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What Did the Great Recession Change?

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Sustainable Real Exchange Rates in the New EU Member States: What Did the Great Recession Change?

Jan Babecký, Aleš Bulíř, and Kateřina Šmídková *

Abstract

The Great Recession affected export and import patterns in our sample of new EU member countries, and these changes, coupled with a more volatile external environment, have a profound impact on our estimates of real exchange rate misalignments and projections of sustainable real exchange rates. We find that real misalignments in several countries with pegged exchange rates and excessive external liabilities widened relative to earlier estimates. While countries with balanced net trade positions may experience sustainable appreciation during 2010–2014, several currencies are likely to require real depreciation to maintain sustainable net external debt.

JEL Codes: F31, F33, F36, F47.

Keywords: Foreign direct investment, Great Recession, new EU member states, sustainable exchange rates.

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* Jan Babecký is Principal Economist at the Czech National Bank (e-mail: jan.babecky@cnb.cz); Aleš Bulíř is Deputy Division Chief at the International Monetary Fund (e-mail: abulir@imf.org); and Kateřina Šmídková is Director of the Economic Research Department at the Czech National Bank and Professor at Charles University, Prague (e-mail: katerina.smidkova@cnb.cz).

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Nontechnical Summary

This paper evaluates the impact of the financial crisis of 2008–2009 (labeled as the "Great Recession") on real exchange rates in nine new EU member states, five of which (Bulgaria, Estonia, Latvia, Lithuania, and, since 2009, Slovakia) fix their exchange rates and the remaining four (the Czech Republic, Hungary, Poland, and Romania) pursue inflation targeting. Four euro-area countries (Greece, Portugal, Spain, and Slovenia) are used as benchmarks.

From several alternative approaches to assessing real exchange rates, we select a structural medium-term approach based on estimates of sustainable real exchange rates (SRER) that allows for medium-term deviation of observed real exchange rate values from sustainable values. This is a feature not available in purely econometric approaches such as behavioral equilibrium exchange rate (BEER) estimates, where observed values converge to equilibrium fast. In the SRER model, macroeconomic fundamentals determine the sustainable values. Specifically, net external debt and the impact of foreign direct investment (FDI) on the trade balance play an important role. Countries with low levels of net external debt and countries receiving FDI into the tradables sector can sustain real exchange rate appreciation in the medium term.

We assess the impact of the Great Recession on both the current misalignment and future path of the SRER. The first indicator shows how much the observed values of the real exchange rate differ from the computed sustainable values. The second indicator is forward-looking. It indicates the future sustainable speed of appreciation (or required depreciation) according to the SRER model. We compare the results with our previous SRER estimates to assess the changes caused by the Great Recession.

For the period 1999–2009, the indicator of real misalignment reveals that real misalignments in countries with fixed exchange rates widened relative to our previous estimates. The increase in currency misalignment was particular sizeable for Greece, Latvia, and Romania. On the other hand, countries with flexible exchange rate arrangements appear to have their currencies closer to sustainable values computed by the SRER. Nevertheless, when one compares the current and previous SRER estimates, it is clear that the Great Recession worsened sustainability across the sample.

We construct SRER projections for the period 2010–2014. Real exchange rates in countries with balanced net trade positions (the Czech Republic, Hungary, Slovakia, and Slovenia) are expected to continue to appreciate and maintain external sustainability at the same time. Yet there are several countries (Bulgaria, Estonia, Greece, Lithuania, and Romania) in which real exchange rate depreciation is needed to ensure sustainability of net external debt.

1. Introduction

The Great Recession of 2008–2009 caused major disruption to intra-European trade and a slowdown in capital flows to the new EU member states (NMS), and temporarily either halted or reversed the trend of real exchange rate appreciation in the NMS observed during the previous 20 years.[1] While there is a number of recent studies which examine the impact of the Great Recession on economic performance in the NMS (e.g. Coricelli and Maurel, 2010; Keppel and Wörz, 2010; and Furceri and Zdzienicka, 2011), our contribution to the literature lies in comparing the determinants of sustainable exchange rates before and during the recent crisis, which has not been done yet to our knowledge. Using simulations based on the Šmídková, Barrell, and Holland (2002) nexus between the real exchange rate, net external debt, and FDI, and by adding a ceiling on external debt, we find that the current real exchange rate trends in the NMS are a mix of sustainable appreciation and persistent misalignments.[2] Real appreciation is deemed sustainable as long as net exports are sufficient to prevent an increase of external debt above some safe threshold, thus the sustainable real exchange rate (SRER).

Most sample currencies appeared to be misaligned in real terms at the end of 2009, in particular in countries with pegged exchange rates (Bulgaria, Latvia, and Lithuania) or those using the euro (Greece, Slovakia, and Spain). Among peggers only Slovenia and Estonia appeared to be on a sustainable path. In contrast, most floating currencies appeared reasonably close to the model-implied sustainable values, with the exception of Romania. Misalignment can be traced to either excessive debt accumulation (Bulgaria, Greece, Latvia, Portugal, and Spain), poor net export performance (Bulgaria and Romania), or both. Looking ahead, the SRER projections indicate continued sustainable real appreciation for the Czech Republic, Slovakia, and Slovenia. For the remaining sample countries the model points to either stable sustainable rates (Bulgaria, Poland, and Spain) or depreciating ones (Estonia, Greece, and Romania).

We estimate the SRER using a set of economic fundamentals: net external debt, the stock of net foreign direct investment, the terms of trade, international interest rates, and domestic and external demand. The relationship between the real exchange rate and external debt is bi-directional. First, ceteris paribus, appreciation of the domestic currency contributes to accumulation of external debt (negative net foreign assets). Second, when the country's net exports are insufficient to service its external debt, there is depreciation pressure. The price elasticity of exports and imports to the real exchange rate is country-specific, reflecting the country's capacity to produce exportable goods and import substitutes. It follows that some countries may require a much larger change in the SRER to support a 1-percent increase in external debt than others. Just like any simulation, this approach provides model-specific results that may differ from those based on alternative approaches. Our SRER estimates are conditional on the structure of our model and on

[1] The new EU member states are the Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, Bulgaria, and Romania. We exclude Cyprus and Malta from our analysis owing to missing data. As a control group we include Greece, Spain, and Portugal since they are converging euro-area economies with incomes per capita initially below the euro-area average and exhibiting a broadly similar type of FDI flows (net inflows) to those of the NMS.

[2] We use the concepts of net external wealth, net debt, and net foreign assets interchangeably in this paper.

macroeconomic projections from the National Institute Global Econometric Model (NiGEM) and the International Monetary Fund (*World Economic Outlook*, WEO).

We observe three recent breaks in the external trade relationships that affect our estimates of sustainable exchange rates. First, the estimated price elasticity of exports declined below one and became insignificant in most panel specifications. Second, the so-called integration gain of FDI is difficult to detect on an aggregate level—the stock of inward FDI is associated with an improvement in the national trade balance in only a few countries. Third, almost all sample countries improved their net export balances during 2008–2009 due to lower imports, going above and beyond the model's in-sample predictions. These changes, coupled with a more volatile external environment, have made computation of sustainable exchange rates more uncertain compared to previous estimates.

The paper is organized as follows. After discussing the stylized facts we outline the empirical model. We then present estimates of the export and import function, calibrate the simulation model, and show the results.

2. Stylized Facts

Until the Great Recession the NMS's currencies were appreciating on average by almost 3 percent annually during 1998–2009. Also, the currencies of Greece, Portugal, and Spain were appreciating in real terms by more than 1 percent annually (Figure 1, see the solid blue line). Depending on the exchange-rate regime, real appreciation was effected through either nominal appreciation, higher domestic inflation, or a combination of these two.[3] The real appreciation either could not be fully attributed to, or appeared to contradict, justifications such as the Balassa–Samuelson effect and the external wealth accumulation hypothesis of Lane and Milesi-Ferretti (2002). Regarding the former, nontradable goods sectors recorded as impressive productivity gains as tradable goods sectors (Mihaljek and Klau, 2004) and the empirical estimates of the Balassa–Samuelson effect fall short of the observed real appreciation. Regarding the latter, the NMS currencies failed to depreciate in order to improve their trade balances in parallel to the rapid accumulation of net external debt. Moreover, the appreciation trend was simply too persistent to be the result of excessive devaluation at the start of the transition process as argued by Halpern and Wyplosz (1997). Further potential sources of trend appreciation—e.g. quality improvements in goods, pricing-to-market practices, country-specific effects of changing oil prices, and incomplete exchange rate pass-through—are discussed in Égert (2010).

Real appreciation in the NMS was also linked to massive inflows of foreign direct investment (FDI), which affected investors' perceptions about the countries' sustainable external balances (Schneider and Frey, 1985).[4] In so far as FDI inflows contribute to export growth, capital inflows

[3] The Baltic countries and Bulgaria retained the hard pegs established during the 1990s, while the Central European countries and later also Romania floated their currencies within the inflation-targeting framework. Slovenia, Cyprus, and Malta floated their currencies within a very narrow corridor against the euro and joined the euro area in 2007 and 2008, respectively.

[4] The manifold effects of FDI inflows are difficult to disentangle empirically (see Bulíř and Šmídková, 2005, for a review). First, export capacity increased to the extent that FDI was directed into sectors producing tradables. Second, productivity spillovers positively affected aggregate productivity and real manufacturing output per

signal future net export gains consistent with sustainable foreign debt (negative net foreign assets) and real appreciation. The evidence on the relationship between FDI and the real exchange rate is mixed, however. On the one hand, in a cross-country setting, we observe a positive relationship between the stock of FDI and trade balance developments: trade balances improved in countries that accumulated more FDI than in those that accumulated less (Figure 2). On the other hand, over time, the increasing FDI-to-GDP ratio corresponds to an improving trade balance in only four sample countries (the Czech Republic, Hungary, Poland, and Slovakia) and to either a worsening or unchanged trade balance in the others (Figure 1, see the red and green dashed lines). These results are also consistent with anecdotal evidence that FDI inflows into the above four countries were directed mostly into tradable goods sectors (manufacturing and tourism) while in the rest of the sample these inflows were directed into nontradables (construction, banking, services, and so on). During 2002–2008 the shares of FDI flowing into tradable sectors in Bulgaria and Latvia were about one quarter of those in Poland or the Czech Republic (Figure 3).

All sample countries except Cyprus and Malta were net external debtors; they had negative net foreign assets (NFA) and external debt exploded in a few (Figure 1, see the black dotted line). While in 1998 only Hungary had external debt equivalent to more than 40 percent of GDP, by the end of the next decade the ratio exceeded 80 percent in Bulgaria, Estonia, Greece, Hungary, Latvia, Portugal, and Spain. What contributed to such accumulation of external liabilities? While in some countries NFA reflected cumulative FDI inflows (Estonia, Romania, and Slovakia), in others external liabilities grew much faster than FDI (Greece, Latvia, Portugal, and also Hungary until 2005). Only in the Czech Republic and Slovenia was the NFA-to-GDP ratio below 40 percent and less than the FDI-to-GDP ratio in 2008.

3. The SRER Modeling Approach

The estimation of the SRER proceeds in two steps. First, in a panel of our sample countries, we estimate export and import equations. For the former we use the relative price of exports, external demand, and the FDI-to-GDP ratio, and for the latter we use the relative price of imports, domestic demand, and the FDI-to-GDP ratio.[5] Second, we simulate the net external debt, FDI, and real exchange rate nexus of Šmídková, Barrel, and Holland (2002), imposing a steady-state ceiling on the stock of external debt. Our approach defines the SRER as a real exchange rate ensuring that net external debt is sustainable in the medium term. The SRER approach belongs to the equilibrium (fundamental) real exchange rate models (Williamson, 1994); furthermore, using the classification of Driver and Westaway (2005), it belongs to the medium-term structural methodologies that work with both stock and flow variables. To the extent that the SRER approach works with both the trade balance and NFA, it encompasses most of the fundamental real exchange rate models, in particular those based on flow variables, including some of the methodologies of the IMF Coordinating Group on Exchange Rate Issues (Lee et al., 2008). The

worker grew. Third, FDI also stimulated imports as the FDI receiving sectors were incorporated into the production chain.

[5] The SRER approach is motivated by a dynamic model of a small, open economy, the external developments of which are affected by FDI (Bulíř and Šmídková, 2005). FDI affects growth through two channels: first, through an increase in total investment (Holland and Pain, 1998) and, second, through interaction of the FDI's more advanced technology with the host's human capital (Borensztein et al., 1998, and Lim, 2001).

SRER estimates hinge on two inputs: the values of the real exchange rate elasticity of external trade and the normatively chosen steady-state level of net external debt, both of which are estimates only.

The SRER literature has emphasized the role of FDI. In countries where FDI has been directed into tradable goods sectors, the resulting improvement in net exports has contributed to sustainable real appreciation. FDI is not homogeneous, and its impact on the economy, the trade balance, and real exchange rates depends on the capacity of the domestic economy to absorb the potential benefits of these inflows. On the one hand, the evidence supports the hypothesis that FDI has a positive effect on economic growth and productivity through the transfer of technology and skills and by augmenting the recipient's domestic capital stock (Kose et al., 2006). On the other hand, FDI inflows seem to contribute to growth only in countries with a stock of human capital beyond a certain threshold or with well-developed financial markets and with sufficient provision of infrastructure (Borensztein, de Gregorio, and Lee, 1998). When such conditions are met, FDI contributes to economic growth by augmenting capital accumulation by "crowding-in" domestic investment.

The SRER calculation is built around empirically estimated trade equations with the usual fundamental variables while directly incorporating the impact of FDI (Šmídková, Barrell, and Holland, 2003). The current account balance is not restricted as NFA define the external equilibrium. The sustainable level of NFA is related to the country's openness to trade as in Lee et al. (2008) and to the amount by which the actual debt deviates from its sustainable level; the more the discrepancy, the more the observed real exchange rate differs from the SRER.

Empirically, exports increase with foreign demand, improvement in the relative price of domestic goods (through either real depreciation or a terms-of-trade change), and the stock of FDI to approximate the integration gain:

$$X = \alpha_0 \left(\frac{EP_m}{P} \right)^{\alpha_1} \left(\frac{P_x}{P_m} \right)^{\alpha_1} \left(Y^* \right)^{\alpha_2} F^{\alpha_3}, \qquad (1)$$

where X denotes an export volume index; E is the US dollar nominal exchange rate vis-à-vis the domestic currency; P_m and P_x are the effective prices of imports and exports, respectively (following the approach of NiGEM, the real exchange rate is defined in terms of the relative import price, which makes it convenient to represent the relative price of exports EP_x/P as the product of the relative import price EP_m/P and the terms of trade P_x/P_m—see Barrell, Holland, and Šmídková, 2002); P is the consumer price level; Y^* is foreign demand; and F is the FDI-to-GDP ratio. Parameters α_1 through α_3 all have nonnegative expected values.[6]

Demand for imports is driven by domestic activity, the real exchange rate, and FDI:

[6] We also experimented with the exclusion of country-specific productivity relative to that of the euro area. However, we finally dropped productivity from the export equation as foreign demand and productivity turned out to be multicorrelated.

$$M = \beta_0 \left(\frac{EP_m}{P} \right)^{\beta_1} Y^{\beta_2} F^{\beta_3}, \tag{2}$$

where M denotes an import volume index and Y is domestic output. The parameter β_1 has a negative expected value and the parameters β_2 and β_3 have positive expected values. The stylized facts suggest that for some but not all countries we should observe that FDI improves net exports, *i.e.*, $\alpha_3 > \beta_3$.

The trade balance, current-period external borrowing, and external-debt interest payments affect the level of net external debt, the sustainable level of which is determined by financial markets. We approximate the path of sustainable debt by considering the initial stock of debt, the country-specific sustainable debt target for the end of the simulation period, and three possible transition paths. The sustainable debt target is based on IMF estimates:

$$D^* = \delta[D_0, D_T], \tag{3}$$

where D* denotes the sustainable path of net external debt (NFA in percent of GDP), and D_0 and D_T are the initial and target levels.

The SRER, C^*, is then defined by solving equations (1)–(3):

$$\left[\overline{M}\beta_0 (C^*)^{\beta_1} Y^{\beta_2} F^{\beta_3} - \overline{X}\alpha_0 (C^*)^{\alpha_1} \left(\frac{P_x}{P_m} \right)^{\alpha_1} (Y^*)^{\alpha_2} F^{\alpha_3} \right] = (1-r)D^* Y - D^*_{-1} Y_{-1}, \tag{4}$$

where $\overline{M}$ and $\overline{X}$ are the volume of real imports and exports, respectively, and r is the world real interest rate.

Trade Equations

The trade equations are estimated in a dynamic equilibrium correction model (ECM) using quarterly data over 1998–2009. The beginning of the sample is given by data availability (in particular with respect to the IMF estimates of the FDI stocks). The actual data cover the period up to 2009q3 or 2009q4 depending on the country under review, followed by the predictions up to 2014:q4 that will be used to perform the simulations. As the variables in levels are nonstationary and our sample period of about one decade is too short for robust testing of the order of integration of the series and cointegration relationships, we specify the equations directly as an ECM, allowing for long-run relationships between the variables in levels and capturing the short-run dynamics. The cointegration tests are performed in the ECM. In addition, we perform system estimates imposing common elasticities across countries but allowing for country-specific terms:

$$\begin{aligned} \Delta \ln(X_{i,t}) = {} & A_{0,i} - \lambda[\ln(X_{i,t-1}) - \alpha_1 \ln(RPX_{i,t-1}) - \alpha_2 \ln(Y^*_{i,t-1}) - \alpha_3 \ln(F_{i,t-1})] \\ & + \alpha_{4,i} \Delta \ln(RPX_{i,t}) + \alpha_{5,i} \Delta \ln(Y^*_{i,t}) + \varepsilon_{i,t}, \end{aligned} \tag{5}$$

$$\Delta \ln(M_{i,t}) = B_{0,i} - \delta[\ln(M_{i,t-1}) - \beta_1 \ln(RPM_{i,t-1}) - \beta_2 \ln(Y_{i,t-1}) - \beta_3 \ln(F_{i,t-1})] \quad (6)$$
$$+ \beta_{4,i} \Delta \ln(RPM_{i,t}) + \beta_{5,i} \Delta \ln(Y_{i,t}) + u_{i,t},$$

where $A_0 = \exp(\alpha_0)$, $B_0 = \exp(\beta_0)$, $RPX = \left(\frac{EP_m}{P}\right)\left(\frac{P_x}{P_m}\right)$ and $RPM = \left(\frac{EP_m}{P}\right)$

are the relative prices of exports and imports, respectively, the parameters λ and δ characterize the speed of adjustment toward the long-run equilibrium, and $\varepsilon_{i,t}$ and $u_{i,t}$ are white noise disturbances.

Data consistency is crucial for the SRER calculations given the endogenous relationships among the variables, and we rely mostly on the global econometric model (NiGEM) and the IMF series (Table 1).[7] The NiGEM series are quarterly, actual observations for the period 1998–2009 and projections for 2010–2014. The IMF's *International Financial Statistics* NFA series are also quarterly, while the *World Economic Outlook* FDI series are annual and we use cubic intrapolation to increase the series frequency. The net external debt trajectory is a normative projection.

Table 1: Variables and Data Sources, 1998–2014

Variable	Notation	Data Source
Effective foreign import demand (in millions of US dollars)	Y^*	NiGEM, January 2010
Effective world real interest rate (in percent)	r	NiGEM, January 2010
Import prices (index)	P_m	NiGEM, January 2010
Export prices (index)	P_x	NiGEM, January 2010
US dollar exchange rate (in domestic currency terms)	E	NiGEM, January 2010
Real domestic output (at constant prices)	Y	NiGEM, January 2010
Real exports (volume)	X	NiGEM, January 2010
Real imports (volume)	M	NiGEM, January 2010
Domestic consumer price index (CPI)	P	NiGEM, January 2010
Net external debt (net foreign assets, in millions of US dollars)	D_0	IMF International Financial Statistics
Net external debt target	D^*	Own calculations based on International Monetary Fund (2002)
Stock of FDI (in percent of GDP)	FDI	IMF World Economic Outlook, October 2009

Note: All sources provide both actual and projected data with the exception of the net external debt projections, which are determined endogenously using debt targets.

The panel approach involves a trade-off between country- and group-specific results. While the former tend to improve the short-run fit for the individual countries, they complicate the long-run

[7] NiGEM is the large-scale quarterly macroeconomic model of the world economy created and maintained by the London-based National Institute of Economic and Social Research (http://www.niesr.ac.uk). Details of the model are available via the Internet: http://nimodel.niesr.ac.uk/.

cross-country comparisons and capture transitional rather than long-run results, see Fic, Barrell, and Holland (2008). Basing the SRER estimates on the country-specific elasticities would mix estimates from the euro-area countries that are reasonably close to their steady state (say, Spain and Slovenia) with those that will experience additional convergence gains.[8] As the NMS countries approach the economic level of the initially rich countries, one can expect the trade patterns in the former countries to start to resemble the patterns in the latter countries. However, combining those two types of countries in a single panel would be likely to lead to misspecified equations.

To address this trade-off between country-specific and panel results, we opt to rely mostly on a generalized calibration oriented toward the euro-area benchmark economies. In addition, to capture the heterogeneity of the sample countries, we allow for country-specific FDI elasticities of exports and imports. These country-specific FDI elasticities allow us to better capture the stylized facts discussed in Section 2, namely, noticeable differences across countries for the FDI-to-GDP ratio and trade balance. In this setup, for example, the economies that received FDI inflows into their nontradable sectors may face a negative integration gain, while economies that received FDI inflows into their tradable sectors may benefit from a sizeable and positive improvement in the trade balance. As Figure 3 illustrates, there are indeed large differences across countries in terms of the structure of FDI. We therefore argue that it is preferable to use common elasticities of the exchange rate and foreign and domestic demand variables based on the euro-area benchmark countries, while allowing for country-specific FDI elasticities of exports and imports.

The estimated long-run elasticities used for the SRER computation are summarized in Table 2 and compared to earlier estimates of a comparable system (Šmídková, Barrell, and Holland, 2002). To assess the effect of the recent crisis, we perform estimations for two samples, 1998–1997 and 1998–2009. We impose a unitary elasticity on foreign and domestic demand in the export and import equations, $\alpha_2 = \beta_2 = 1$, to ensure consistency in the NiGEM series. Such elasticities then allow us to interpret equations (5) and (6) as share equations (Armington, 1969). These restrictions are not arbitrary, as the unconstrained panel estimates of α_2 and β_2 are not too far from one. The relative price elasticity of exports is about five times higher than that of imports, confirming that a large share of imports in small open economies is just inputs for exports, with little or no price elasticity.

[8] Following Babecký, Bulíř, and Šmídková (2008), four countries—Greece, Spain, Portugal, and Slovenia—are chosen as euro-area benchmark countries since they are converging euro-area economies with incomes per capita initially below the euro-area average and exhibiting a broadly similar type of FDI flows (net inflows) to those of the NMS. Other non-core euro-area countries, such as Ireland or Finland, being characterized by net FDI outflows, would need a different modeling framework to link FDI to the exchange rate.

Table 2: Panel Estimates of Trade Equations

		This paper		Šmídková, Barrell, Holland (2002) [1]
		1998–2007	1998–2009	
Real exchange rate elasticity of exports	α_1	1.50	1.73	3.15***
Foreign demand elasticity of exports [2/]	α_2	1.00	1.00	1.00
FDI elasticity of exports	α_3	Country-specific		0.70***
Speed of adjustment to long-run equilibrium	λ	0.05	0.05*	0.13***
Real exchange rate elasticity of imports	β_1	-0.32	-0.55	-0.62**
Domestic demand elasticity of imports [2]	β_2	1.00	1.00	1.00
FDI elasticity of imports	β_3	Country-specific		0.24***
Speed of adjustment to long-run equilibrium	δ	0.12***	0.09***	0.13***

Note: Long-run components of the export and import equations (5) and (6) estimated in an equilibrium correction panel comprising Greece, Portugal, Spain, and Slovenia. Sample period starting from 1998q4 and reaching 2007q4 (main model) or 2009q3 (alternative model), with common short-run coefficients. The country-specific elasticities of FDI (α_3 and β_3) are presented in Table 3. Statistical significance at the 1 percent, 5 percent, and 10 percent level is denoted by ***, **, and *, respectively.

[1] Panel estimates comprising the Czech Republic, Estonia, Hungary, Poland, and Slovenia, 1994q1–1999q4.

[2] The unitary values of foreign and domestic demand elasticities are imposed.

The estimated equilibrium adjustment is comparatively slow at about 5 percent and 12 percent quarterly for exports and imports, respectively. Therefore, only about ¼ of the initial disequilibrium in the export market is clearing in a year. The equilibrium correction model is estimated for the 1998q4 to 2007q4 sample period with common short-run coefficients. We estimated the panel for two sample periods (1998–2007 and 1998–2009) with small differences in coefficient size and summary tests. Compared to earlier estimates (Šmídková, Barrell, and Holland, 2002, Fic, Barrell, and Holland, 2008, and Babecký, Bulíř, and Šmídková, 2009) we find the absolute value of the estimates of real exchange rate elasticities to be lower and statistically insignificant in this paper. This development can be traced to the Great Recession: in all sample countries exports declined, but imports declined even more, creating a trade wedge.[9] The country-specific FDI elasticities indicate some improvement in net exports, $\alpha_3 > \beta_3$, only in the Czech Republic, Hungary, and Slovakia (Table 3). For other countries, changes in FDI are negatively related to net exports ($\alpha_3 - \beta_3 < 0$). The FDI elasticity of exports (α_3) is even negative in the case of Greece, Latvia, Portugal, and Spain. Such FDI elasticities reflect the deterioration of trade balances occurring in the background of the continued FDI inflows (and rising FDI-to-GDP ratios), albeit in some cases decelerating FDI inflows toward the end of the sample (and correspondingly declining FDI-to-GDP ratios). Overall, the estimated export elasticities are lower

[9] Levchenko, Lewis, and Tesar (2009) report a similar result for the U.S., also with income elasticity. One possible explanation for the wedge is that these import demand equations do not include the direct effects of the credit boom and, hence, may miss the impact of the inflation/deflation of the credit bubble on demand for imports (Bakker and Gulde, 2010).

than earlier estimates shown in the right column of Table 2, as they reflect either the slowdown in FDI inflows or the decrease in net exports.

Table 3: Country-Specific FDI Elasticities

	FDI elasticity of exports (α_3)		FDI elasticity of imports (β_3)	
	1998–2007	1998–2009	1998–2007	1998–2009
Bulgaria	0.05**	0.05*	0.21***	0.21***
Czech Republic	0.87***	0.94***	0.53***	0.45***
Estonia	0.17***	0.18***	0.24***	0.21***
Greece	-0.22***	-0.20***	-0.14***	-0.16***
Hungary	0.66***	0.73***	0.27***	0.23***
Lithuania	0.32**	0.29**	0.72***	0.70***
Latvia	-0.21***	-0.26***	0.31***	0.34***
Poland	0.22***	0.21***	0.37***	0.38***
Portugal	-0.10***	-0.07**	0.14***	0.11***
Romania	0.54***	0.57***	0.78***	0.69***
Slovenia	0.26***	0.28***	0.28***	0.26***
Spain	-0.11***	-0.09**	0.20***	0.16***
Slovakia	0.35***	0.38***	0.16***	0.14***

Note: The elasticities correspond to α_3 and β_3 in equations (5) and (6) and are estimated in an equilibrium correction panel comprising Greece, Portugal, Spain, and Slovenia. Sample period from 1998q4 to 2007q4 (main model) and 1998q4 to 2009q3 (alternative model), with common short-run coefficients. The panel coefficients are summarized in Table 2. Statistical significance at the 1 percent, 5 percent, and 10 percent level is denoted by ***, **, and *, respectively.

The performance of the calibrated export and import equations and a comparison of the actual and predicted net exports for the main model can be found in Annex I. The dynamics of both imports and exports are captured sufficiently well to proceed to the next step of preparing the SRER model.

Macroeconomic and Debt Scenarios

The SRER approach defines external equilibrium as a combination of net exports and a real exchange rate that ensures that net external debt converges to its steady-state target. Hence, two issues need to be addressed: first, the steady-state level of net debt and, second, the range of possible macroeconomic developments. To this end, we simulate 11 scenarios (three debt-path and eight macroeconomic scenarios) from which we construct the interval estimates ("corridors") of the SRER, using the parameter point estimates from our trade equations. Each scenario is represented with a mean and two standard deviations. In focusing on the uncertainty of macroeconomic developments we leave out the question of model uncertainty—unlike in Bulíř and Šmídková (2005) we do not take into account the parameter uncertainty of the trade equations in constructing the corridors, thus narrowing our estimated SRER corridors.

Regarding external debt, it has been argued that sustainable external debt is related to countries' ability to service it (International Monetary Fund, 2002) rather than being a universal number

equal to, say, 60 percent of GDP (Ades and Kaune, 1997). To this end, we derive the steady-state debt levels from the countries' openness to trade: the more open the country, the higher the sustainable level of external debt (Table 4). We calculate the SRER across three transition paths: slow, fast, and very fast.

Table 4: Net External Debt Targets

(in percent of GDP)

Country	Exports	Debt Target
Bulgaria, the Czech Republic, Estonia, Latvia, Lithuania, Hungary, Slovakia, Slovenia	Higher than 40	65
Greece, Poland, Portugal, Romania, Spain	Higher than 30, but lower than 40	53

Source: Authors' calculations based on International Monetary Fund (2002).

The three alternative paths for sustainable debt differ in the speed with which the steady-state debt target is reached, producing different estimates of misalignment (Figure 4). The baseline path, D1, assumes that sustainable debt during 1998–2009 was close to the actual debt-to-GDP ratio and that in the long run (in the horizon of 100 years, that is, by 2110) it will have slowly converged to the target (polynomial extrapolation, Table 5). While this path generates minimal misalignment during 1998–2009 due to the similarity between the observed and sustainable debt levels, it also allows for a long period of above-target debt. Second, sustainable debt is set to equal its 1998 value and it converges toward the 2110 target thereafter along a logarithmic extrapolation trajectory, D2. This scenario produces more visible misalignments for countries whose 1998–2009 debt was either below or above the sustainable path. Third, for a fast-convergence scenario with debt achieving the steady-state level in 2018 (logarithmic extrapolation, D3), the misalignment estimates are similar to those in scenario D2.

Regarding macroeconomic developments, we construct a set of eight scenarios for the exogenous variables: one standard deviation shocks to the external risk premium, domestic and foreign demand, and the FDI stock (Table 5). For example, the risk premium scenarios capture two relevant possibilities: on the one hand, that the adoption of the euro would be accompanied by a decrease in the risk premium (Schadler et al., 2005) and, on the other hand, that the 2009–2010 Greek debt crisis spills over into the NMS. These shocks are relatively large, as the corresponding standard deviations are equivalent to about 10 percent of the 2007 values. The computed SRER intervals are therefore quite robust, in particular capturing uncertainty related to the recent financial crisis through the scenarios of lower and higher risk premiums and reduced export demand.

Table 5: Summary of the 11 Simulation Scenarios

No.	Notation	Scenario description
1	D1	Baseline trajectory: Polynomial extrapolation using the actual series for 1998–2009 and the debt target applied to 2110.
2	D2	Gradual net external debt convergence toward the target: Logarithmic extrapolation using the actual series for 1998 and the debt target applied to 2110.
3	D3	Fast net external debt convergence toward the target: Logarithmic extrapolation using the actual series for 1998 and the debt target applied to 2018.
4	R_low	A decrease in the risk premium by 2 percentage points during 1998–2014
5	R_high	An increase in the risk premium by 2 percentage points during 1998–2014
6	Y_low	A decrease in real domestic output by one standard deviation
7	Y_high	An increase in real domestic output by one standard deviation
8	Y*_low	A decrease in export demand by one standard deviation
9	Y*_high	An increase in export demand by one standard deviation
10	FDI_low	A decrease in the stock of FDI by one standard deviation
11	FDI_high	An increase in the stock of FDI by one standard deviation

4. Simulation Results

We report two types of simulation results, all performed in the EViews 7 package. First, we report estimates of currency misalignment for 1999–2009 using elasticities from the main model. The estimate range indicates real overvaluation/undervaluation if the interval is above/below the zero horizontal line. Second, we show the SRER projections for 2010–2014. Horizontal estimate ranges indicate a stable real exchange rate; downward/upward sloping ranges indicate real appreciation/depreciation.

Misalignment

Looking back, the floating exchange rates in the inflation-targeting countries were mostly close to their sustainable values, while the rates in the pegging countries were mostly overvalued, although with some exceptions. Our results are consistent with the common view that pegged currencies are more likely to be overvalued in real terms compared to floating ones (see Coudert and Couharde, 2009, and Dubas, 2009). To this end, in Figure 5 we report in the first column the inflation-targeting countries (the Czech Republic, Hungary, Poland, Slovakia, and Romania), in the second the euro-area countries (Greece, Portugal, Spain, and Slovenia), and in the third those with hard pegs (Bulgaria, Estonia, Latvia, and Lithuania).[10] The values for real misalignment in 2009 are shown in Table 7.

The inflation-targeting countries all had short-lived periods of either over- or undervaluation—the Czech Republic in 2007/2008, Hungary in the mid-2000s, Poland in 2001/2002, and Slovakia in 2009—but the currency misalignments disappeared quickly. Quantitatively, we estimate that these misalignments were about 10 percent or less. Despite fast accumulation of external liabilities and

[10] Slovakia joined the euro area in 2009, so we still include it among the inflation targeters.

real appreciation of the national currencies, the actual real exchange rate remained close to the SRER, mainly on account of improvements in the trade balance. Slovakia shows an overvaluation of about 10–15 percent as the koruna was revalued prior to the adoption of the euro on January 1, 2009 and as Slovak inflation picked up relative to Germany and France.[11] Romania, which floated its national currency only in 2005, was an exception in the subsample: the misalignment of the leu kept growing to almost 30 percent as the trade balance worsened and the real exchange rate continued to appreciate until 2008.

All three early euro-area countries (Greece, Portugal, and Spain) show signs of persistent overvaluation. Portugal and Spain narrowed their estimated misalignments from 20 percent and 10 percent, respectively, to almost nil before the recent crisis and a renewed widening in 2008–2009. Meanwhile, Greece's currency appears to be overvalued throughout the sample period by 20–30 percent, with an increase to about 40 percent in 2009. In contrast, the estimated corridor for Slovenia's currency is close to equilibrium, with relatively small appreciation vis-à-vis the SRER after the adoption of the euro in 2007. All four pegged currencies also appear to be overvalued, with Estonia and Lithuania only marginally such that the bottom of the corridor is either below or touching the equilibrium line. In contrast, from 2001 to 2009 the Bulgarian and Latvian currencies are estimated to have been overvalued by 10 percent and 20 percent, respectively. In addition, the estimated corridor is wide on account of net export volatility.

Real exchange misalignment is defined as the mean of the 11 simulation scenarios listed in Table 5. Table 6 illustrates the extent to which each of the eleven scenarios listed in Table 5 contributes to real misalignment. Overall, the scenarios of a change in export demand (Nos. 8–9) account for the most of the extreme values, followed by changes to domestic demand (Nos. 6–7), FDI inflows (Nos. 10–11), and changes in the risk premium and debt scenarios. However, there are some country/group-specific features. For example, in the three Baltic States, changes in domestic demand represent the largest contribution to currency misalignment. In Hungary, it is a change (specifically a decrease) in FDI which drives the misalignment. In Greece, the second-largest factor after foreign demand is a change in the risk premium. Notice that due to the non-linearity of the model, responses to shocks are not necessarily symmetric. For example, a one standard deviation decrease in export demand produces a 5 pp to 13 pp larger contribution to real misalignment, in absolute terms, compared to an increase in export demand of similar magnitude.

[11] Bulíř and Hurník (2009) noted that a number of euro-area countries suffered from a sudden increase in inflation after euro adoption as pent-up inflationary pressures were released.

Table 6: Contributions of the 11 Simulation Scenarios to Real Misalignment, 1999–2009 (%)

Scenario No.	1	2	3	4	5	6	7	8	9	10	11
	D1	D2	D3	R_low	R_high	Y_low	Y_high	Y*_low	Y*_high	FDI_low	FDI_high
Bulgaria	-1.4	10	7.2	-17	14	-48	44	**90**	**-82**	**-56**	39
Czech Rep.	-0.8	-1.5	-7.7	-7.7	6.0	-31	29	**104**	**-93**	**41**	-38
Estonia	-0.7	2.5	1.1	-12	11	**-94**	**88**	**67**	-60	-6.8	4.8
Greece	-2.7	8.9	3.9	**-55**	49	-17	12	**98**	**-92**	-7.7	2.1
Hungary	-6.1	-3.2	-3.2	-16	4.0	-27	15	40	**-46**	**118**	**-75**
Lithuania	0.3	1.0	-2.2	-10	10	**-83**	**79**	**66**	-57	-47	42
Latvia	-0.2	6.1	3.5	-14	14	**-87**	**80**	47	-42	**-60**	52
Poland	-1.8	8.5	2.5	-29	26	**-48**	44	**96**	**-88**	-35	26
Portugal	-1.5	5.0	1.3	-39	36	-21	18	**100**	**-91**	**-41**	34
Romania	-0.4	4.3	-1.3	-11	11	**-61**	58	**85**	**-76**	-51	42
Slovenia	0.8	-5.4	-12	-3.2	4.8	-52	53	**103**	**-90**	-1.9	3.2
Spain	-3.2	12	6.3	-36	30	-30	23	**101**	**-95**	-29	22
Slovakia	-2.8	3.8	-0.2	-12	6.6	-59	52	**87**	**-82**	46	-39
IT mean	-2.4	2.4	-2.0	-15	10	**-45**	40	**82**	**-77**	24	-17
HP mean	-0.5	4.9	2.4	-13	12	**-78**	**73**	**67**	-60	-42	34
EA mean	-1.7	5.2	-0.2	-33	30	-30	26	**101**	**-92**	-20	15
Sample mean	-1.6	4.0	-0.1	-20.2	17.0	-51	46	**83**	**-77**	-10	8.9

Note: For each simulation scenario, the numbers in the table indicate the average magnitude of the real misalignment associated with that particular scenario, expressed in % relative to the one standard deviation band plotted on Figure 5 "Real Exchange Rate Misalignment". Positive values correspond to currency overvaluation; negative values indicate undervaluation of the national currency.

For each country, the numbers in bold denote the three contributions with the largest magnitudes; the two largest values, in absolute terms, are highlighted.

For example, in the case of Bulgaria the scenario with the largest contribution to currency misalignment is a decrease in export demand by one standard deviation (scenario No. 8, "Y*_low"), which produces an average misalignment of 90% as compared to the one standard deviation misalignment corridor calculated across the 11 scenarios.

The SRER Projections

Looking forward, the SRER projections send mixed signals (Figure 6; cumulative SRER changes are also shown in Table 7). While our simulations foresee continued sustainable real appreciation in some countries, several countries would need to depreciate their currencies to ensure external sustainability. We compute SRER projections for five years ahead, conditional on both the NiGEM and IMF projections of the fundamental variables and the 11 macroeconomic scenarios.

We find only five countries with sustainable real appreciation of their currencies during 2010–2014, and in these cases the projections indicate moderate appreciation only. Four of these countries have shown sustained improvements in net exports (the Czech Republic, Hungary, Slovakia, and Slovenia). The fifth country with an appreciating currency is, surprisingly, Portugal; however, this result is driven by rather optimistic net export projections by NiGEM. Our simulations for Greece project some real appreciation in 2010–2012; however, the end-of-sample SRER level is depreciated relative to 2007. It is important to note that a country could be characterized by both an overvalued currency (i.e., a positive misalignment) and sustainable

appreciation foreseen in the medium term. The reason is that the historical misalignment is not informative about the future SRER trajectory. If a currency is overvalued in real terms, it could depreciate, followed by subsequent SRER appreciation.

The simulations point to stable SRERs in three countries (Poland, Spain, and Latvia) and depreciating SRERs in the rest (Bulgaria, Estonia, Lithuania, and Romania). Most notable is the depreciation required to achieve sustainable debt in Romania—some 30–40 percent relative to 2009. These simulations are conditional on the NiGEM projections for the individual countries, and these projections may change materially: for example, in January 2010 the growth, export, and import projections for Estonia changed so much that the direction of the sustainable exchange rate path changed.

Table 7: Real Misalignment and Sustainable Real Exchange Rate Appreciation

Country	Regime [a]	Misalignment (%) [b]	SRER changes (%) [c]	
		2009	2000–2009	2010–2014
Bulgaria	HP	28.1	0.4	-0.3
Czech Republic	IT	9.4	-2.5	-2.6
Estonia	HP	12.0	-0.5	2.7
Greece	EA	38.6	0.4	-2.6
Hungary	IT	0.4	-2.7	-4.0[d]
Lithuania	HP	22.6	0.0	0.3
Latvia	HP	27.9	1.7	0.7
Poland	IT	6.6	0.3	0.0
Portugal	EA	13.7	-1.3	-1.5
Romania	IT	30.5	-1.1	6.9
Slovenia	EA	6.3	-0.9	-1.5
Spain	EA	14.7	-0.3	-0.9
Slovakia	IT	16.0	-1.1	-2.4
IT average		12.6	-1.4	-0.4
HP average		22.7	0.4	0.9
EA average		18.3	-0.5	-1.6
Sample average		17.5	-0.6	-0.4

Notes: [a] Policy regime: inflation targeters (IT), hard-peggers (HP), and euro area (EA).
[b] Positive values of real misalignment correspond to overvaluation.
[c] Negative values of SRER changes correspond to appreciation.
[d] -1.6% if considered for 2011–2014. In Hungary, SRER experienced depreciation of 10.6% in 2009, followed by appreciation of 13.5% (2010), 5.9% (2011), and 1.8% (2012), then depreciation of 0.5% (2013) and 0.7% (2014).

Comparisons with the Pre-Crisis Results

We compare our estimates of SRER misalignment and projections with two sets of our own estimates based on the pre-crisis data. First, the quarterly SRER estimates from Babecký, Bulíř, and Šmídková (2008) based on the trade elasticities from Barrell et al. (2002) are considered. Second, the annual SRER estimates based on Babecký, Bulíř, and Šmídková (2009) are also

utilized. We can therefore trace the impact of the recent crisis on the SRER estimates through two channels. First, the projections for macroeconomic variables from NiGEM and FDI flows from WEO changed dramatically during the crisis. Second, the present SRER estimates use different calibrations based on alternative trade equations. Moreover, the former paper covers only the Czech Republic, Greece, Hungary, Poland, Portugal, Slovakia, Slovenia, and Spain, while the latter adds Bulgaria, Estonia, Latvia, Lithuania, and Romania. For illustration of the impact of these differences, the previous estimates (from Babecký, Bulíř, and Šmídková, 2009) are shown in Appendix I.3 (real exchange rate misalignment) and Appendix I.4 (SRER projections).

While in a few countries (the Czech Republic and Slovenia) the misalignment estimates are practically indistinguishable from one another, in most countries the mean estimate shifted upward in the aftermath of the crisis, keeping the slope of the path of the misalignment estimate unchanged. The shift was negligible for Estonia, Poland, and Slovakia; however, it was sizable for Greece, Latvia, and Romania. For example, the annual-series simulations in Babecký, Bulíř, and Šmídková (2009) estimated that Greece's currency may be overvalued by 10 percent at most, but the current estimate suggests overvaluation close to 30 percent.

We find a pronounced impact of the Great Recession on trade and net external debt in our 2010–2014 SRER projections. To recapitulate, in this paper we assess the impact of the Great Recession by estimating the elasticities for two samples, 1998–2007 and 1998–2009. As illustrated in Tables 2 and 3, the estimated elasticities are fairly similar across periods. Thus, that main effect of the recent crisis on real exchange rate misalignment and SRER projections was due to changes in the underlying macroeconomic variables rather than the coefficients of the model. While in the earlier papers' simulations we found either appreciating or stable SRERs in our sample countries (see Figure 4 in Babecký, Bulíř, and Šmídková, 2008, or Figure V.2 in Babecký, Bulíř, and Šmídková, 2009), in this paper we find that a number of countries will require real depreciation to stabilize their external position. These changes are particularly pronounced for Bulgaria, Estonia, Greece, and Romania. In contrast, countries with healthy net trade balances (the Czech Republic, Hungary, Slovakia, and Slovenia) seem unaffected by the recent developments.

5. Conclusions

We simulate sustainable real exchange rates using a set of economic fundamentals and find that the Great Recession had a profound impact on our estimates of real exchange rate misalignments and SRER projections. We find that after the crisis, the so-called integration gain of FDI inflows was limited to the Czech Republic, Hungary, and Slovakia. The price elasticity of exports and imports declined, becoming insignificant in most specifications. A weakening of the relative-price-equilibrating mechanism affects the SRER—the lower the relative price elasticities, the more the real exchange rate must depreciate to support the debt service on an existing stock of external liabilities. Our estimates of the SRER are conditional on the structure of our model and on macroeconomic projections from the National Institute Global Econometric Model and the IMF (*World Economic Outlook*).

We find, first, that real misalignments in countries with mostly pegged exchange rates and with excessive external liabilities widened relative to earlier estimates of the SRER. In contrast,

countries with flexible exchange rates seem to be closer to their fundamental equilibria; however, even their currencies appeared overvalued at the end of 2009. Looking ahead, countries with balanced net trade positions are expected to continue to appreciate during 2010–2014; still, several currencies are likely to require real depreciation to maintain sustainable net external debt. As most of the latter countries either are members of the euro area or have their currencies pegged to the euro, real depreciation will require a decrease of either domestic prices or external debt. Our estimates of the sustainable real exchange rates do not explicitly account for the structure of FDI and thus the differences in the results could also be due to the extent to which FDI inflows are divided between the tradable and non-tradable sectors of the economy. This could be an avenue for future research.

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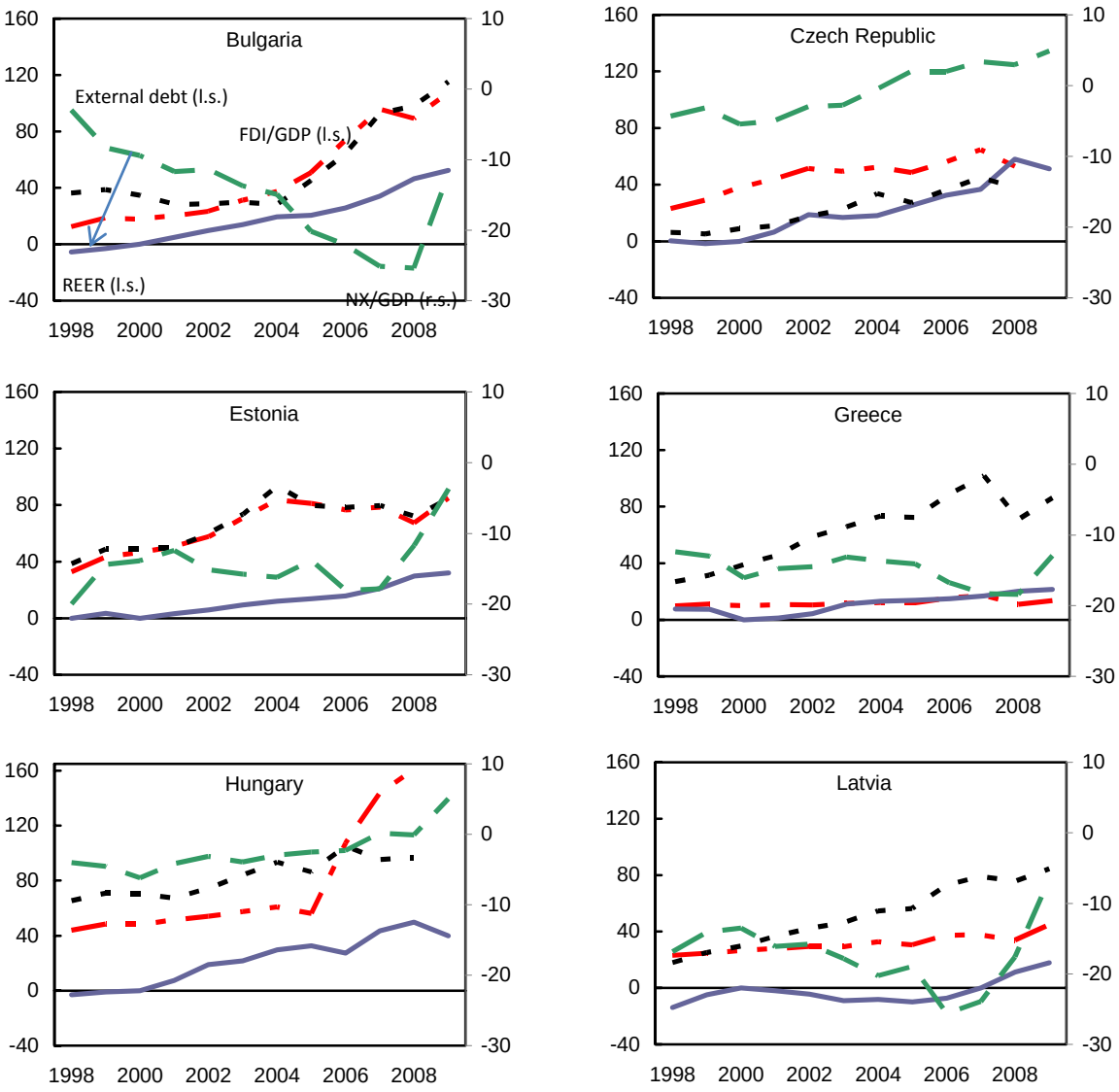
Figures

Figure 1: FDI, Real Effective Exchange Rate, External Debt, Net Exports



Notes:

1. Foreign direct investment (FDI, _.._) is the stock of inward FDI as a ratio to GDP; in percent; left-hand scale. Source: *International Financial Statistics*, Balance of Payments Statistics.
2. Real effective exchange rate (REER, __) is the CPI-based, trade-weighted measure of external price competitiveness, 2000 = 0; in percent; left-hand scale. An upward-sloping line indicates real appreciation, that is, ceteris paribus, a loss of competitiveness. Source: *IMF Information Notice System*.
3. Net external debt (...) is the economy's net foreign assets (assets minus liabilities) as a ratio to GDP; in percent; left-hand scale. Source: *International Financial Statistics*.
4. Net exports (NX, --) is the balance on trade in goods (export minus imports) as a ratio to GDP; in percent; right-scale scale. Source: *World Economic Outlook*.

Figure 1: FDI, Real Effective Exchange Rate, External Debt, Net Exports (Continued)

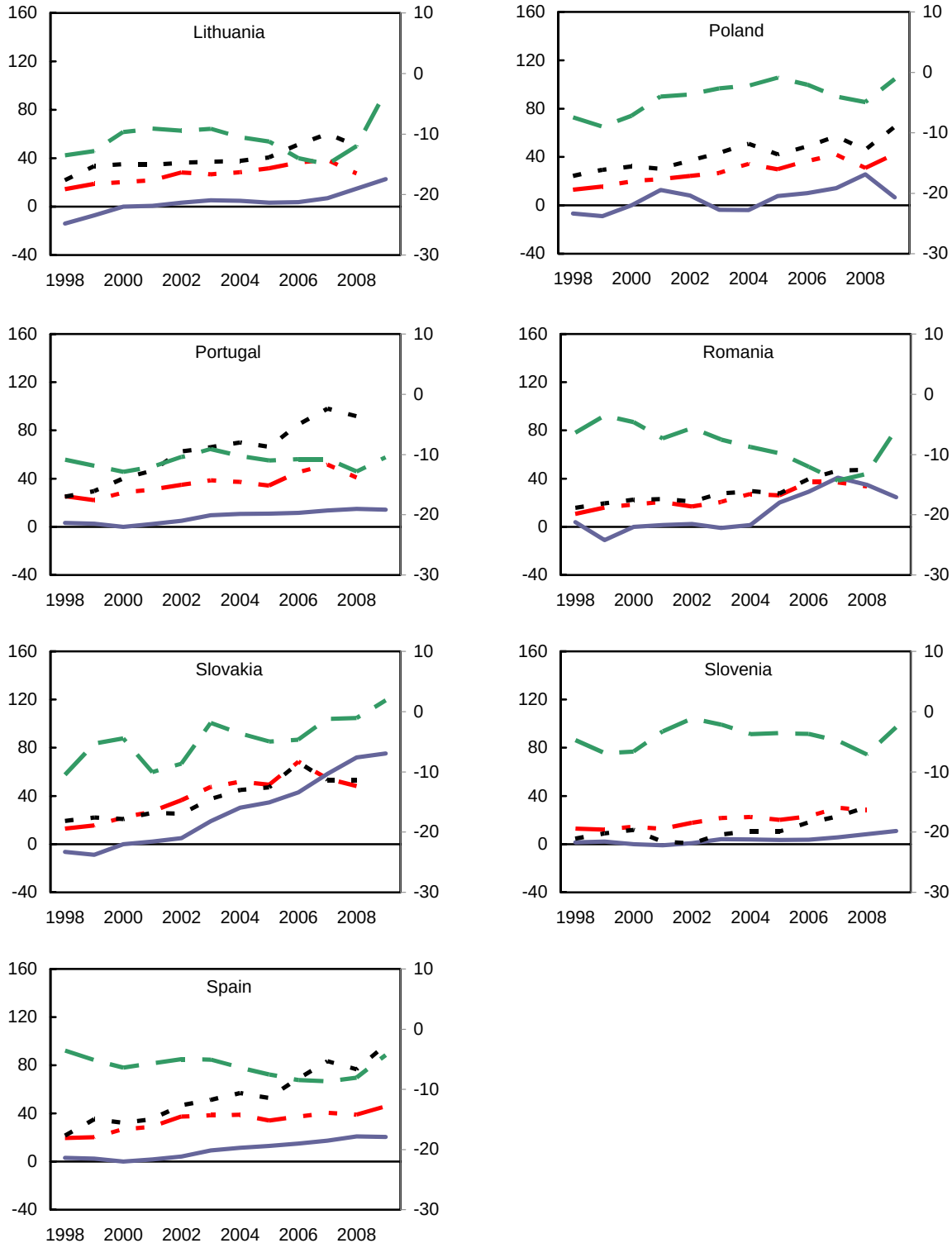
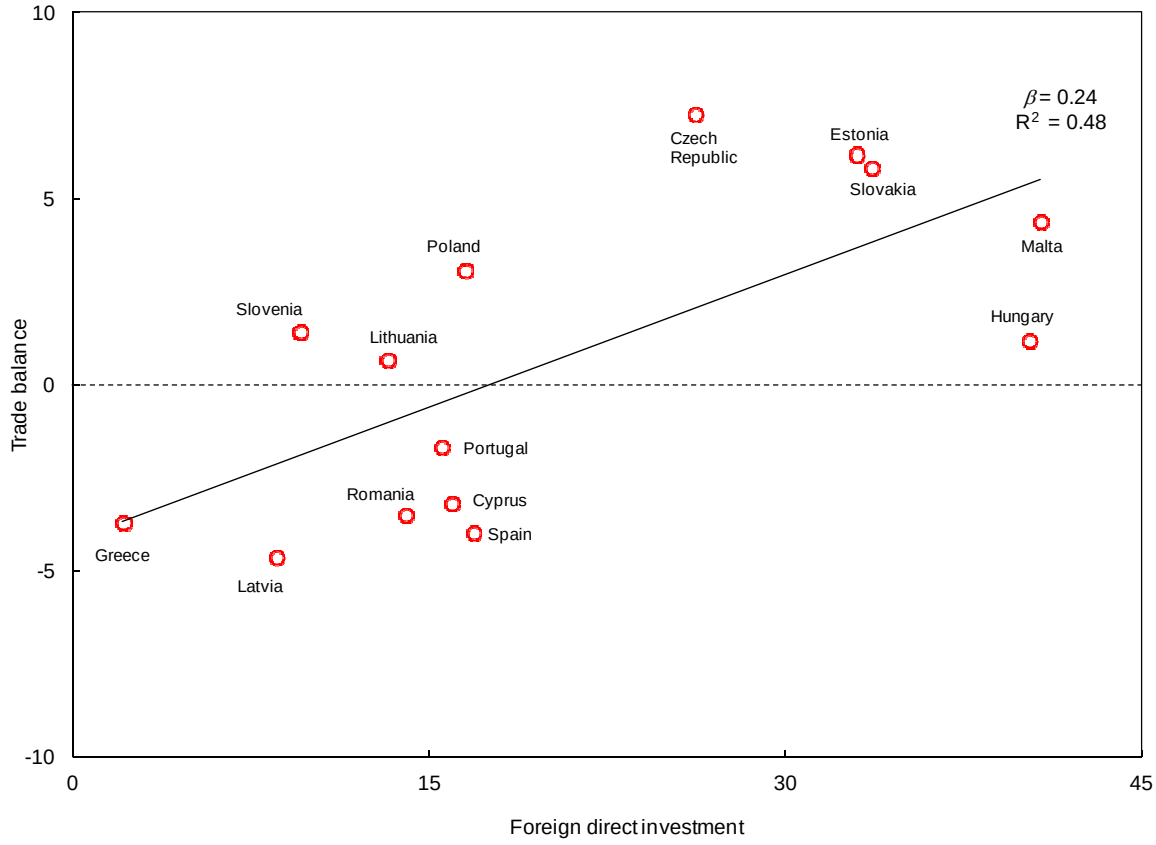


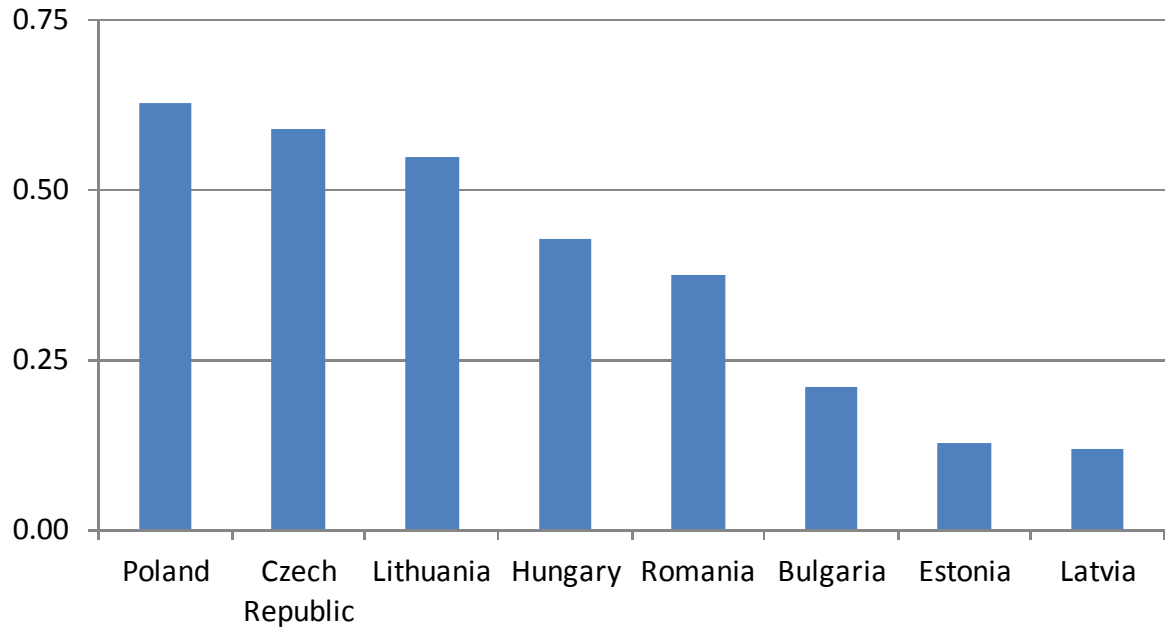
Figure 2: FDI Inflows Are Paying Off, 1998–2008[1]
(FDI and the trade balance in goods, change in percent of GDP)



Source: IMF *World Economic Outlook*, authors' calculations.

Note: [1] On the horizontal axis is the difference between the stock of net FDI-to-GDP ratio in 2001–2008 and 1996–1998. On the vertical axis is the difference between the average trade balance in goods as a ratio to GDP in 2001–2008 and 1996–1998. The simple linear regression implies that a 1-percentage-point increase in the stock of FDI corresponds to an improvement in the trade balance by about 0.2 percentage points.

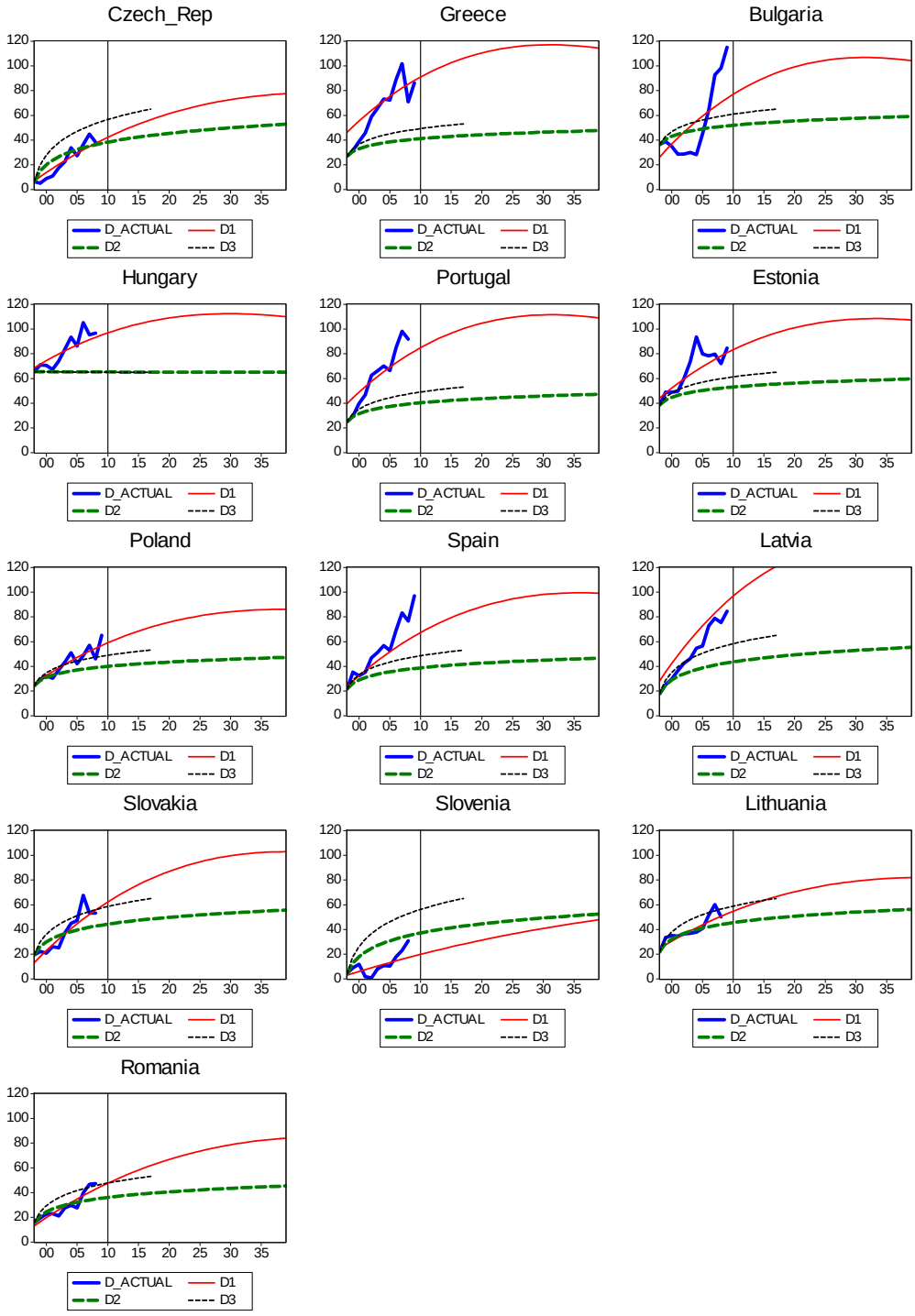
Figure 3: "Tradable FDI" as a Share of "Nontradable FDI," 2002–2008[1]



Source: National central banks. We are indebted to Esteban Vesperoni for sharing these series.

Note: [1] Tradable-sector FDI inflows are defined as those directed into manufacturing and tourism; nontradable-sector FDI is the residual. For Hungary, Poland, and Romania the series end in 2007. For Romania they start in 2004. The level of detail of the sectoral breakdown differed significantly across the sample.

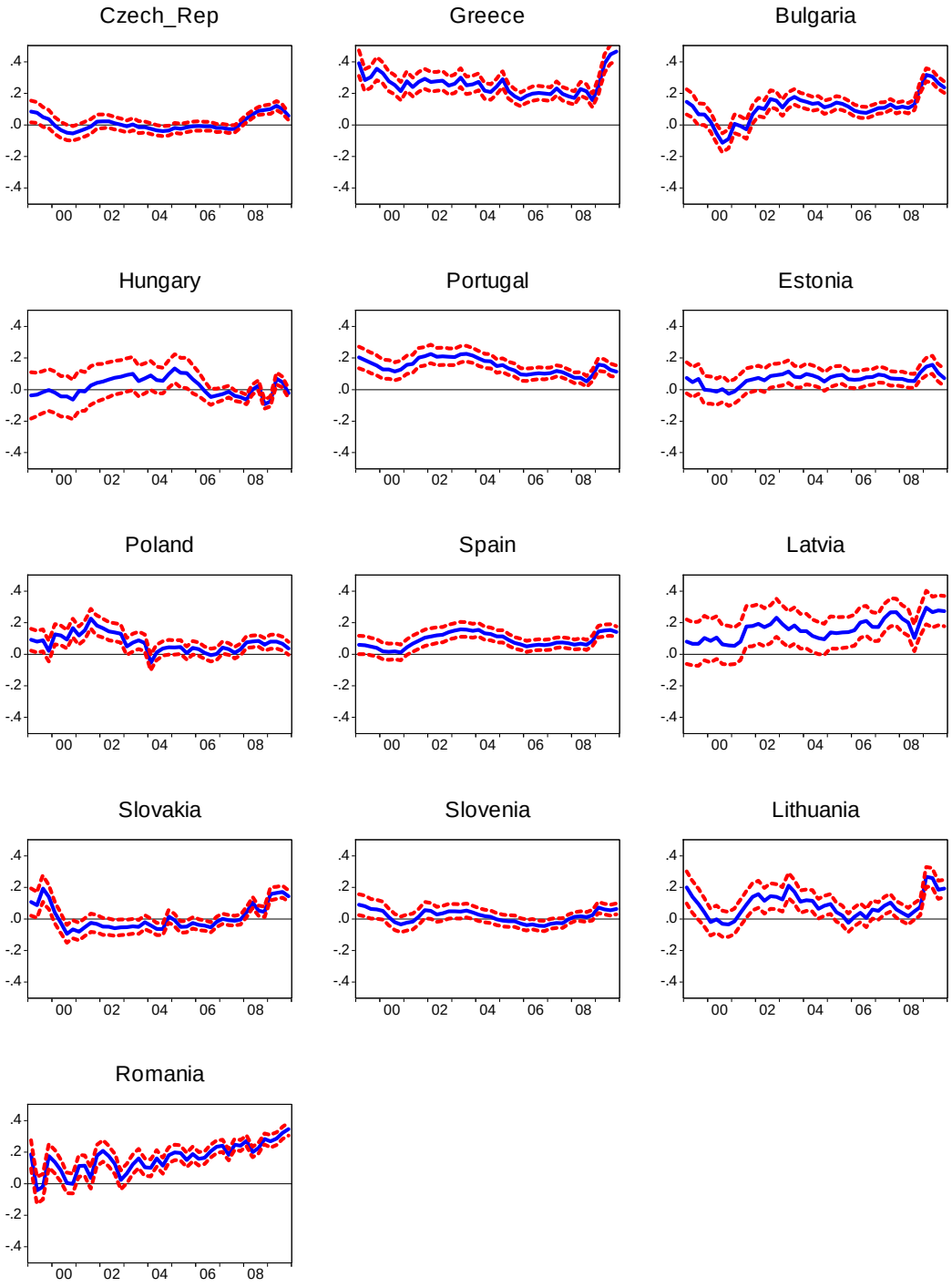
Figure 4: Net Foreign Debt: Actual and Simulated Trajectories, 1998–2039 (in percent of GDP)



Source: *International Financial* Statistics; authors' calculations

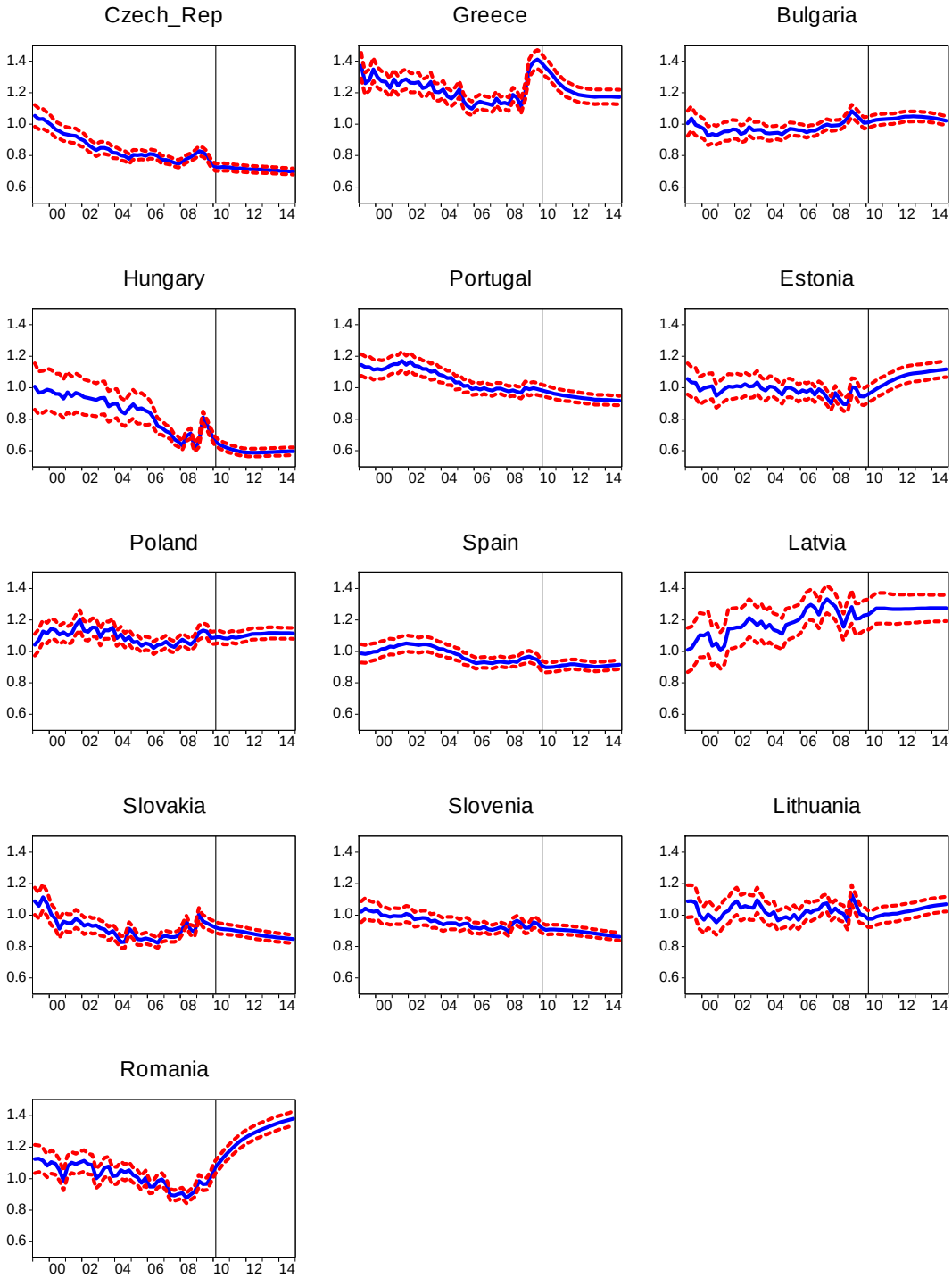
Notes: Actual data (D_ACTUAL); sustainable debt close to actual in 1998–2009 (D1); gradual convergence to the target (D2); and fast convergence to the target (D3). In countries with above-target net external debt, the D1 trajectory only gradually converges to the target.

Figure 5: Real Exchange Rate Misalignment, 1999–2009
(based on the panel estimates of the trade equations in Tables 2 and 3)



Notes: Values above/below the zero line indicate over/undervaluation of the national currency. Overvaluation is equivalent to excessive appreciation and, hence, a loss in external competitiveness. The blue middle line is the mean of the 11 scenarios described in the text; the upper and lower dashed lines show ±2 standard deviations.

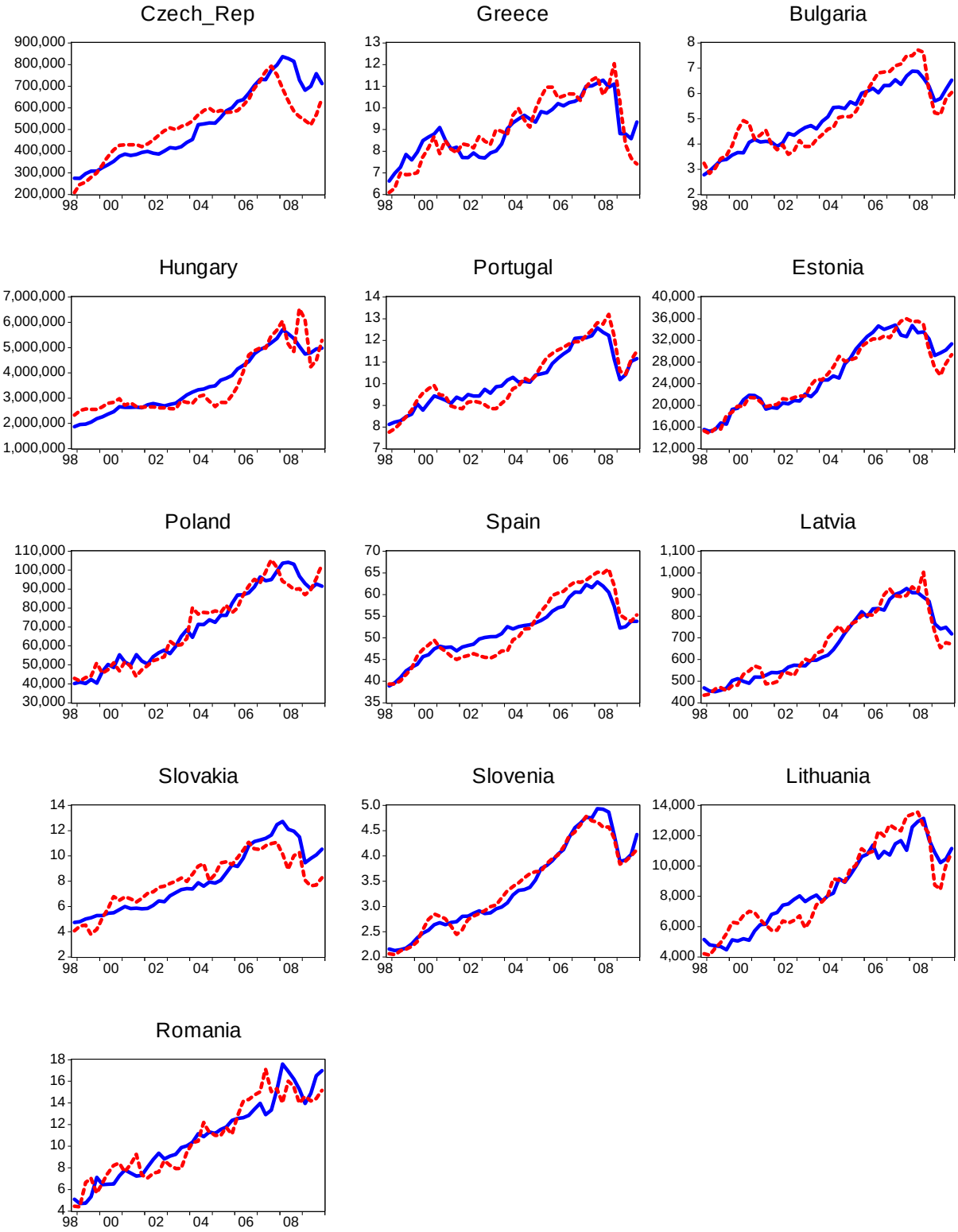
Figure 6: Projections of Sustainable Real Exchange Rates, 1999–2014 (based on the panel estimates of the trade equations in Tables 2 and 3)



Notes: Downward/upward sloping lines indicate sustainable appreciation/depreciation of the national currency. The blue middle line is the mean of the 11 scenarios described in the text; the upper and lower dashed lines show ±2 standard deviations.

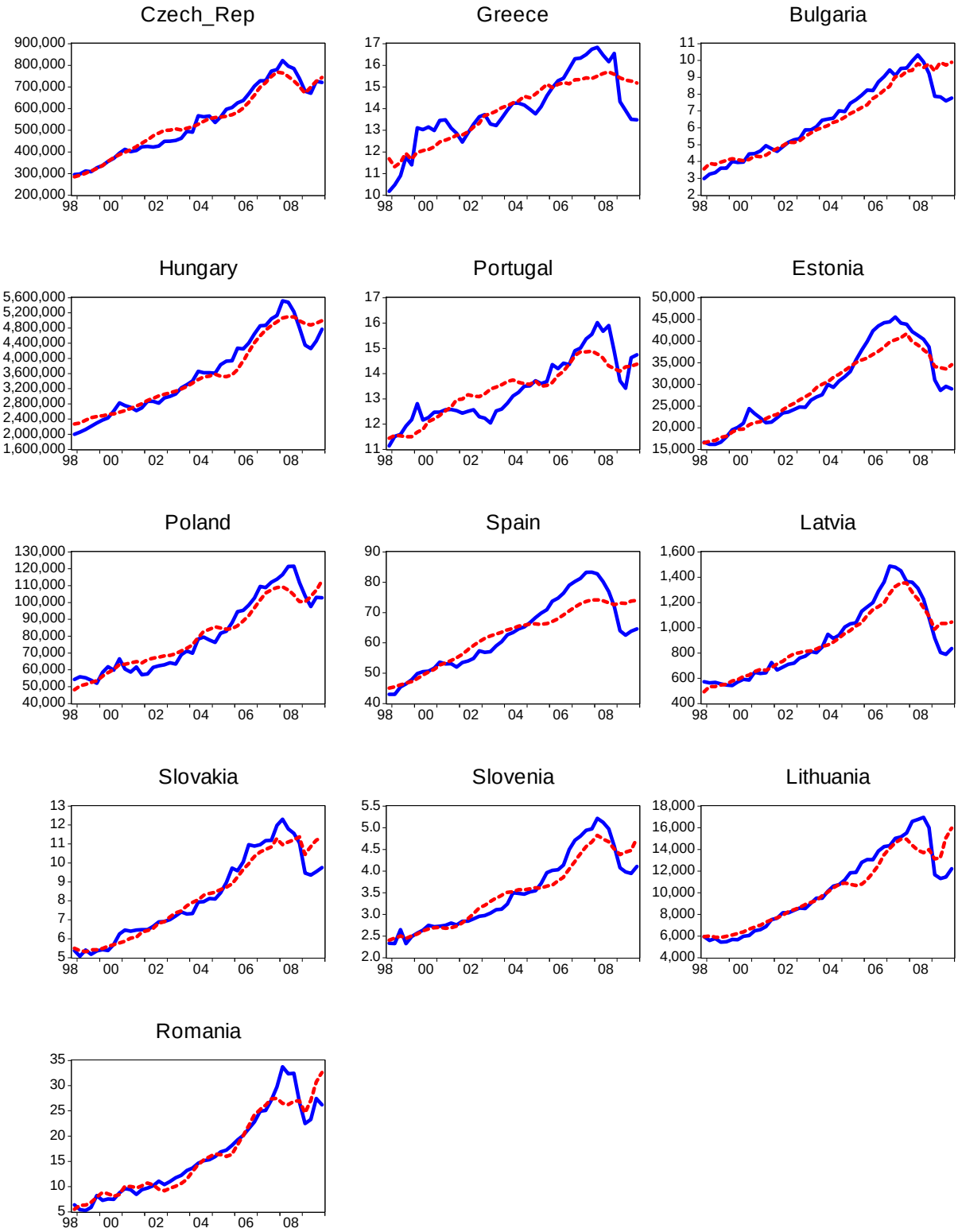
Appendix

Appendix I.1: Real Exports, 1998–2009, Actual (—) versus Estimated (- - -) Values



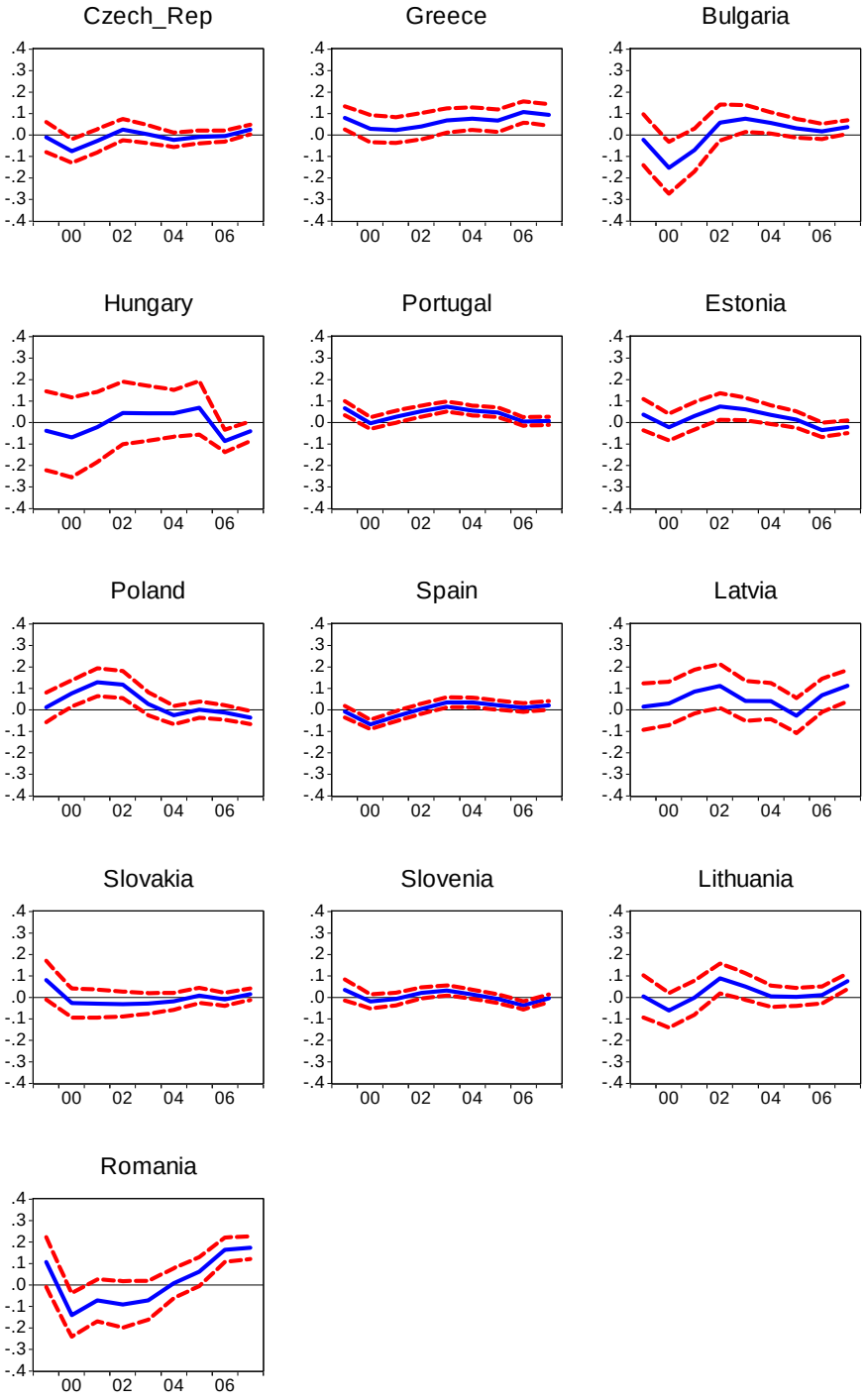
Note: Actual values show export volumes (XVOL). Estimated values are based on the main model, which uses estimates of demand and price elasticities on 1998q4–2007q4, country-specific FDI elasticities, and constant terms calibrated on 1998q4–2009q4.

Appendix I.2: Real Imports, 1998–2009, Actual (—) versus Estimated (- - -) Values



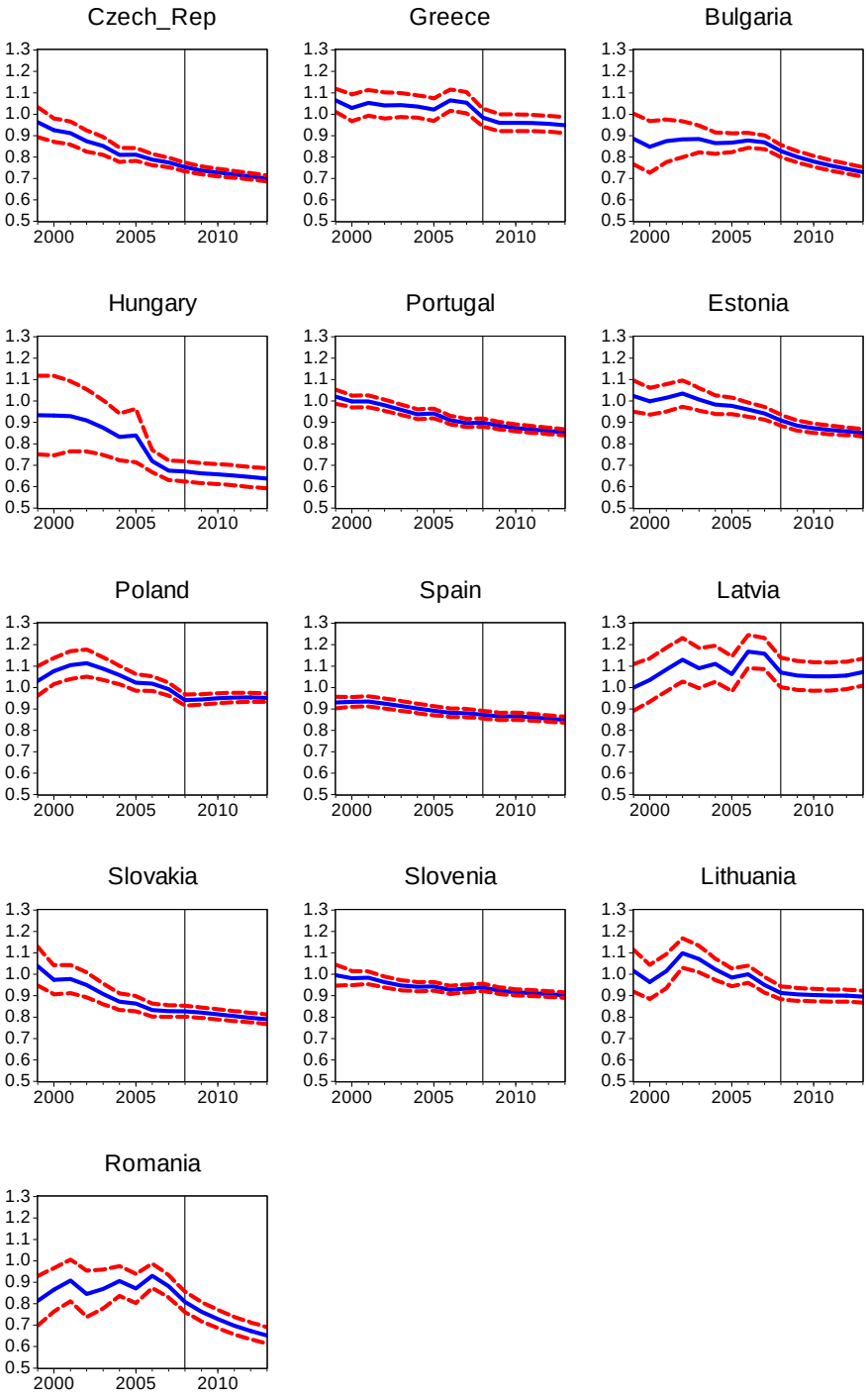
Note: Actual values show import volumes (MVOL). Estimated values are based on the main model, which uses estimates of demand and price elasticities on 1998q4–2007q4, country-specific FDI elasticities, and constant terms calibrated on 1998q4–2009q4.

Appendix I.3: Real Exchange Rate Misalignment, 1999–2007
(from Babecký, Bulíř, and Šmídková, 2009)



Notes: Values above/below the zero line indicate over/undervaluation of the national currency. Overvaluation is equivalent to excessive appreciation and, hence, a loss in external competitiveness. The blue middle line is the mean of the 22 scenarios; the upper and lower dashed lines show ±2 standard deviations.

Appendix I.4: Projections of Sustainable Real Exchange Rates, 1999–2013 (from Babecký, Bulíř, and Šmídková, 2009)



Notes: Downward/upward sloping lines indicate sustainable appreciation/depreciation of the national currency. Vertical lines denote 2008, when the SRER projections start. The blue middle line is the mean of the 22 scenarios; the upper and lower dashed lines show ±2 standard deviations.

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Czech National Bank
Economic Research Department
Na Příkopě 28, 115 03 Praha 1
Czech Republic
phone: +420 2 244 12 321
fax: +420 2 244 14 278
http://www.cnb.cz
e-mail: research@cnb.cz
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