)	(0.080)	(0.071)	(0.100)	(0.076)	(0.096)
Foreign Income	-0.667***	0.645***	-0.757***	0.923***	-0.918***	0.600***
	(0.151)	(0.205)	(0.180)	(0.175)	(0.173)	(0.197)
Government Deficit	-0.267	-1.489***	-0.177	-2.545***	-0.228	-1.840***
	(0.208)	(0.339)	(0.175)	(0.306)	(0.204)	(0.351)
Interest Rate	0.057	-0.452	0.244	0.111	0.236	-0.686
	(0.181)	(0.476)	(0.152)	(0.437)	(0.182)	(0.450)
Terms of Trade	0.080*	0.354***	0.110***	0.246***	0.126***	0.395***
	(0.041)	(0.067)	(0.033)	(0.053)	(0.036)	(0.081)
Backward GVC Linkages	-0.012	-0.861***				
	(0.090)	(0.286)				
Interact (CM*Back. GVC Link.)	2.186***	7.791***				
	(0.830)	(2.963)				
Forward GVC Linkages			-1.123***	-0.814		
			(0.386)	(0.603)		
Interact (CM*Forward GVC Link.)			-8.235**	18.326*		
			(3.770)	(9.875)		
GVC Participation					-0.047	-1.008***
					(0.100)	(0.318)
Interact (CM*GVC Particip.)					1.127	9.232***
					(0.953)	(3.003)
Constant	4.481***	-7.934***	4.648***	-9.292***	5.786***	-6.146***
	(1.051)	(1.727)	(1.251)	(1.491)	(1.230)	(1.665)
Short-run equation						
Error Correction	-0.273***	-0.178**	-0.287***	-0.179**	-0.272***	-0.182**
	(0.069)	(0.081)	(0.072)	(0.085)	(0.066)	(0.092)
D.Currency Misalignment	0.046	-0.155	0.029	-0.131	0.036	-0.197
	(0.173)	(0.121)	(0.169)	(0.117)	(0.165)	(0.134)
D.Domestic Income	-0.023	-0.013	-0.033	-0.163	-0.048	0.050
	(0.242)	(0.405)	(0.270)	(0.225)	(0.207)	(0.455)
D.Foreign Income	0.037	0.352	0.076	0.401*	0.085	0.180
	(0.355)	(0.244)	(0.347)	(0.237)	(0.352)	(0.264)
D.Government Deficit	0.219	0.246	0.594	0.374	0.303	0.285
	(0.447)	(0.317)	(0.607)	(0.412)	(0.451)	(0.360)
D.Interest Rate	-0.387	-0.912	-0.459	-0.664	-0.440	-0.665
	(0.307)	(0.804)	(0.327)	(0.683)	(0.321)	(0.690)
D.Terms of Trade	0.595	0.205	0.375	0.445	0.587	0.317
	(0.514)	(0.226)	(0.290)	(0.465)	(0.516)	(0.395)
Sample	2001-2011	2005-2016	2001-2011	2005-2015	2001-2011	2005-2015
Observations	483	495	483	451	483	451

Notes: Standard errors are in parentheses. * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

nologically advanced exports have a lower elasticity to exchange rate movements. Therefore, we hypothesize that increased export sophistication could further limit the effects of currency misalignments on the trade balance. To address this hypothesis, we include an interaction term between the measure of currency misalignments and the measure of export sophistication. As the measure of export sophistication, we use the index proposed by Hausman et al. (2007) and expressed in log form.

The results of this estimation are available in Table 6.[15] After including the interaction term between currency misalignments and export sophistication (column 1), our measure of currency misalignments loses its statistical significance. The coefficient on the interaction term is, however, statistically significant and negative. This result is rather surprising, as it indicates that higher export sophistication exacerbates the effects of currency misalignments on the trade balance.

To investigate further whether the result is driven by undervaluation and/or overvaluation episodes, we replace our measure of currency misalignments with two separate measures for undervaluation and overvaluation. Furthermore, we separately include in our regression framework (in columns (2) and (3), respectively) an interaction term between export sophistication and undervaluation and one between export sophistication and overvaluation. We find that our results are driven by undervaluation periods. Undervaluation helps improve the trade balance when a country's exports are more sophisticated. On the other hand, higher export sophistication does not influence the effect of overvaluation on the trade balance. This finding is at odds with the theoretical prediction that the elasticity of demand for more sophisticated products should be lower. We argue that this result could be explained by the fact that while foreign investment inflows have contributed to higher sophistication of exports in the new EU member states, these countries' exports are still less sophisticated than the exports of advanced countries. As a result, the new EU member states now produce goods (for example, automobiles) that are subject to strong competition from many of their peers (including among the new member states themselves). In such a competitive environment, even a very small price advantage caused by an undervalued exchange rate may boost exports and, by extension, lead to an improvement in the trade balance.

[15] We do not include the measure of domestic income or relative productivity in these regressions because of the high correlation between these measures and the index of export sophistication.

Table 6: Effect of Real Currency Misalignments on the Trade Balance: Role of Export Sophistication

Variables	(1)	(2)	(3)
	Balance of trade		
Long-run equation			
Currency misalignment	0.181		
	(0.162)		
Undervaluation		-0.465*	0.076
		(0.252)	(0.173)
Overvaluation		-0.269	-0.034
		(0.186)	(0.284)
Foreign Income	0.270***	0.290***	0.273***
	(0.071)	(0.069)	(0.073)
Government Deficit	-0.263	-0.342	-0.430
	(0.287)	(0.278)	(0.292)
Interest Rate	0.016	-0.046	-0.763**
	(0.266)	(0.261)	(0.312)
Terms of Trade	0.064**	0.055**	0.058**
	(0.027)	(0.025)	(0.024)
Export Sophistication	0.550***	0.416***	0.637***
	(0.138)	(0.144)	(0.143)
Interact (CM*Export Sophistication)	-4.621***		
	(1.742)		
Interact (Undervaluation*Export Sophistication)		7.164**	
		(2.895)	
Interact (Overvaluation*Export Sophistication)			-3.736
			(2.840)
Constant	-1.899**	-2.084***	-1.918**
	(0.747)	(0.721)	(0.762)
Short-run equation			
Error Correction	-0.161***	-0.163***	-0.159***
	(0.024)	(0.024)	(0.029)
D.Currency Misalignment	-0.073		
	(0.113)		
D.Undervaluation		-0.021	-0.067
		(0.125)	(0.127)
D.Overvaluation		-0.133	-0.156
		(0.156)	(0.162)
D.Foreign Income	-0.446***	-0.427***	-0.505***
	(0.138)	(0.139)	(0.171)
D.Government Deficit	0.072	0.073	0.014
	(0.218)	(0.215)	(0.249)
D.Interest Rate	-0.347	-0.364	-0.352
	(0.245)	(0.244)	(0.244)
D.Terms of Trade	0.070	0.092	0.132
	(0.158)	(0.150)	(0.187)
Observations	789	789	789

Notes: Standard errors are in parentheses. * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

6 Conclusions

Using quarterly data for the years 2001-2018 for a group of 11 new EU member states, we examine the effect of currency misalignments on the trade balance. First, we estimate the equilibrium exchange rate for the countries in our sample using the BEER model, which enables us to capture the medium-term deviations of the actual REER from the equilibrium REER. We find that apart from a few exceptions, the new EU member states did not experience very large real currency misalignments. We also find that the misalignments are persistent, to a certain extent.

Next, we use the heterogeneous panel cointegration estimator of Pesaran and Smith (1995) and Pesaran et al. (1999), which allows for short-term heterogeneity but long-term homogeneity in the estimated coefficients. The results show that real currency misalignments have an effect on the balance of trade. Real overvaluation exhibits a moderately negative effect on the balance of payments, while real undervaluation has a positive but insignificant effect on the balance of trade. These nonlinear effects of overvaluations and undervaluation are broadly in line with the results of earlier studies (Aguirre and Calderon, 2005; Nouira and Sekkat, 2012; Cuestas et al., 2020).

Therefore, our results suggest that an overvalued domestic currency is likely harmful for former transition economies, as it could lead to deterioration of their balance of trade or to the creation of persistent trade balance deficits. Nevertheless, we do not find evidence that an undervalued REER leads to an improvement in the trade balance in the new EU member states. By extension, undervaluation seems to be rather unlikely to have a positive impact on the real economy. Thus, policymakers may be less inclined to conduct competitive devaluations to improve economic performance or kickstart an economic recovery.

Next, we assess whether the high GVC participation among the countries in our sample reduces the responsiveness of the trade balance to exchange rate misalignments. We find that increased GVC participation (measured by backward GVC linkages) does indeed reduce the effects of real misalignments on the trade balance. Therefore, according to our results, the globalization of production reduces the ability of exchange rates to stimulate the economy. These findings are in line with earlier studies (Ahmed et al., 2017).

Finally, we also find that with higher export sophistication, undervaluation positively affects the trade balance of the new EU member states. Nonetheless, increasing export sophistication does not seem to influence the effect of overvaluation on the trade balance. As a result, the increasing domestic productivity and resulting higher technological sophistication of exports may help reduce the negative effects of real overvaluation on the trade balance, while it could make the policy of keeping the domestic currency undervalued more effective in stimulating improvements in the balance of trade.

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Appendix

Table A1: Data Description

Variable	Description	Source
REER	Real effective exchange rate (broad index)	BIS
Balassa-Samuelson	Ratio of CPI to PPI	IMF Eurostat
Terms of Trade	Ratio of exports to imports unit value indices	
Real Interest Rate	3-month interbank rate adjusted for inflation	OECD NCBs
Trade Balance	Ratio of exports to imports of goods and services	IMF
Domestic Income	GDP per capita PPP, international dollars	IMF
Foreign Income	GDP per capita PPP, international dollars	IMF
Government Deficit	General government deficit ratio to GDP	Eurostat
Interest Rate	3-month interbank rate	OECD NCBs
Relative Productivity	Ratio of domestic to foreign income	IMF
Backward GVC Linkages	Share of foreign value added in total exports	OECD
Forward GVC Linkages	Ratio of domestic value added in third-country exports to total domestic exports	OECD
Export Sophistication	Level of technological sophistication embodied in a country's exports portfolio	World Bank

Table A2: Correlations between Variables

	REER	BS	ToT	Real IR Diff	Trade Balance	CM	CM CEPII	Dom Inc	Foreign Inc	Gov Deficit	Interest Rate	Rel Prod	Back GVC	Forw GVC
REER	1.00													
BS	0.29	1.00												
ToT	0.44	-0.04	1.00											
Real IR Diff	0.12	0.30	-0.10	1.00										
Trade Balance	0.20	-0.14	0.07	0.17	1.00									
CM	0.67	-0.02	0.02	-0.01	0.21	1.00								
CM CEPII	0.71	0.07	0.48	0.15	0.35	0.58	1.00							
Domestic Income	0.44	-0.05	0.23	-0.07	0.74	0.31	0.43	1.00						
Foreign Income	0.47	0.15	0.19	0.02	0.61	0.32	0.36	0.87	1.00					
Gov Deficit	0.01	0.13	-0.01	-0.36	-0.08	-0.03	-0.15	0.09	0.20	1.00				
Interest Rate	-0.21	0.28	-0.12	0.26	-0.49	-0.20	-0.14	-0.61	-0.56	-0.20	1.00			
Rel Prod	0.34	-0.12	0.20	-0.13	0.72	0.25	0.40	0.94	0.65	0.04	-0.53	1.00		
Backward GVC	-0.11	-0.17	0.14	-0.11	0.45	0.05	0.46	0.37	0.04	0.10	-0.15	0.46	1.00	
Forward GVC	0.03	0.17	0.52	-0.05	0.03	-0.16	0.02	0.18	0.22	0.03	-0.08	0.13	-0.24	1.00
Exp Sophistication	0.05	-0.14	0.03	0.04	0.63	0.10	0.29	0.68	0.36	-0.27	-0.23	0.80	0.38	0.20

Notes: *REER* represents the real effective exchange rate, *BS* stands for our measure of the Balassa-Samuelson effect (expressed as the ratio of consumer and producer prices), *ToT* stands for terms of trade, *Real IR Diff* stands for the real interest rate differential, *CM* is our measure of real currency misalignments, *CM CEPII* represents the real currency misalignments of Couharde et al. (2017), *Gov Deficit* stands for the government deficit, *Interest Rate* represents the nominal interest rate, *Rel Prod* stands for relative productivity, *Backward GVC* is the measure of backward GVC linkages (expressed as the share of foreign value added in gross exports), while *Forward GVC* represents the forward GVC linkages (expressed as the share of domestic value added in third country exports to total domestic exports). Finally, *Exp Sophistication* stands for the measure of sophistication of a country's exports.

Cointegration tests for the equilibrium exchange rate model

Table A3: Johansen-Fisher Panel Cointegration Test

Hypothesized No. of CE(s)	Fisher Stat. (from max-eigen test)	Prob.
None	116.5	0.0000
At most 1	31.31	0.0899
At most 2	19.96	0.5855
At most 3	44.38	0.0032

Table A4: Kao Cointegration Test

	Statistic	p-value
Modified Dickey-Fuller t	-3.2395	0.0006
Dickey-Fuller t	-2.1555	0.0156
Augmented Dickey-Fuller t	-2.8407	0.0023
Unadjusted Modified Dickey-Fuller t	-2.3827	0.0086
Unadjusted Dickey-Fuller t	-1.8383	0.0330

Cointegration test for the balance of trade model

Table A5: Westerlund Cointegration Test

Statistic	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Gt	0.000***	0.000***	0.001***	0.000***	0.000***	0.000***	0.007***
Ga	0.001***	0.017**	0.011**	0.037**	0.988	1.000	0.602
Pt	0.000***	0.000***	0.000***	0.000***	0.019**	0.010**	0.001***
Pa	0.000***	0.000***	0.000***	0.000***	0.645	0.986	0.002***

Notes: These results correspond to the specifications in Table 3. The reported results represent p-values. For the Gt and Ga statistics, the rejection of H0 provides evidence for the presence of cointegration of at least one of the cross-sectional units. For the Pt and Pa statistics, the rejection of H0 provides evidence of cointegration for the entire panel.

Table A6: Effects of the Couharde et al. (2017) Measure of Real Currency Misalignments on the Trade Balance

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Balance of trade						
Long-run equation							
Currency Misalignment	-0.053	0.025	-0.047	-0.067	-0.085	-0.161**	-0.110*
	(0.060)	(0.061)	(0.062)	(0.065)	(0.060)	(0.074)	(0.064)
Domestic Income	0.179***		0.113*	0.149**	0.227***	0.188**	
	(0.021)		(0.061)	(0.062)	(0.068)	(0.074)	
Foreign Income		0.281***	0.123	0.076	-0.062	0.020	
		(0.045)	(0.115)	(0.128)	(0.116)	(0.129)	
Government Deficit				-0.075	-0.107	-0.100	-0.066
				(0.266)	(0.260)	(0.260)	(0.250)
Interest Rate					-0.374	-0.289	-0.527**
					(0.256)	(0.265)	(0.236)
Terms of Trade						0.060*	0.027
						(0.033)	(0.030)
Relative Productivity							0.472***
							(0.089)
Constant	-0.764***	-1.877***	-1.380**	-1.252	-0.602	-1.135	0.660***
	(0.209)	(0.465)	(0.643)	(0.801)	(0.733)	(0.830)	(0.075)
Short-run equation							
Error Correction	-0.144***	-0.110***	-0.150***	-0.154***	-0.165***	-0.174***	-0.154***
	(0.024)	(0.025)	(0.025)	(0.024)	(0.031)	(0.032)	(0.030)
D.Currency Misalignment	-0.012	-0.015	-0.007	0.005	0.011	0.019	0.033
	(0.102)	(0.108)	(0.096)	(0.095)	(0.111)	(0.113)	(0.124)
D.Domestic Income	-0.358***		-0.521***	-0.510***	-0.348**	-0.368**	
	(0.084)		(0.160)	(0.158)	(0.150)	(0.172)	
D.Foreign Income		-0.551***	0.070	0.032	-0.113	-0.169	
		(0.171)	(0.280)	(0.279)	(0.242)	(0.281)	
D.Government Deficit				0.223	0.247	0.250	0.208
				(0.291)	(0.293)	(0.298)	(0.268)
D.Interest Rate					-0.394	-0.408	-0.282
					(0.270)	(0.268)	(0.261)
D.Terms of Trade						0.166	0.115
						(0.234)	(0.178)
D.Relative Productivity							-0.548**
							(0.257)
Observations	792	792	792	791	789	789	789

Notes: Standard errors are in parentheses. * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

Table A7: Effect of Undervaluation on Trade Balance

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Balance of trade						
Long-run equation							
Undervaluation	0.310*	0.275	0.307*	0.245	0.204	0.176	0.165
	(0.185)	(0.188)	(0.174)	(0.174)	(0.154)	(0.160)	(0.175)
Domestic Income	0.178***		0.072	0.087	0.147**	0.117	
	(0.019)		(0.061)	(0.062)	(0.063)	(0.076)	
Foreign Income		0.324***	0.197*	0.202*	0.088	0.148	
		(0.039)	(0.113)	(0.122)	(0.111)	(0.129)	
Government Deficit				-0.219	-0.207	-0.249	-0.072
				(0.249)	(0.244)	(0.244)	(0.248)
Interest Rate					-0.387	-0.227	-0.508**
					(0.263)	(0.262)	(0.243)
Terms of Trade						0.017	-0.003
						(0.026)	(0.026)
Relative Productivity							0.447***
							(0.091)
Constant	-0.765***	-2.325***	-1.735***	-1.947***	-1.360*	-1.713**	0.706***
	(0.195)	(0.405)	(0.618)	(0.739)	(0.708)	(0.782)	(0.071)
Short-run equation							
Error Correction	-0.143***	-0.110***	-0.149***	-0.155***	-0.167***	-0.176***	-0.153***
	(0.021)	(0.025)	(0.024)	(0.024)	(0.031)	(0.029)	(0.027)
D.Undervaluation	-0.132	-0.118	-0.137	-0.140	-0.112	-0.093	-0.093
	(0.098)	(0.102)	(0.095)	(0.089)	(0.095)	(0.103)	(0.101)
D.Domestic Income	-0.425***		-0.617***	-0.581***	-0.442**	-0.430**	
	(0.087)		(0.173)	(0.180)	(0.179)	(0.194)	
D.Foreign Income		-0.650***	0.060	-0.031	-0.153	-0.214	
		(0.177)	(0.273)	(0.276)	(0.252)	(0.284)	
D.Government Deficit				0.243	0.269	0.280	0.205
				(0.274)	(0.278)	(0.282)	(0.261)
D.Interest Rate					-0.346	-0.288	-0.201
					(0.254)	(0.247)	(0.248)
D.Terms of Trade						0.158	0.113
						(0.229)	(0.169)
D.Relative Productivity							-0.656**
							(0.278)
Observations	790	790	790	789	789	789	789

Notes: Standard errors are in parentheses. * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

Figure A1: Actual and Equilibrium Exchange Rates

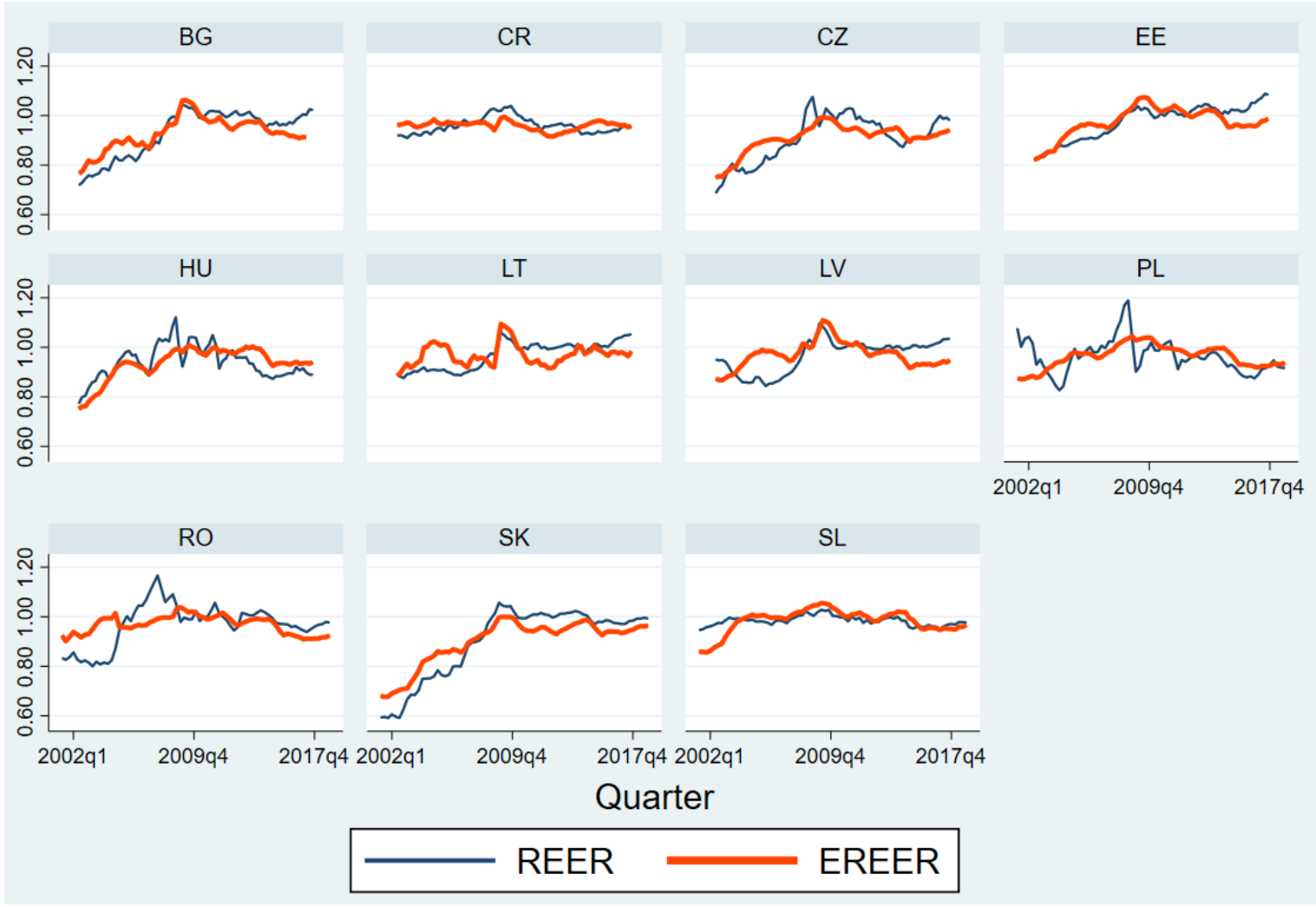
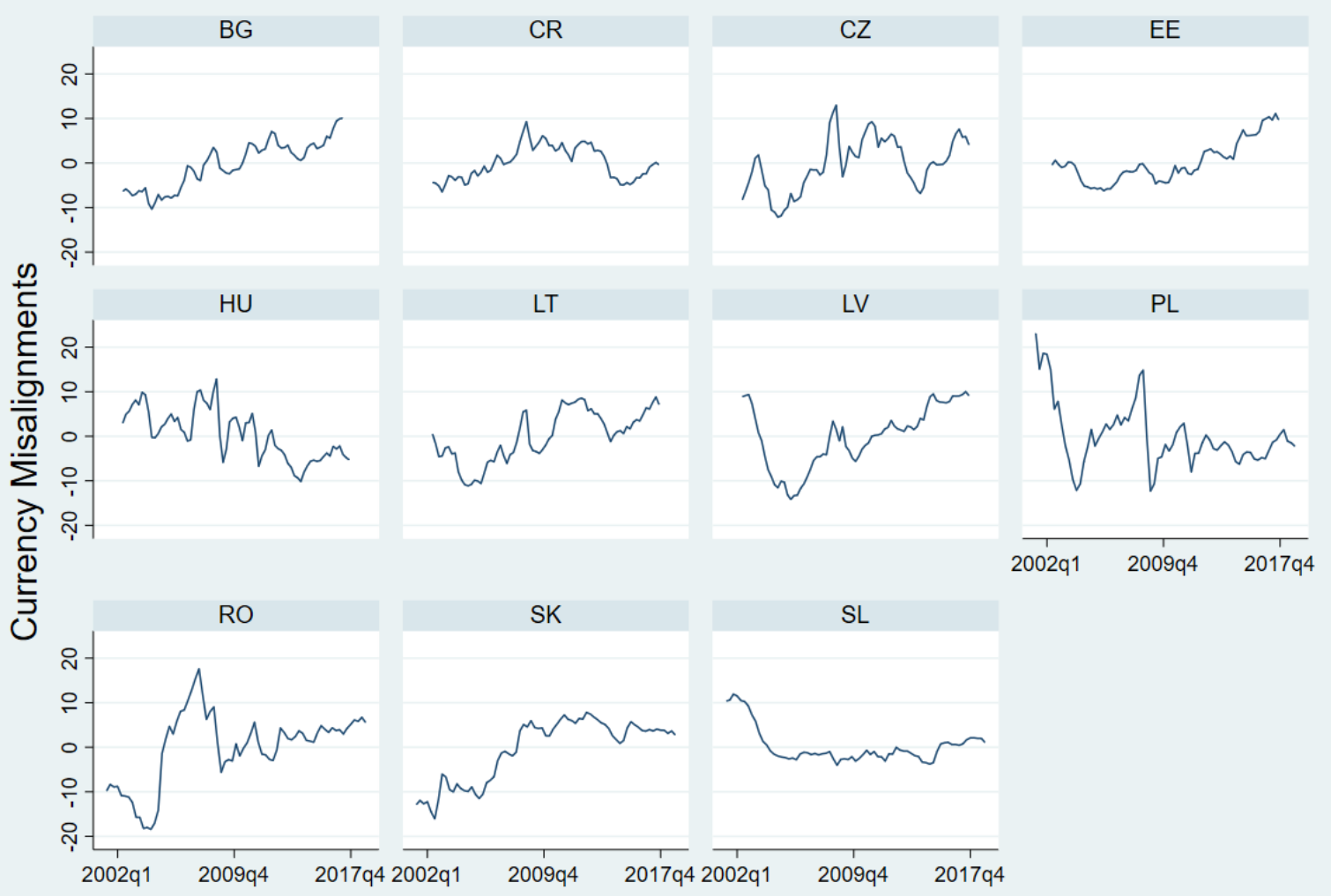


Figure A2: Real Currency Misalignments (%)



Notes: Real currency misalignments are expressed as a percentage of the equilibrium exchange rate.

Figure A3: Trade Balance (Ratio of Exports to Imports)

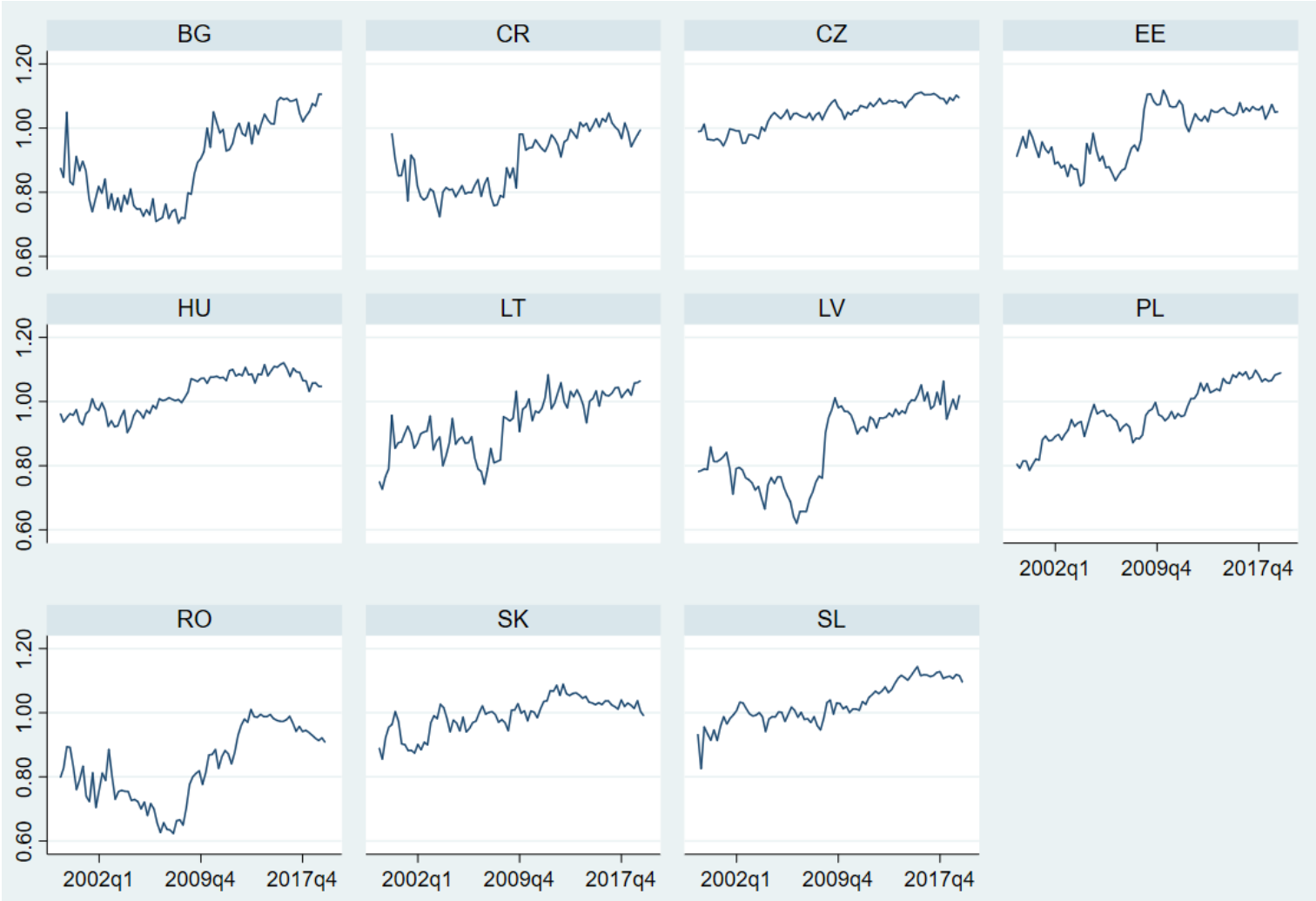


Figure A4: Backward GVC Linkages - Share of Foreign Value Added in Total Exports (%)

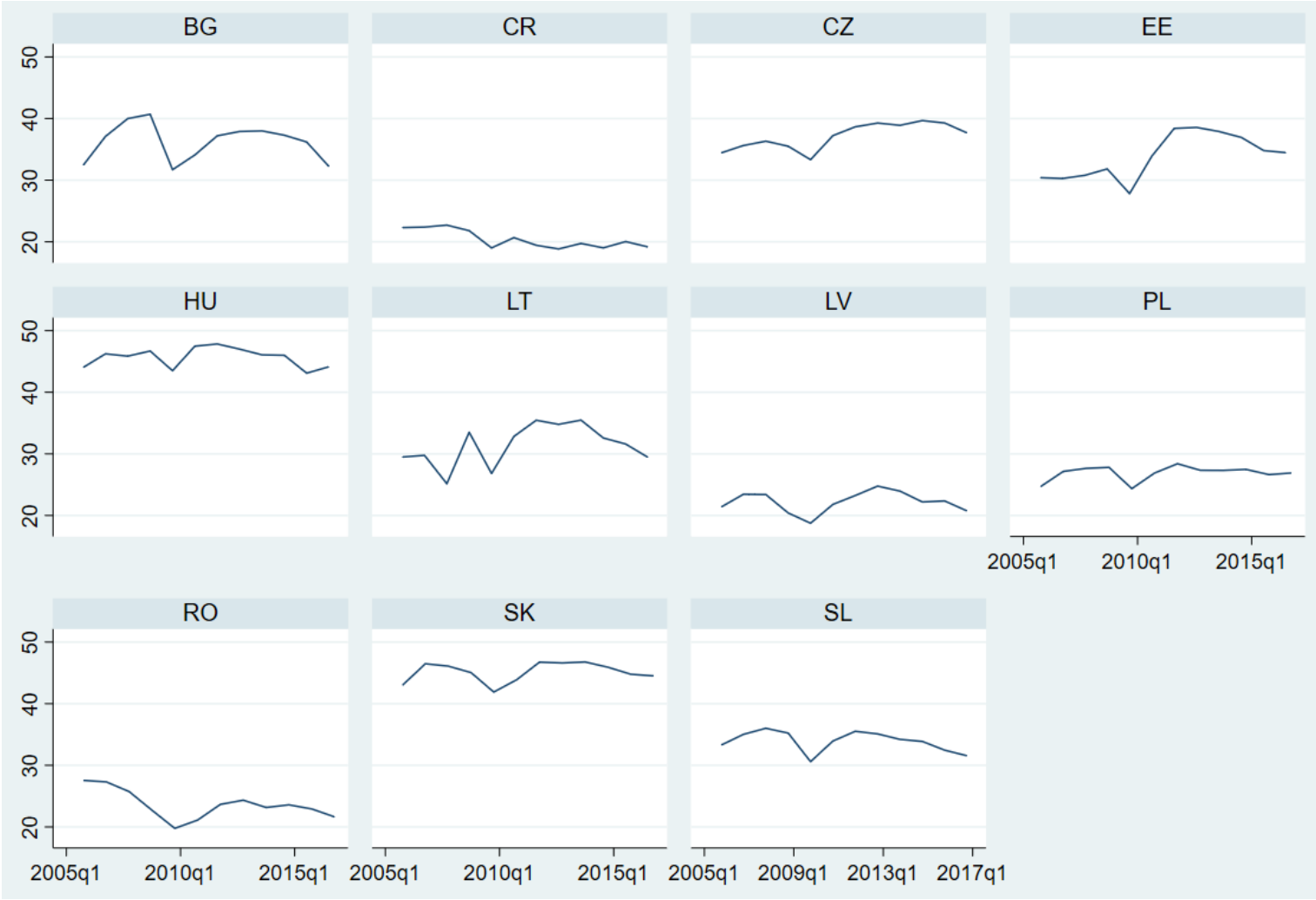


Figure A5: Forward GVC Linkages - Share of Domestic Value Added in Third Country Exports (%)

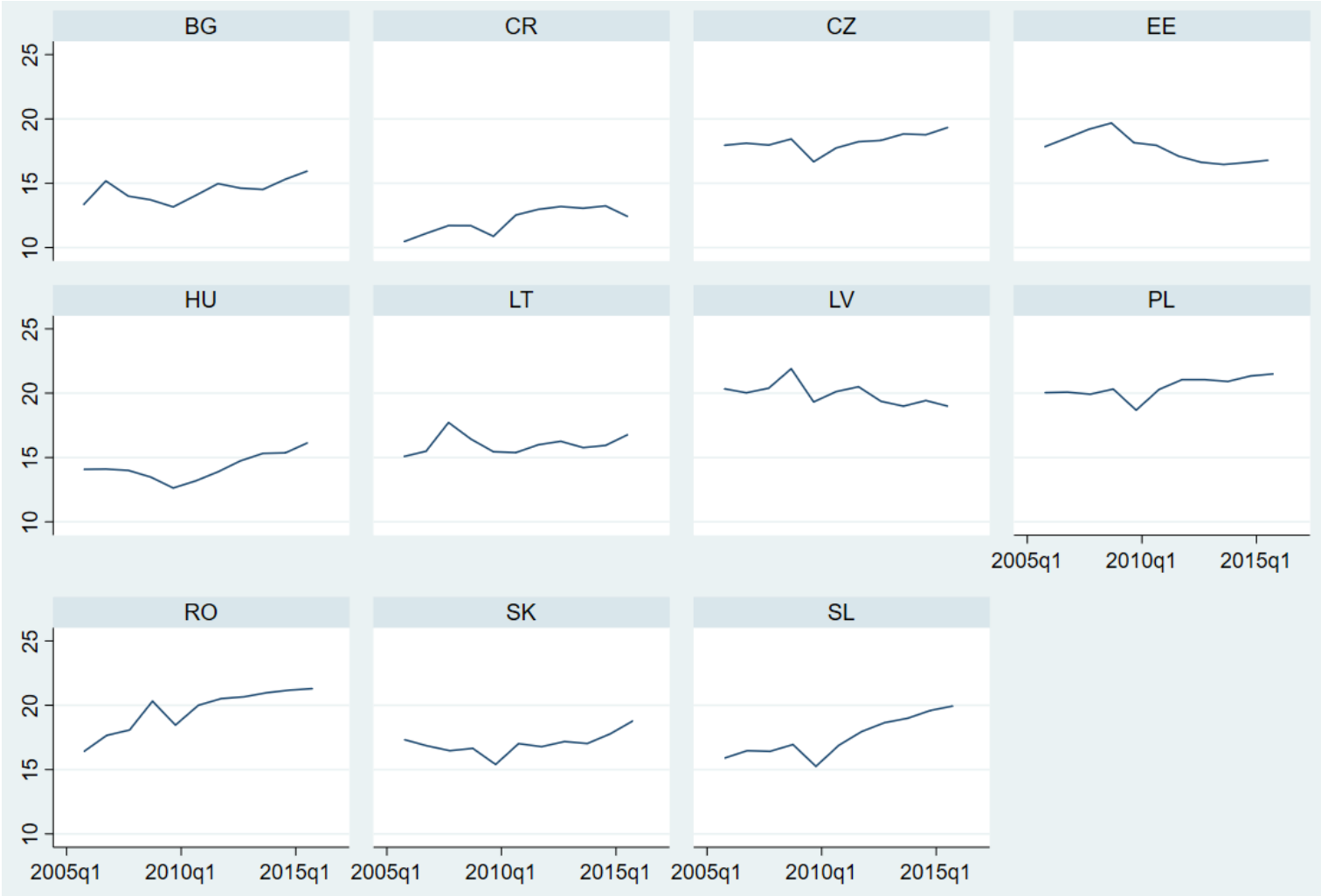
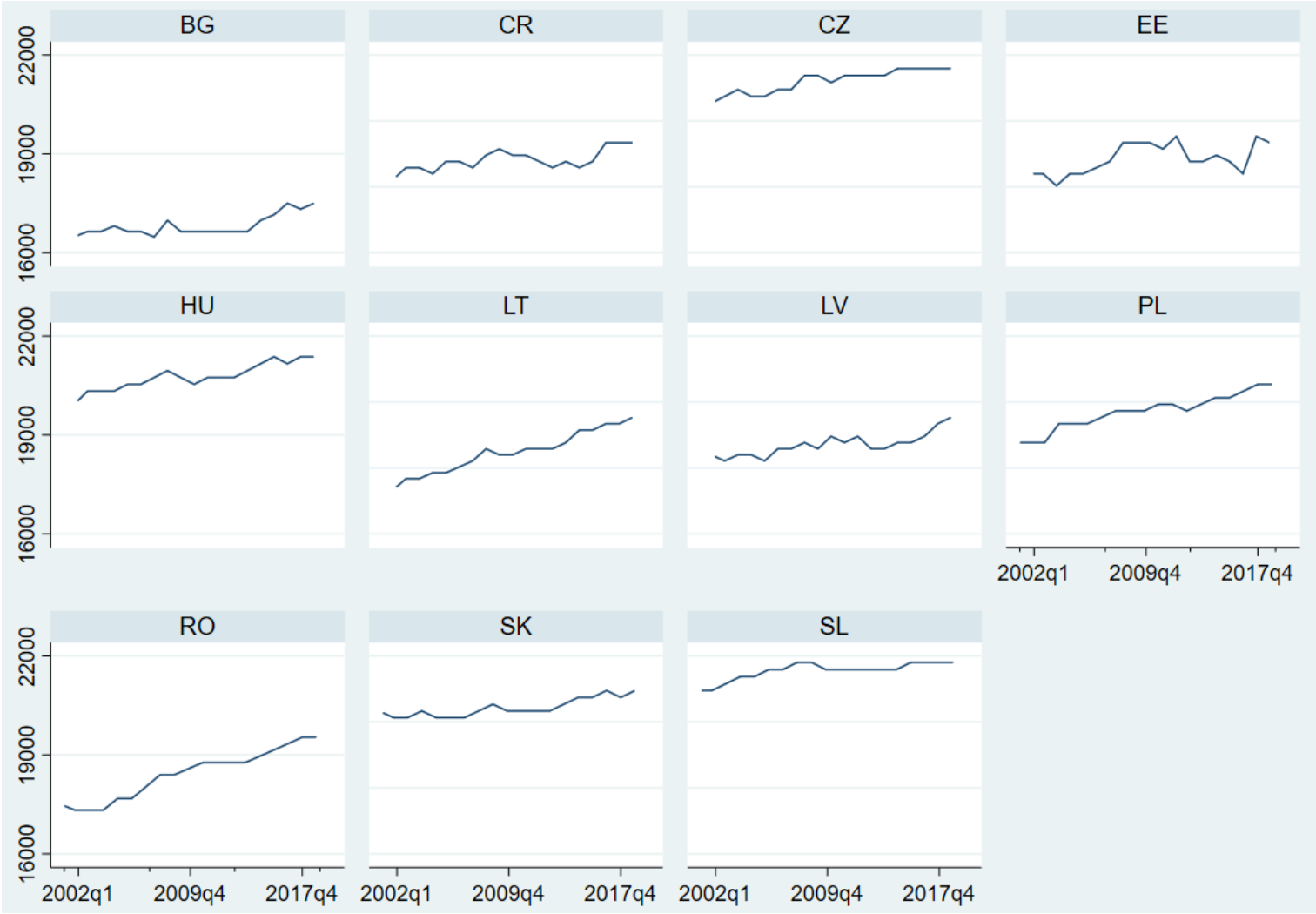


Figure A6: Export Sophistication Index



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