Appendix to: Austerity in the Aftermath of the Great Recession*

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A Details on Estimation Method

A.1 Austerity and Economic Performance

Our main cross-sectional regression (ignoring controls) is

$$\frac{1}{5}\left(\sum_{t=2010}^{2014} \ln X_{i,t} - \ln \widehat{X}_{i,t}\right) = \alpha_0 + \alpha \frac{G_i}{Y_i}\frac{1}{5}\left(\sum_{t=2010}^{2014} \ln G_{i,t} - \ln \widehat{G}_{i,t}\right) + \varepsilon_{i,t}. \tag{A.1}$$

Here, $X_{i,t}$ refers to country i's economic performance at time t (GDP, inflation, consumption,...), and $\widehat{X}_{i,t}$ is its forecast. Note that for consumption and investment, we pre-multiply the left-hand side by X_i/Y_i, the share of consumption / investment in GDP, averaged over 2000 - 2010. Similarly, $G_{i,t}$ is a government finance variable for country i at time t (e.g. shortfalls in government purchases, shortfalls in govenment outlays, or government revenue). Denote the growth rate, defined as the change in logs, for any variable X by g^X. To construct our forecasts of $\ln X_{i,t}$ and $\ln G_{i,t}$ we only use data on the forecasted variable up to T_{cut} to construct forecasts for $t > T_{cut}$. For instance, in our benchmark estimation for government finance variables, we only use data of $G_{i,t}$ up to 2009 to construct forecasts up to 2014.

Using the definition of g, we can express the value of $\ln X_{i,t}$ as its value in $t = T_{cut}$ plus the cumulative growth rate between T_{cut} and t: $\ln X_{i,t} = \ln X_{i,T_{cut}} + \sum_{s=T_{cut}+1}^{t} g_{i,s}^X$. Now, let

$$\bar{g}_{i,2010:2014}^X = \frac{1}{5}\sum_{t=2010}^{2014}\sum_{s=T_{cut}+1}^{t} g_{i,s}^X$$

be country i's average multi-year growth rate of variable X. These mutli-year growth rates $\sum_{s=T_{cut}}^{t} g_{i,s}^X$ refer to the growth rate between the cutoff year T_{cut} and time t, with t being the years 2010 to 2014. Given this definition, we can rewrite the cross-sectional regression (A.1) as

$$\bar{g}_{i,2010:2014}^X - \widehat{\bar{g}}_{i,2010:2014}^X = \alpha_0 + \alpha\frac{G_i}{Y_i}\left(\bar{g}_{i,2010:2014}^G - \widehat{\bar{g}}_{i,2010:2014}^G\right) + \varepsilon_i.$$

Now, we discuss how we derive estimates of $\ln \widehat{X}_{i,t}$ and $\ln \widehat{G}_{i,t}$, and their corresponding estimated growth rates, $\hat{g}_{i,t}^X$ and $\hat{g}_{i,t}^G$.

A.2 Economic Performance

Our forecasting specification for GDP, consumption and investment is

$$\ln \widehat{X}_{i,t} = \begin{cases} \ln X_{i,t-1} + \hat{g}^X_{EU} + \hat{\gamma}^X \left(\ln \widehat{X}_{EU,t-1} - \ln X_{i,t-1} \right) & \forall t-1 \leq T_{cut} \\ \ln \widehat{X}_{i,t-1} + \hat{g}^X_{EU} + \hat{\gamma}^X \left(\ln \widehat{X}_{EU,t-1} - \ln \widehat{X}_{i,t-1} \right) & \forall t-1 > T_{cut}. \end{cases} \tag{A.2}$$

Here, $X_{i,t}$ is country i's GDP, consumption or investment at time t, and $\widehat{X}_{i,t}$ is its forecast. The specification takes last period's value of (the log of) $X_{i,t}$ and adds a country- and time-specific growth rate, which is composed of two parts: a common term capturing the average rate of growth of the core European countries, $\hat{g}^X_{EU}$, and a catch-up term that raises this growth rate for poorer countries and lowers it for richer countries, $\gamma \left(\ln \widehat{X}_{EU,t-1} - \ln X_{i,t-1} \right)$. Finally, T_{cut}, denotes the cutoff date. Only data up to T_{cut} is used to construct forecasts for $t > T_{cut}$.

This specification is based on the conditional convergence hypothesis. We assume that countries in Europe converge to a common path for GDP per capita. This can be justified on basis of the Single European Act (Article 158), which foresees economic cohesion across all member states as a central goal of the EU. Economic cohesion is typically interpreted as reducing disparities in GDP per capita. This convergence process especially affects our forecasts for Central and Eastern European countries, which, after strong economic growth in the 90s and 2000s, have reduced the gap to Western European countries. For instance, between 1995 and 2014, Estonia increased its GDP per capita from 30% to more than 60% of the EU-12 average.

Estimation of g^X_{EU}. In a first step, we estimate the growth rate g^X_{EU} on data from 1993:1 to 2005:4:

$$\ln X_{EU,t} = \beta_0 + g^X_{EU} t + \epsilon^X_{EU,t},$$

Here, X_{EU} is the aggregate of the 12 core European economies (Belgium, Denmark, Germany, Ireland, Spain, France, Italy, Luxembourg, Austria, Netherlands, Portugal and Finland). The estimate of g^Y_{EU} is 0.49 percent with a standard deviation of 0.01 percent, i.e. the average annual growth rate over this time period was about 2 percent. Note that this also gives a forecast of $\ln X_{EU,t}$ that is used in (A.2).

Estimation of γ^X. In a second step, we estimate the time-varying part of the growth rate. We assume that the time-varying part is a linear function of the log difference between the predicted EU-12 X and a country's X:

$$g_{i,t}^X - \hat{g}_{EU}^X = \gamma^X \left(\ln \widehat{X}_{EU,t-1} - \ln X_{i,t-1} \right) + \epsilon_{i,t}^X.$$

where $\ln \widehat{X}_{EU,t-1} = \hat{\beta}_0 + \hat{g}_{EU}^X (t-1)$. We estimate a common γ^X for all countries in Central and Eastern Europe (Bulgaria, Czech Republic, Estonia, Greece, Cyprus, Latvia, Lithuania, Hungary, Poland, Romania and Slovenia, Slovak Republic) using 1993:1 (or earliest available data) to 2005:4 as our sample period. Our estimate of γ^Y is 0.51 percent with a standard deviation of 0.05 percent. The positive γ indicates convergence.[1]

For future reference, we define the estimated growth rate of country i's X at time t as

$$\hat{g}_{i,t}^X = \begin{cases} \hat{g}_{EU}^X + \hat{\gamma}^X \left(\ln \widehat{X}_{EU,t-1} - \ln X_{i,t-1} \right) & \forall t-1 \leq T_{cut} \\ \hat{g}_{EU}^X + \hat{\gamma}^X \left(\ln \widehat{X}_{EU,t-1} - \ln \widehat{X}_{i,t-1} \right) & \forall t-1 > T_{cut}. \end{cases} \tag{A.3}$$

This is also our forecast for the growth rate of GDP used in our regression analysis.

Our forecasts for inflation, exchange rates and net exports are:

$$\widehat{X}_{i,t} = \frac{1}{8} \sum_{s=2008Q1}^{2009Q4} X_{i,s}$$

for dates t after 2009. Note that for these variables, we are using the absolute value instead of the log in regression (A.1).

[1] We repeat this two-step procedure to forecast private consumption and total investment. The estimated values for g and γ are 0.45 (0.01) percent and 0.71 (0.06) percent for private consumption, and 0.67 (0.03) percent and 1.17 (0.22) percent for total investment.

A.3 Austerity

We also use the 'convergence' estimator to predict the government finance variables (except for the primary balance). In particular, we construct our forecast as[2]

$$\ln \widehat{G}_{i,t} = \begin{cases} \ln G_{i,t-1} + \hat{g}^Y_{i,t} + \hat{\theta}^G \left(\ln Y_{i,t} - \ln \widehat{Y}_{i,t} \right) & \forall t-1 \leq T_{cut} \\ \ln \widehat{G}_{i,t-1} + \hat{g}^Y_{i,t} + \hat{\theta}^G \left(\Delta \ln Y_{i,t} - \Delta \ln \widehat{Y}_{i,t} \right) & \forall t-1 > T_{cut} \end{cases} \tag{A.4}$$

and θ^G is an (estimated / calibrated) elasticity of the government finance variable with respect to deviations of GDP from its trend.

The first part of our forecast adds a country- and time-specific growth rate $\hat{g}^Y_{i,t}$ to last year's actual realization of $\ln G_{i,t-1}$ (within sample) or last year's predicted value of $\ln G_{i,t-1}$ (out of sample). This growth rate $\hat{g}^Y_{i,t}$ is the estimated growth rate of country i's GDP per capita at time t, calculated as in (A.3), but using annual data for GDP.[3] We prefer using the growth rate of GDP instead of G in this step because countries strongly differ in terms of their ratios of government purchases, total outlays and total revenue to GDP. Economic cohesion in terms of GDP per capita is an explicit goal of the European Union, but the European Union does not try to achieve convergence in the level of all government finance variables.

The second part of our forecast, $\theta^G \left(\ln Y_{i,t} - \ln \widehat{Y}_{i,t} \right)$, adjusts for deviations of GDP from its trend. This is particularly relevant for government revenue variables. We either estimate θ^G or use values from the literature discussed in the main body of the text.

Our forecast for the growth rate of G is therefore composed of three parts:

$$\hat{g}^G_{i,t} = \begin{cases} \hat{g}^Y_{EU} + \hat{\gamma}^Y \left(\ln \widehat{Y}_{EU,t-1} - \ln Y_{i,t-1} \right) + \hat{\theta}^G \left(\ln Y_{i,t} - \ln \widehat{Y}_{i,t} \right) & \forall t-1 \leq T_{cut} \\ \hat{g}^Y_{EU} + \hat{\gamma}^Y \left(\ln \widehat{Y}_{EU,t-1} - \ln \widehat{Y}_{i,t-1} \right) + \hat{\theta}^G \left(\ln Y_{i,t} - \ln \widehat{Y}_{i,t} \right) & \forall t-1 > T_{cut}. \end{cases}$$

Estimation of θ^G: To estimate θ^G, we use two approaches. In the first approach (our benchmark approach), we regress our forecast error of $\ln G_{i,t}$ based on a forecast that ignores

[2]Note the presence of Δ in the out-of-sample forecast. Abstracting from $\hat{g}^Y_{i,t}$, we forecast $\ln G_{i,t}$ to equal $\ln G_{i,t-1}$ if the GDP deviation from trend, $\ln Y_{i,t} - \ln \widehat{Y}_{i,t}$, remains unchanged relative to its value in $t-1$. If the GDP deviation from trend goes up, we adjust our estimate of $\ln G_{i,t}$ upward (if $\theta^G > 0$).

[3]The estimated values for g and γ are 1.89 percent and 2.32 percent.

the GDP adjustment on the deviations of GDP from its trend:

$$\ln G_{i,t} - \ln G_{i,t-1} - \hat{g}^Y_{i,t} = \theta^G_{0,i} + \theta^G \left(\ln Y_{i,t} - \ln \widehat{Y}_{i,t} \right) + \epsilon^\theta_{i,t} \tag{A.5}$$

This is estimated on data up to 2005.

In the second approach, we construct average multi-year growth rates of GDP and G for 5-year windows:

$$\bar{g}^Y_{i,t:t+4} = \frac{1}{5} \sum_{r=t}^{t+4} \sum_{s=T_{cut}(t)}^{r} g^Y_{i,s},$$

where we adjust the cutoff-year T_{cut} accordingly.[4] Then, we estimate the regression

$$\bar{g}^G_{i,t:t+4} - \widehat{\bar{g}}^Y_{i,t:t+4} = \theta^G_{0,i} + \theta^G \left(\bar{g}^Y_{i,t:t+4} - \widehat{\bar{g}}^Y_{i,t:t+4} \right) + \varepsilon^\theta_{i,t}. \tag{A.6}$$

on data up to $t = 2001$.

B Additional Empirical Results

B.1 Austerity and GDP for Different Subsamples

Tables A2a and A2b rerun the regressions underlying Table 2 without the inclusion of Greece and the GIIPS countries. In both cases the coefficient on the shortfall of government purchases without any controls (column 1) and the coefficient in our preferred specification (column 11) remains around and slightly above 2.

B.2 Additional Scatter Plots

Figures A3a - A3d illustrate the results from regression (2.5) for private consumption, investment, the nominal effective exchange rate and the growth rate of GDP. The specification is the same as the one used for Figure 3a and shows both the empirical results (a) and the results from the simulated data (b).

[4] If we choose the cutoff year $T_{cut} = 2009$ in (A.1), then the cutoff-year for the window stretching $t = 1990$ to $t + 4 = 1994$ would be $T_{cut}(1990) = 1989$.

B.3 Fiscal spillovers

To analyze whether a shortfall in government purchases affects output in neighboring countries, we follow the approach taken in Auerbach and Gorodnichenko (2012). Specifically, we estimate the following regression

$$\tilde{X}_{i,2010-2014} = \alpha_0 - \alpha \times Gshock_i - \alpha^* \times Gshock_i^* + \varepsilon_i, \tag{B.1}$$

where $Gshock_i$ is a measure of country i's domestic government spending and $Gshock_i^*$ is a measure of government spending spillovers to country i. Specifically, $Gshock_i$ is defined as

$$Gshock_i = dom_i \tilde{G}_{i,2010-2014}$$

and $Gshock_i^*$ is country i's spillover shock:

$$Gshock_i^* = \sum_{j \neq i}^{N} imp_j^i \frac{Y_j}{Y_i} \tilde{G}_{j,2010-2014}.$$

Country i's domestic austerity shock $Gshock_i$ is the average forecast residual of government purchases G_i, expressed in percent of domestic GDP. In contrast to our baseline regression (2.5), we multiply this austerity shock by dom_i, which is country i's share of final demand that is accounted for by domestic production:

$$dom_i = 1 - \frac{Imp_i}{C_i + I_i + G_i},$$

where Imp_i are country i's imports, and C_i, I_i and G_i are its consumption, investment and government purchases. This corrects for countries' trade openness and captures the idea that domestic fiscal shocks 'leak out' to other economies if a large share of final demand is satisfied by imports.

Similarly, country i's spillover shock $Gshock_i^*$ is the sum of all other countries' austerity shocks, expressed in terms of i's GDP and multiplied by a scaling factor, imp_j^i. This scaling factor is calculated as the share of country j's final demand that is satisfied by imports from country i:

$$imp_j^i = \frac{Imp_j^i}{C_j + I_j + G_j},$$

where Imp_j^i denotes j's imports from i. The scaling factor captures country i's exposure to changes in country j's final demand. By introducing this scaling factor, we implicitly assume that a country's GDP response to a €1 reduction in government purchases in another country scales with its exports to that country. The scaling factor corrects for the observed heterogeneity in trade linkages across countries in our sample.[5] This specification distributes the effects of fiscal austerity in country i across its trading partners and to the domestic economy because $dom_i + \sum_{j \neq i}^{N} imp_i^j = 1$. Data on the domestic share, dom_i, and the import shares, imp_j^i, are taken from the OECD Trade in Value Added database, as explained in section 3.7.

Figure A4 illustrates the spillover effect of government purchase shortfalls on GDP in the cross-section. For the moment, we focus on the left panel, which displays the actual data. The vertical axis of the scatter plot displays the part of the average forecast residual for GDP (the dependent variable in regression (B.1) that cannot be explained by domestic government purchases shocks, $Gshock$, in log points times 100. The horizontal axis displays the spillover shock, $Gshock^*$, in the same units as the GDP forecast residual. For example, the value 0.5 on the horizontal axis is a *reduction* in foreign government purchases, scaled by the export share, corresponding to 0.005 log points of GDP.

Spillover shocks are relatively modest compared to domestic shocks. Despite strong reductions in government purchases across many countries, no country in our sample received a spillover shock exceeding one percent of its GDP. Indeed, spillover shocks are about a magnitude smaller than domestic shocks for most countries. One reason is that export shares, $\sum_{j \neq i}^{N} imp_j^i$, are somewhat smaller than the domestic shares, dom_i. Countries are therefore less exposed to foreign government purchases shocks than to domestic government purchases shocks. Another reason is that exports are naturally diversified, so that positive and negative spillover effects from different export markets cancel each other out. Overall, spillover shocks were negative over the sample period, meaning that all countries faced decreased government purchases in their export markets. Particularly hit were small countries exposed to large, austere countries such as Italy, Spain, France and the United Kingdom. This group comprises Luxembourg, Ireland and Cyprus. On the other end of the spectrum are countries with small export exposure, such as the United States, Italy and Greece, or countries like Latvia, which

[5] One difference between our analysis and the analysis in Auerbach and Gorodnichenko (2012) is that our scaling factor is imports as a share of total economic activity while their's is imports as a share of total government purchases.

mainly exports to Northern European markets and Germany. Formal regressions of equation (B.1) confirm that austerity in export markets has little or no impact on economic activity at home (see Table A3). Our results are in contrast to Auerbach and Gorodnichenko (2012) who find strong and statistically significant positive spillover effects for the period before the great recession.[6]

Figure A4 also compares the spillover regression B.1 in the data to the same regression on simulated data from the model. Compared to the data, the model suggests modest spillover effects of fiscal austerity on trading partners. The difference in the predicted shortfall of GDP between Ireland, which saw reductions of government purchases in its export markets of the order of 0.8 percent of its own GDP, and Greece, for which this figure is smaller than 0.3 percent, is less than 2 percentage points. Whereas the implied "multiplier" on foreign government purchases shocks is around 4 and non-negligible, there is too little variation in these shocks across countries to account for a large fraction of the observed cross-sectional variation in GDP performance. More importantly, the spillover regression on the simulated data produces a fairly noisy estimate, which suggests that direct trade linkages as they are incorporated in our measure of the foreign government purchases shocks are not the only factor in explaining the transmission of fiscal shocks across countries.

B.4 Additional Government Finance Variables

Here, we present additional empirical results based on the estimation equation (A.1). We do not include any controls and report the estimates for α for the entire sample, as well as for the subsamples of fixed and floating exchange rates. Results are reported for various government finance variables: shortfall in government purchases (Table A5a), total government outlays (measured as the sum of government purchases and social benefits and excluding interest and debt payments, Table A5b), the government primary balance (measured as government revenue less government expenditure net of net government interest payments, and expressed in percent of nominal GDP; Table A5c), total government revenue (Table A5d), the VAT rate (Table A5e)[7], the statutory income tax rate (Table A5f) and the statutory corporate

[6] Our results cannot be directly compared because we use a different data sample and different forecasting methods, and we also use a different scaling factor imp_j^i on the austerity shocks. Using the same scaling factor as in Auerbach and Gorodnichenko (2012), our coefficients remain statistically insignificant.

[7] We derive changes in VAT rates from the difference of two consumer price indices: the Harmonized Index of Consumer Prices and the Harmonized Index of Consumer Prices at Constant Taxes. Differences in these indices can be attributed to changes in tax rates on consumer goods (mostly VAT). One advantage of this approach is that it covers all types of consumption tax changes, in both standard and reduced VAT rates,

tax rate (Table A5g). Note that we omit the term G_i/Y_i in regression (A.1) for the primary balance and all tax rates. The analyzed economic performance measures include all measures discussed in the main body of the text, plus the unemployment rate and the debt-to-GDP ratio (both forecasted using the unit root forecast (A.2); the debt-to-GDP ratio is measured as end-of-2009 nominal government debt over 2005 nominal GDP).

C Structural Shocks in Model

C.1 Government Spending Shocks

In our empirical section we estimate deviations for government finance variables from their forecasts constructed from annual data. In the quantitative analysis, we treat those deviations as shocks and feed them into our model. The model, however, is calibrated at quarterly frequency. We use the Chow-Lin method to transform our predicted annual government spending series to quarterly series. As auxiliary high-frequency indicators we solely rely on real, quarterly GDP. Adding quarterly unemployment rates would barely affect the resulting time-series and the estimated coefficients are most of the time statistically non-significant. We estimate the model with maximum likelihood. The government spending shocks that we feed into our model are then the deviations of actual quarterly government spending data from their predicted quarterly levels.

C.2 Monetary Policy Rules

We measure monetary policy shocks as deviations of the central bank interest rates from a monetary policy rule. These deviations are calculated for each country with an independent monetary policy[8] (Czech Repbulic, Hungary, Poland, Romania, Sweden, United Kingdom, Norway, Switzerland and the United States) as well as the ECB.

Here, we present results for various different specifications of monetary policy rules. Eventually, we retain the generalized Taylor rule specification proposed by Clarida, Gali and Gertler

and weights those changes by the weight of the consumption good in the overall consumption basket. We index these changes in the tax rates to the observed statutory standard VAT rate as observed in 2014 in each country (see Data Appendix for sources). A few countries do not publish a price index at constant taxes for the entire time period we are interested in. In those cases, we approximate changes in the VAT by changes in the statutory standard VAT rate (mostly Norway and Switzerland). For the US, we assume that the VAT rate has not changed in the over the sample period and set it equal to 8.5 percent.

[8]This includes all countries with central banks that were free or managed floaters or whose monetary policy followed a wide crawling peg, according to the classification in Itzetzki, Reinhart and Rogoff (2004).

(1997).

C.2.1 Specifications

Simple Taylor rule

$$i_t = \pi_t + r + \phi_\pi \left(\pi_t - \pi^{tar}\right) + \phi_{GDP}\%GDP_t + \epsilon_t$$

where i_t is the nominal interest rate, r is the long-run real interest rate, π_t is inflation measured by the GDP deflator, π^{tar} is the inflation target, $\%GDP_t$ are percent deviations of real GDP from its trend (output gap), and ϵ_t is an error term.

In the original Taylor rule, the parameters are set to $r = 2$ and $\pi^{tar} = 2$, and the estimated coefficients are $\phi_\pi = 0.5$ and $\phi_{GDP} = 0.5$. Bernanke (2015)[9] suggests to use core inflation as a measure of π and sets $\phi_{GDP} = 1$.

Generalized Taylor rule Clarida, Gali and Gertler (1997) (henceforth CGG) propose a generalized Taylor rule that allows for interest rate smoothing:[10]

$$i_t = \rho i_{t-1} + (1-\rho)\left[\pi_t + r + \phi_\pi \left(\pi_t - \pi^{tar}\right) + \phi_{GDP}\%GDP_t\right].$$

Their estimates are $\rho = 0.79$, $\phi_\pi = 1.15$ and $\phi_{GDP} = 0.93$. They don't provide an estimate for the intercept or r.

Mankiw rule

$$i_t = \phi + \phi_{\pi,u}(\pi_t - u_t) + \epsilon_t,$$

where i_t is the nominal interest rate, π_t is core inflation, u_t is unemployment, and ϵ_t is an error term. Mankiw estimates $\phi = 8.5$ and $\phi_{\pi,u} = 1.4$.

C.2.2 Estimation

For all specifications, interest rates, inflation and the unemployment rate are measured in annual percent. For the US, we estimate three different rules: A simple Taylor rule, a generalized Taylor rule as in CGG, and a Mankiw rule. For the euro area and all countries with

[9] see http://www.brookings.edu/blogs/ben-bernanke/posts/2015/04/28-taylor-rule-monetary-policy

[10] In addition, their rule depends on expected inflation and the expected output gap instead of contemporaneous inflation and output gap. Their β coefficient corresponds to $1 + \phi_\pi$ in our setup.

floating exchange rates, we us the slope coefficients ϕ from the regressions and estimate a new intercept. We always impose that inflation targets a rate of 2%.[11]

Taylor rule Starting from the generalized Taylor rule

$$i_t = \phi_i i_{t-1} + (1-\phi_i)\left[\pi_t + r + \phi_\pi \left(\pi_t - \pi^{tar}\right) + \phi_{GDP}\%GDP_t + \epsilon_t\right],$$

our estimation equation is

$$\frac{i_t - \phi_i i_{t-1}}{1-\phi_i} - \pi_t = \beta_0 + \beta_1 \left(\pi_t - \pi^{tar}\right) + \beta_2 \%GDP_t + \epsilon_t. \tag{C.1}$$

Our estimates for r, ϕ_π and ϕ_{GDP} are $\hat{\beta}_0$, $\hat{\beta}_1$ and $\hat{\beta}_2$. In our estimation approach, we set $\phi_i = 0$ for the original Taylor rule and $\phi_i = 0.79$ for the CGG specification.

When we only estimate the intercept, the estimation equation is

$$\frac{i_t - \phi_i i_{t-1}}{1-\phi_i} - \pi_t - \hat{\phi}_\pi \left(\pi_t - \pi^{tar}\right) - \hat{\phi}_{GDP}\%GDP_t = \beta_0 + \epsilon_t \tag{C.2}$$

Mankiw rule Our estimation equation for the Mankiw rule is

$$i_t = \beta_0 + \beta_1(\pi_t - u_t) + \epsilon_t. \tag{C.3}$$

Our estimates for ϕ and $\phi_{\pi,u}$ are $\hat{\beta}_0$ and $\hat{\beta}_1$.

When we only estimate the intercept, the estimation equation is

$$i_t - \hat{\phi}_{\pi,u}(\pi_t - u_t) = \beta_0 + \epsilon_t. \tag{C.4}$$

Data and estimation periods Data on the central bank interest rates, i_t, directly comes from the central banks' websites (see the Data Appendix for more details). Data sources for the inflation rate, π_t and the unemployment rate u_t are explained in the Data Appendix. The output gap, $\%GDP_t$, is measured as the percent deviation of GDP from its potential GDP. Data on potential GDP for the US comes from the Gongressional Budget Office. For

[11]Unless we make further restrictions, we cannot estimate r and π^{tar} separately, so we fix one of the two parameters prior to the estimation. CGG assume that r equals its average value of their estimation period and then estimate π^{tar}. They do not report their estimate of r. Their estimate of π^{tar} is 3.56. Here, we us the alternative approach of fixing $\pi^{tar} = 2$ and estimate r for every specification, including the original CGG specification.

all other countries, we rely on annual data published by AMECO and the OECD. We linearly interpolate the log of potential GDP to obtain quarterly estimates.

The estimation periods are as follows. USA: 1985Q1 - 2005Q4, Eurozone: 1999Q2 - 2005Q4, Czech Republic: 2000Q2 - 2005Q4, Hungary: 2002Q2 - 2005Q4, Poland: 2002Q2 - 2005Q4, Romania: 2003Q2 - 2005Q4, Sweden: 1994Q3 - 2005Q4, UK: 1985Q1 - 2005Q4, Norway: 1991Q2 - 2005Q4, Switzerland: 1991Q1 - 2005Q4.

Tables A6 and A7 display the estimated coefficients for the US Monetary policy and the intercepts for all central banks in our sample.

C.3 Spread Shocks

Our measure of financial shocks comes from data on spreads between lending rates and central bank interest rates.

Data on interest rates on business loans mainly comes from the ECB, but has been complemented by additional sources. The ECB reports monthly interest rates for new business loans with up to 1 year original maturity to non-financial corporations in domestic currency (e.g. MIR.M.AT.B.A2A.F.R.0.2240.EUR.N for Austria - AT). For countries accessing the euro area over the sample period, we try to use loans in domestic currency up to the year they access the euro area, and then switch to loans in euros. For some countries (e.g. Bulgaria, Estonia, Cyprus, Malta, Slovak Republic, Sweden, UK, Norway and Switzerland) we used national bank data sources to append the data series (or replace them if missing). For a few countries, we used data from the Fixed Income Global Financial Database to append the data series.[12] Finally, US data comes from the Federal Reserve Survey of Terms of Business Lending, where we use the weighted-average effective loan rate for all commercial and industry loans.

For central bank interest rates, we use the central banks' main policy rates. For countries accessing the euro area over the sample period, we use the national central bank's interest rate up to the year they access the euro area.[13] The Data Appendix lists all data series used to calculate the spread shocks.

[12] We checked that the GFD data tracks reasonably well our preferred interest rate series for time periods with overlap.

[13] In our model, we assign those countries directly to the euro area, ignoring the fact that in the beginning of the sample period they had an independent monetary policy.

D Non-Targeted Steady-State Shares

Figure A7 displays the non-target steady-state shares of net exports to final demand, NX_n/Y_n, and investment to final demand, X_n/Y_n. It compares the average shares observed in the data over 2000 - 2010 to the model-implied shares. The correlation between model and data is 0.9975 for net exports. This is a surprisingly high correlation because the net export shares in the model are derived from parameters calibrated using data for 2005 and 2010 only: Net export shares in the model are functions of the trade preference parameters ω_n^j and relative country sizes $\mathbf{N}_n Y_n$, both of which are calibrated using input-output tables and the trade in value added database covering the years 2005 and 2010. The correlation between model and data for investment is substantially lower, but still positive: 0.53. The depreciation rate is calibrated so that the average investment shares in data and model match each other. Three features of the model create dispersion in investment shares: cross-country differences in net export positions NX_n/Y_n, cross-country differences in the external finance premium F_n, and cross-country differences in the taxation of capital income, τ_n^K. The figure suggests that the model underpredicts investment shares of countries in Central and Eastern Europe such Bulgaria, Romania and Latvia, but overpredicts investment shares of most advanced countries like Luxembourg, Norway and Great Britain. The high investment shares in Central and Eastern Europe might indicate a catching up process towards the European core countries that we ignore in our model.

E Sticky Wages

In our robustness analysis, we introduce sticky wages. To do so, we follow the treatment by Erceg, Henderson and Levin (2000) and Christiano, Eichenbaum and Evans (2005) by assuming that the household supplies labor to firms through unions that have some market power. Specifically, we assume that *effective* labor is a CES mix of different labor types. These labor types are aggregated by aggregation firms that then supply the labor aggregate to the firms at a nominal wage of $W_{n,t}$. Effective labor is given by

$$L_{n,t} = \left(\int_0^1 l_{n,t}\left(z\right)^{\frac{\psi_l - 1}{\psi_l}} \, dz \right)^{\frac{\psi_l}{\psi_l - 1}}$$

where $L_{n,t}$ is the effective amount of labor supplied to the firms in country n at time t and $l_{n,t}(z)$ is the amount of type s labor supplied. The parameter $\psi_l > 1$ governs the degree to which different labor types are substitutable. The labor aggregating firm behaves competitively and supplies effective labor to the firms at the flow nominal wage $W_{n,t}$ but hires labor by type according to the type-specific nominal wages $w_{n,t}(z)$. Demand for each labor type is

$$l_{n,t}(z) = L_{n,t}\left(\frac{w_{n,t}(z)}{W_{n,t}}\right)^{-\psi_l} \tag{E.1}$$

and the competitive aggregate nominal wage in country n at time t is

$$W_{n,t} = \left(\int_0^1 w_{n,t}(z)^{1-\psi_l}\,dz\right)^{\frac{1}{1-\psi_l}}.$$

Wages for each type of labor are set by monopolistically competitive worker-types. Given the elasticity of demand $-\psi_l$, workers desire a real wage $(1-\tau_n^L)w_{n,t}(z)/P_{n,t}$ which is a constant markup over the marginal rate of substitution between consumption and leisure, $-U_{2,n,t+j}/U_{1,n,t+j}$ (i.e., the competitive wage). The desired markup is $\mu_w = \frac{\psi_l}{\psi_l-1} > 1$.

As in Erceg, Henderson and Levin (2000), we model sticky wages with a Calvo mechanism. Let θ_w be the probability that a worker cannot reset his or her wage in a given period. Whenever possible, workers reset wages to maximize the utility of the representative household in country n. The marginal benefit of additional money at time $t+j$ is $\frac{C_{n,t+j}^{-\frac{1}{\sigma}}}{(1+\tau_n^C)P_{n,t+j}}$ and the marginal disutility to the representative household from supplying additional labor is $\kappa_n L_{n,t+j}^{\frac{1}{\eta}}$. Workers take the demand curve (E.1) as given whenever they can choose a new reset wage. Denote the optimal reset wage in country n at time t as $w_{n,t}^*$. The optimal reset wage satisfies

$$w_{n,t}^* = \frac{\psi_l}{\psi_l-1}\frac{-\sum_{j=0}^{\infty}(\theta_w\beta)^j\sum_{s^{t+j}}\pi(s^{t+j}|s^t)L_{n,t+j}W_{n,t+j}^{\psi_l}\kappa_n L_{n,t+j}^{\frac{1}{\eta}}}{\sum_{j=0}^{\infty}(\theta_w\beta)^j\sum_{s^{t+j}}\pi(s^{t+j}|s^t)L_{n,t+j}W_{n,t+j}^{\psi_l}(1-\tau_n^L)\frac{C_{n,t+j}^{-\frac{1}{\sigma}}}{(1+\tau_n^C)P_{n,t+j}}}. \tag{E.2}$$

Given (E.2), the nominal wage for effective labor evolves according to

$$W_{n,t} = \left[\theta_w\left(W_{n,t-1}\right)^{1-\psi_l} + (1-\theta_w)\left(w_{n,t}^*\right)^{1-\psi_l}\right]^{\frac{1}{1-\psi_l}}.$$

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Table A1a: Summary Statistics of Forecast Deviations: Government Finance Variables

	Gov't. Purchases	Total Outlays	Primary Balance	Total Revenue	VAT	Income Tax Rate	Corporate Tax Rate
Average	−10.88	−9.99	0.51	0.10	1.55	0.92	−0.72
Std. deviation	9.04	7.53	3.33	3.80	1.53	4.99	2.65
			Correlation matrix				
Gov't. Purchases	1.00						
Total Outlays	0.95	1.00					
Primary Balance	−0.25	−0.28	1.00				
Total Revenue	−0.08	0.13	−0.07	1.00			
VAT	−0.72	−0.82	0.37	−0.05	1.00		
Income Tax Rate	−0.35	−0.20	−0.13	0.39	−0.06	1.00	
Corporate Tax Rate	0.31	0.36	−0.13	−0.08	−0.43	−0.14	1.00

Notes: Table displays statistics of the log-difference (*100) between the actual time series and the forecast, averaged over 2010 - 2014, for government purchases, total outlays, total revenue, the primary balance, the VAT, the personal income tax rate and the corporate tax rate. The first row displays the average of this difference across countries; the second row displays the standard deviation across countries. The remaining rows display the correlation across the various measures.

Table A1b: Summary Statistics of Forecast Deviations: Economic Performance Variables

	GDP	Inflation	Consumption	Investment	NX to GDP	Exchange Rate	GDP Growth	Unemployment	Debt to GDP
Average	−4.53	−1.31	−6.33	−13.45	3.70	−1.29	−1.72	9.94	16.91
Std. deviation	6.50	1.72	6.75	18.51	3.81	4.90	2.10	4.71	14.57
				Correlation matrix					
GDP	1.00								
Inflation	0.25	1.00							
Consumption	0.90	0.15	1.00						
Investment	0.95	0.31	0.87	1.00					
NX to GDP	−0.46	−0.56	−0.59	−0.55	1.00				
Exchange Rate	0.25	−0.09	0.34	0.29	−0.16	1.00			
GDP Growth	0.97	0.25	0.86	0.92	−0.46	0.25	1.00		
Unemployment	−0.53	−0.32	−0.56	−0.59	0.58	−0.17	−0.49	1.00	
Debt to GDP	−0.40	0.08	−0.43	−0.54	0.42	−0.34	−0.33	0.64	1.00

Notes: Table displays statistics of the log-difference (*100) between the actual time series and the forecast, averaged over 2010 - 2014, for GDP, inflation, consumption, investment, net exports over GDP, the nominal effective exchange rate, real per capita GDP growth, unemployment and the debt-to-GDP ratio. The first row displays the average of this difference across countries; the second row displays the standard deviation across countries. The remaining rows display the correlation across the various measures.

Table A2a: Austerity and GDP: Without Greece

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Gov't. Purchases	−2.68	−2.60	−2.16	−2.66	−2.53	−1.96	−2.52	−2.00	−2.17	−1.75	−2.15
	(0.33)	(0.30)	(0.31)	(0.33)	(0.31)	(0.52)	(0.31)	(0.29)	(0.30)	(0.46)	(0.30)
Total Revenue		−1.12						−0.96	−0.82	−0.58	−0.79
		(0.50)						(0.41)	(0.44)	(0.46)	(0.50)
TFP			0.42					0.44	0.33	0.34	0.36
			(0.12)					(0.11)	(0.13)	(0.12)	(0.13)
HH Debt to GDP				0.01				0.03			
				(0.02)				(0.02)			
Credit Spread 2010-2014					−1.04				−0.31		
					(0.44)				(0.45)		
Gov't. Bond Rate						−0.83				−0.53	
						(0.51)				(0.44)	
Gov't Debt to GDP							−0.05				−0.01
							(0.02)				(0.02)
R^2	0.72	0.77	0.81	0.72	0.77	0.77	0.77	0.86	0.84	0.85	0.84

Notes: See Table 2. Sample excludes Greece.

Table A2b: Austerity and GDP: Without GIIPS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Gov't. Purchases	−2.07	−2.11	−1.98	−1.95	−2.16	−1.93	−2.13	−1.76	−2.00	−1.63	−2.04
	(0.44)	(0.40)	(0.39)	(0.47)	(0.45)	(0.57)	(0.42)	(0.35)	(0.38)	(0.50)	(0.37)
Total Revenue		−1.22						−1.27	−1.06	−0.83	−0.90
		(0.54)						(0.46)	(0.52)	(0.53)	(0.55)
TFP			0.38					0.37	0.35	0.36	0.31
			(0.15)					(0.13)	(0.16)	(0.15)	(0.15)
HH Debt to GDP				0.02				0.04			
				(0.02)				(0.02)			
Credit Spread 2010-2014					−0.59				0.15		
					(0.57)				(0.54)		
Gov't. Bond Rate						−0.31				−0.79	
						(0.79)				(0.70)	
Gov't Debt to GDP							−0.04				−0.01
							(0.02)				(0.02)
R^2	0.52	0.63	0.64	0.54	0.55	0.57	0.60	0.78	0.71	0.73	0.72

Notes: See Table 2. Sample excludes Greece, Ireland, Italy, Portugal and Spain.

Table A3: AUSTERITY AND SPILLOVERS

	Government Purchases (Shortfall)								
	All countries			Fixed XRT			Floating XRT		
	α_1	α_1^*	R^2	α_1	α_1^*	R^2	α_1	α_1^*	R^2
GDP	−3.62	−2.06	0.66	−3.87	1.13	0.68	−2.90	−11.57	0.75
	(0.52)	(5.02)		(0.67)	(6.52)		(0.70)	(7.54)	
Inflation	−0.29	0.86	0.07	−0.24	2.40	0.09	−0.36	−2.77	0.36
	(0.23)	(2.20)		(0.31)	(3.02)		(0.21)	(2.32)	
Consumption	−2.29	−4.81	0.61	−2.46	−1.66	0.70	−1.78	−14.07	0.51
	(0.36)	(3.51)		(0.40)	(3.85)		(0.79)	(8.58)	
Investment	−2.46	−4.37	0.70	−2.63	−2.59	0.73	−1.89	−8.00	0.68
	(0.31)	(3.05)		(0.39)	(3.78)		(0.53)	(5.75)	
NX to GDP	1.43	6.79	0.31	1.38	5.63	0.31	1.27	3.98	0.25
	(0.43)	(4.19)		(0.51)	(4.99)		(0.89)	(9.69)	
Exchange Rate	−1.10	−1.48	0.11	0.17	−0.64	0.05	−4.37	2.70	0.52
	(0.63)	(6.15)		(0.22)	(2.16)		(1.82)	(19.69)	
GDP Growth	−1.06	−0.13	0.55	−1.11	1.49	0.58	−0.87	−4.01	0.66
	(0.19)	(1.86)		(0.25)	(2.39)		(0.26)	(2.81)	
Unemployment	2.03	0.43	0.40	2.47	−2.86	0.60	0.19	−2.05	0.04
	(0.50)	(4.85)		(0.52)	(5.06)		(0.66)	(7.14)	

Notes: Table displays the estimated coefficients and standard errors on the austerity (α) and spillover shock (α^*) from regression (B.1) as well as its R^2. Reported standard errors in parentheses are (untreated) OLS errors.

Table A4: AVERAGE FORECAST ERRORS

	Gov't. Purchases	Total Outlays	Primary Balance	Total Revenue	VAT	Income Tax Rate	Corporate Tax Rate	GDP
Belgium	−2.9	−3.2	−0.3	2.6	−0.0	0.0	0.0	−4.2
Bulgaria	−18.0	−16.2	−0.3	−4.7	1.2	0.0	0.0	−12.0
Czech Republic	−13.6	−11.5	4.6	4.0	2.3	2.8	−1.5	−7.1
Denmark	−4.6	−2.9	−1.3	2.1	0.9	−6.8	−0.1	−1.4
Germany	−0.4	−3.5	0.4	−0.9	−0.1	−0.0	0.0	1.7
Estonia	−9.0	−13.2	0.4	−7.5	2.2	0.0	0.0	2.8
Ireland	−19.6	−16.1	−8.2	0.3	0.7	4.3	0.0	0.4
Greece	−35.0	−29.7	5.7	5.6	5.2	7.8	−11.8	−26.0
Spain	−19.6	−13.9	−0.5	3.8	2.1	5.8	0.0	−9.9
France	−4.2	−3.8	−0.9	3.9	−0.1	3.1	2.1	−3.0
Italy	−13.6	−10.4	5.5	−0.3	0.8	2.1	0.0	−7.7
Cyprus	−23.8	−19.1	2.9	−4.4	1.5	4.0	1.0	−14.5
Latvia	−8.0	−12.2	0.2	3.0	3.6	0.8	0.0	−0.1
Lithuania	−12.8	−18.9	−0.8	−10.5	3.2	−4.5	−2.5	3.8
Luxembourg	−3.7	−4.2	−1.1	−2.2	0.7	3.0	−0.2	2.9
Hungary	−10.8	−12.7	4.7	−4.1	4.0	−17.4	−0.7	−8.6
Netherlands	−5.8	−3.4	−1.3	1.8	1.1	0.0	−0.4	−3.7
Austria	−5.9	−5.0	0.4	1.0	0.3	0.0	0.0	−1.8
Poland	−5.6	−6.0	−0.6	1.2	1.3	−4.0	0.0	−4.9
Portugal	−22.0	−16.2	1.5	2.7	2.3	9.6	4.0	−11.2
Romania	−31.8	−27.8	0.8	0.5	5.6	0.0	0.0	−11.1
Slovenia	−9.4	−8.4	−1.1	−0.6	1.6	3.6	−3.1	−8.7
Slovak Republic	−6.5	−5.0	1.3	1.8	0.9	2.4	1.4	−4.2
Finland	−3.0	−2.2	−2.8	3.1	0.9	0.4	−1.8	−2.5
Sweden	−1.2	−3.0	−2.1	−2.8	−0.0	0.2	−2.6	1.9
United Kingdom	−11.3	−9.3	−3.3	0.4	2.3	8.0	−4.6	−2.7
Norway	−5.4	−5.7	7.8	−1.6	0.2	−0.2	−0.2	−0.4
Switzerland	1.2	−0.1	1.3	−1.5	0.3	0.0	−0.0	0.6
United States	−9.2	−6.1	−5.1	6.2	0.0	1.7	−0.1	0.1

Notes: Table displays the log-difference ($\times 100$) between the actual time series and the forecast,averaged over 2010 - 2014, for various government finance variables and GDP.

Table A5a: AUSTERITY AND ECONOMIC PERFORMANCE

	Government Purchases (Shortfall)					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	−2.55	0.66	−2.78	0.66	−1.95	0.74
	(0.36)		(0.47)		(0.44)	
Inflation	−0.27	0.10	−0.27	0.08	−0.22	0.26
	(0.15)		(0.21)		(0.14)	
Consumption	−1.58	0.59	−1.73	0.68	−1.14	0.38
	(0.25)		(0.28)		(0.55)	
Investment	−1.72	0.71	−1.87	0.73	−1.27	0.67
	(0.21)		(0.26)		(0.33)	
NX to GDP	1.06	0.33	1.04	0.34	0.92	0.29
	(0.29)		(0.34)		(0.54)	
Exchange Rate	−0.79	0.11	0.16	0.06	−3.13	0.53
	(0.43)		(0.15)		(1.12)	
GDP Growth	−0.76	0.56	−0.82	0.55	−0.58	0.64
	(0.13)		(0.17)		(0.16)	
Unemployment	1.45	0.40	1.82	0.58	0.19	0.03
	(0.34)		(0.36)		(0.41)	
Debt to GDP	4.38	0.38	4.55	0.45	3.20	0.26
	(1.07)		(1.19)		(2.05)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (2.5) without any controls as well as its R^2. Regressions are run for the whole set of countries, only fixed exchange rate countries, or only floating exchange rate countries. Reported standard errors in parentheses are (untreated) OLS errors.

Table A5b: AUSTERITY AND ECONOMIC PERFORMANCE

	Total Outlays (Shortfall)					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	−1.78	0.51	−1.82	0.45	−1.65	0.82
	(0.34)		(0.47)		(0.29)	
Inflation	−0.30	0.21	−0.33	0.20	−0.20	0.31
	(0.11)		(0.16)		(0.11)	
Consumption	−1.14	0.50	−1.15	0.48	−1.08	0.52
	(0.22)		(0.28)		(0.39)	
Investment	−1.24	0.59	−1.27	0.54	−1.11	0.80
	(0.20)		(0.27)		(0.21)	
NX to GDP	0.91	0.38	0.89	0.40	0.81	0.36
	(0.22)		(0.26)		(0.41)	
Exchange Rate	−0.61	0.11	0.19	0.13	−2.66	0.59
	(0.34)		(0.11)		(0.84)	
GDP Growth	−0.53	0.43	−0.53	0.37	−0.50	0.73
	(0.12)		(0.16)		(0.11)	
Unemployment	1.16	0.41	1.42	0.57	0.24	0.07
	(0.27)		(0.29)		(0.32)	
Debt to GDP	2.94	0.28	3.05	0.32	2.06	0.17
	(0.92)		(1.04)		(1.74)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (2.5) without any controls as well as its R^2. Regressions are run for the whole set of countries, only fixed exchange rate countries, or only floating exchange rate countries. Reported standard errors in parentheses are (untreated) OLS errors.

Table A5c: AUSTERITY AND ECONOMIC PERFORMANCE

	Primary Balance					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	−0.95	0.24	−1.39	0.33	−0.48	0.18
	(0.33)		(0.46)		(0.38)	
Inflation	−0.10	0.04	−0.11	0.03	−0.13	0.34
	(0.10)		(0.15)		(0.07)	
Consumption	−0.55	0.19	−0.77	0.27	−0.35	0.15
	(0.22)		(0.30)		(0.32)	
Investment	−0.48	0.14	−0.67	0.19	−0.31	0.16
	(0.23)		(0.32)		(0.26)	
NX to GDP	0.11	0.01	0.19	0.02	0.13	0.02
	(0.22)		(0.29)		(0.31)	
Exchange Rate	0.07	0.00	0.16	0.11	−0.14	0.00
	(0.28)		(0.10)		(0.81)	
GDP Growth	−0.32	0.27	−0.50	0.41	−0.15	0.17
	(0.10)		(0.14)		(0.12)	
Unemployment	0.10	0.01	0.47	0.08	−0.19	0.12
	(0.27)		(0.38)		(0.19)	
Debt to GDP	−1.42	0.10	−0.68	0.02	−1.94	0.39
	(0.80)		(1.12)		(0.92)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (2.5) without any controls as well as its R^2. Regressions are run for the whole set of countries, only fixed exchange rate countries, or only floating exchange rate countries. Reported standard errors in parentheses are (untreated) OLS errors.

Table A5d: AUSTERITY AND ECONOMIC PERFORMANCE

	Total Revenue					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	−1.57	0.09	−1.86	0.12	−0.38	0.01
	(0.95)		(1.20)		(1.60)	
Inflation	0.41	0.09	0.50	0.11	0.14	0.03
	(0.25)		(0.33)		(0.31)	
Consumption	−0.69	0.04	−0.95	0.08	0.41	0.01
	(0.64)		(0.75)		(1.30)	
Investment	−0.81	0.06	−0.96	0.08	−0.10	0.00
	(0.63)		(0.78)		(1.09)	
NX to GDP	−0.83	0.07	−1.19	0.18	0.26	0.01
	(0.56)		(0.60)		(1.20)	
Exchange Rate	−0.64	0.03	−0.29	0.08	−1.75	0.05
	(0.74)		(0.24)		(2.97)	
GDP Growth	−0.42	0.06	−0.48	0.08	−0.13	0.01
	(0.31)		(0.39)		(0.51)	
Unemployment	0.56	0.02	0.63	0.03	−0.03	0.00
	(0.72)		(0.87)		(0.78)	
Debt to GDP	4.23	0.13	3.25	0.09	6.94	0.35
	(2.09)		(2.41)		(3.59)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (2.5) without any controls as well as its R^2. Regressions are run for the whole set of countries, only fixed exchange rate countries, or only floating exchange rate countries. Reported standard errors in parentheses are (untreated) OLS errors.

Table A5e: AUSTERITY AND ECONOMIC PERFORMANCE

	VAT					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	−2.28	0.29	−2.51	0.21	−2.17	0.88
	(0.69)		(1.14)		(0.31)	
Inflation	−0.50	0.20	−0.79	0.28	−0.23	0.27
	(0.19)		(0.30)		(0.15)	
Consumption	−1.50	0.29	−1.54	0.21	−1.57	0.68
	(0.45)		(0.70)		(0.40)	
Investment	−1.60	0.34	−1.86	0.29	−1.44	0.83
	(0.43)		(0.69)		(0.25)	
NX to GDP	1.23	0.24	1.36	0.23	1.26	0.53
	(0.42)		(0.59)		(0.45)	
Exchange Rate	−1.17	0.13	0.52	0.24	−3.15	0.51
	(0.57)		(0.22)		(1.16)	
GDP Growth	−0.65	0.22	−0.69	0.16	−0.66	0.79
	(0.23)		(0.38)		(0.13)	
Unemployment	1.45	0.22	2.72	0.51	0.37	0.11
	(0.52)		(0.62)		(0.40)	
Debt to GDP	3.02	0.10	4.30	0.16	2.39	0.14
	(1.74)		(2.34)		(2.25)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (2.5) without any controls as well as its R^2. Regressions are run for the whole set of countries, only fixed exchange rate countries, or only floating exchange rate countries. Reported standard errors in parentheses are (untreated) OLS errors.

Table A5f: AUSTERITY AND ECONOMIC PERFORMANCE

	Income Tax Rate					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	−0.35	0.07	−1.18	0.37	0.25	0.14
	(0.24)		(0.36)		(0.23)	
Inflation	0.05	0.02	0.09	0.03	0.04	0.12
	(0.07)		(0.12)		(0.05)	
Consumption	−0.17	0.04	−0.78	0.43	0.29	0.28
	(0.16)		(0.21)		(0.17)	
Investment	−0.23	0.08	−0.83	0.45	0.21	0.23
	(0.16)		(0.22)		(0.15)	
NX to GDP	0.02	0.00	0.23	0.05	−0.23	0.21
	(0.15)		(0.23)		(0.17)	
Exchange Rate	0.19	0.04	0.04	0.01	0.42	0.11
	(0.19)		(0.09)		(0.45)	
GDP Growth	−0.10	0.06	−0.33	0.29	0.08	0.14
	(0.08)		(0.12)		(0.07)	
Unemployment	0.28	0.09	0.70	0.27	−0.15	0.23
	(0.17)		(0.27)		(0.11)	
Debt to GDP	1.58	0.29	2.54	0.43	0.64	0.12
	(0.47)		(0.68)		(0.65)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (2.5) without any controls as well as its R^2. Regressions are run for the whole set of countries, only fixed exchange rate countries, or only floating exchange rate countries. Reported standard errors in parentheses are (untreated) OLS errors.

Table A5g: AUSTERITY AND ECONOMIC PERFORMANCE

	Corporate Tax Rate					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	0.95	0.15	1.15	0.23	−0.51	0.03
	(0.43)		(0.49)		(1.07)	
Inflation	0.11	0.03	0.17	0.07	−0.33	0.34
	(0.12)		(0.15)		(0.17)	
Consumption	0.65	0.17	0.76	0.27	−0.01	0.00
	(0.28)		(0.29)		(0.89)	
Investment	0.56	0.13	0.70	0.21	−0.37	0.03
	(0.29)		(0.32)		(0.73)	
NX to GDP	−0.09	0.00	−0.21	0.03	0.56	0.07
	(0.28)		(0.29)		(0.79)	
Exchange Rate	−0.16	0.01	−0.12	0.07	−0.22	0.00
	(0.35)		(0.10)		(2.07)	
GDP Growth	0.24	0.09	0.30	0.15	−0.14	0.02
	(0.15)		(0.17)		(0.35)	
Unemployment	−0.48	0.07	−0.59	0.12	−0.20	0.02
	(0.33)		(0.37)		(0.52)	
Debt to GDP	−1.13	0.04	−1.12	0.06	−3.00	0.14
	(1.03)		(1.09)		(2.80)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (2.5) without any controls as well as its R^2. Regressions are run for the whole set of countries, only fixed exchange rate countries, or only floating exchange rate countries. Reported standard errors in parentheses are (untreated) OLS errors.

Table A6: US MONETARY POLICY COEFFICIENTS

Panel A: Taylor rules				
	r	ϕ_π	ϕ_{GDP}	ϕ_i
Taylor	2.00	0.50	0.50	0.00
	–	–	–	–
Bernanke	2.00	0.50	1.00	0.00
	–	–	–	–
Estimated Bernanke	2.88	0.39	0.75	0.00
	(0.18)	(0.14)	(0.10)	–
CGG	2.35	1.15	0.93	0.79
	(0.24)	–	–	–
Estimated CGG	2.98	0.22	1.08	0.79
	(0.29)	(0.23)	(0.15)	–
Panel B: Mankiw rule				
	ϕ	$\phi_{\pi,u}$		
Mankiw	8.50	1.40		
	–	–		
Estimated Mankiw	10.73	1.79		
	(0.56)	(0.17)		

Notes: Every row displays the coefficients for a different estimation run on US data. Reported standard errors are (untreated) OLS errors. See text for estimation period.

Table A7: ESTIMATED INTERCEPTS

	USA	ECB	CZE	HUN	POL	ROM	SWE	GBR	NOR	CHE
Bernanke	2.88	0.48	0.94	1.34	7.22	1.52	4.57	3.58	3.88	1.40
	(0.18)	(0.09)	(0.43)	(0.31)	(0.31)	(0.93)	(0.29)	(0.24)	(0.34)	(0.21)
CGG	2.35	0.07	0.15	0.27	6.90	−1.98	4.11	3.42	3.70	1.25
	(0.24)	(0.24)	(0.48)	(1.48)	(0.51)	(2.65)	(0.37)	(0.35)	(0.48)	(0.27)

Notes: Coefficients are estimated intercepts for the Bernanke rule and the CGG rule. The intercept corresponds to the real interest rate, r. See text for estimation period.

Table A8: Interest Rates and Spreads

	CB rate			Taylor deviation			Spread		
	04-07	08-09	10-14	04-07	08-09	10-14	04-07	08-09	10-14
Belgium	2.7	2.6	0.8	0.1	-0.1	1.8	1.6	1.9	1.6
Bulgaria	2.7	2.6	0.8	0.1	-0.1	1.8	7.9	8.5	7.8
Czech Republic	3.3	3.5	1.1	−1.3	-4.1	1.3	1.4	1.6	2.2
Denmark	2.9	3.1	0.6	0.1	-0.1	1.8	2.0	2.9	3.6
Germany	2.7	2.6	0.8	0.1	-0.1	1.8	2.4	2.3	2.5
Estonia	2.7	2.6	0.8	0.1	-0.1	1.8	2.3	3.5	3.0
Ireland	2.7	2.6	0.8	0.1	-0.1	1.8	2.3	2.7	3.6
Greece	2.7	2.6	0.8	0.1	-0.1	1.8	2.9	3.1	5.5
Spain	2.7	2.6	0.8	0.1	-0.1	1.8	1.7	2.5	3.8
France	2.7	2.6	0.8	0.1	-0.1	1.8	1.5	1.8	1.7
Italy	2.7	2.6	0.8	0.1	-0.1	1.8	1.9	2.1	3.2
Cyprus	4.7	2.6	0.8	0.1	-0.1	1.8	2.4	4.4	5.8
Latvia	4.4	5.3	2.5	0.1	-0.1	1.8	3.5	8.5	2.8
Lithuania	2.7	2.6	0.8	0.1	-0.1	1.8	3.2	5.9	4.3
Luxembourg	2.7	2.6	0.8	0.1	-0.1	1.8	1.8	1.7	1.6
Hungary	8.3	8.7	5.0	−0.4	2.2	4.3	2.6	3.1	3.2
Netherlands	2.7	2.6	0.8	0.1	-0.1	1.8	1.4	2.0	2.5
Austria	2.7	2.6	0.8	0.1	-0.1	1.8	1.4	1.6	1.6
Poland	4.9	4.7	3.5	−1.4	-6.5	−5.9	2.1	2.7	2.2
Portugal	2.7	2.6	0.8	0.1	-0.1	1.8	3.5	4.1	5.5
Romania	11.8	9.4	5.2	−1.0	-0.9	5.4	6.3	7.6	4.6
Slovenia	3.8	2.6	0.8	0.1	-0.1	1.8	2.5	3.7	4.8
Slovak Republic	4.1	2.6	0.8	0.1	-0.1	1.8	1.6	2.5	3.2
Finland	2.7	2.6	0.8	0.1	-0.1	1.8	1.5	1.6	2.1
Sweden	2.4	2.4	1.0	−2.3	-3.2	−1.8	1.5	1.6	2.3
United Kingdom	4.8	2.7	0.5	0.6	-0.7	−0.7	1.0	1.7	2.0
Norway	2.7	3.5	1.7	−1.1	-3.6	−2.6	2.0	2.4	2.7
Switzerland	1.5	1.2	-0.1	0.3	-2.8	−0.7	0.7	0.9	1.8
United States	3.6	1.0	0.1	−0.4	-0.9	0.4	1.8	2.1	2.3
Average	3.5	3.2	1.2	−0.1	-0.8	1.2	2.4	3.1	3.2

Notes: Table displays the average central bank interest rates (CB rate, in percent), the average central bank interest rate less the rate implied by a monetary policy rule (Taylor deviations, in percentage points) and the spread between lending rates to businesses and the central bank interest rate (Spread, in percentage points). Averages are taken over 2004 - 2007, 2008 - 2009 and 2010 - 2014. See text for details on the monetary policy rule.

Table A9: STEADY-STATE GOVERNMENT PURCHASES AND TAX RATES

	Purchases	Cons Tax	Labor Tax	Capital Tax
Belgium	24.6	20.6	53.7	34.0
Bulgaria	22.8	18.1	18.4	12.0
Czech Republic	24.4	16.5	25.2	23.0
Denmark	28.1	23.9	62.3	26.2
Germany	20.5	18.5	46.2	35.3
Estonia	22.4	16.4	22.2	22.2
Ireland	20.3	21.1	42.4	12.5
Greece	25.5	17.5	40.0	31.2
Spain	22.3	17.7	43.8	32.5
France	27.2	19.5	47.0	34.5
Italy	22.5	20.7	44.6	34.9
Cyprus	21.1	15.8	30.0	10.0
Latvia	22.5	15.7	24.6	15.0
Lithuania	23.1	16.7	25.2	17.4
Luxembourg	19.2	13.8	39.0	29.6
Hungary	25.3	21.6	38.8	19.8
Netherlands	26.9	18.6	52.0	27.5
Austria	21.9	19.5	50.0	25.0
Poland	22.0	20.3	38.4	19.0
Portugal	24.9	19.8	41.6	26.9
Romania	21.0	17.3	16.0	16.0
Slovenia	22.7	19.0	44.6	23.2
Slovak Republic	22.2	18.7	19.0	19.0
Finland	25.9	21.8	50.3	26.0
Sweden	29.2	24.6	56.5	27.7
United Kingdom	22.7	17.4	40.0	29.6
Norway	23.6	24.4	40.7	28.0
Switzerland	14.0	7.6	41.9	21.3
United States	19.4	8.5	41.6	39.3
RoW	18.1	8.5	41.6	39.3
Average	22.9	18.0	39.3	25.3

Notes: Table displays the steady-state values for the share of government purchases in GDP, the consumption tax rate, the labor tax rate, and the capital tax rate, as they are used in the model. For government purchases, the average is taken over 2000 - 2010; for tax rates, the average is taken over 2005 - 2009.

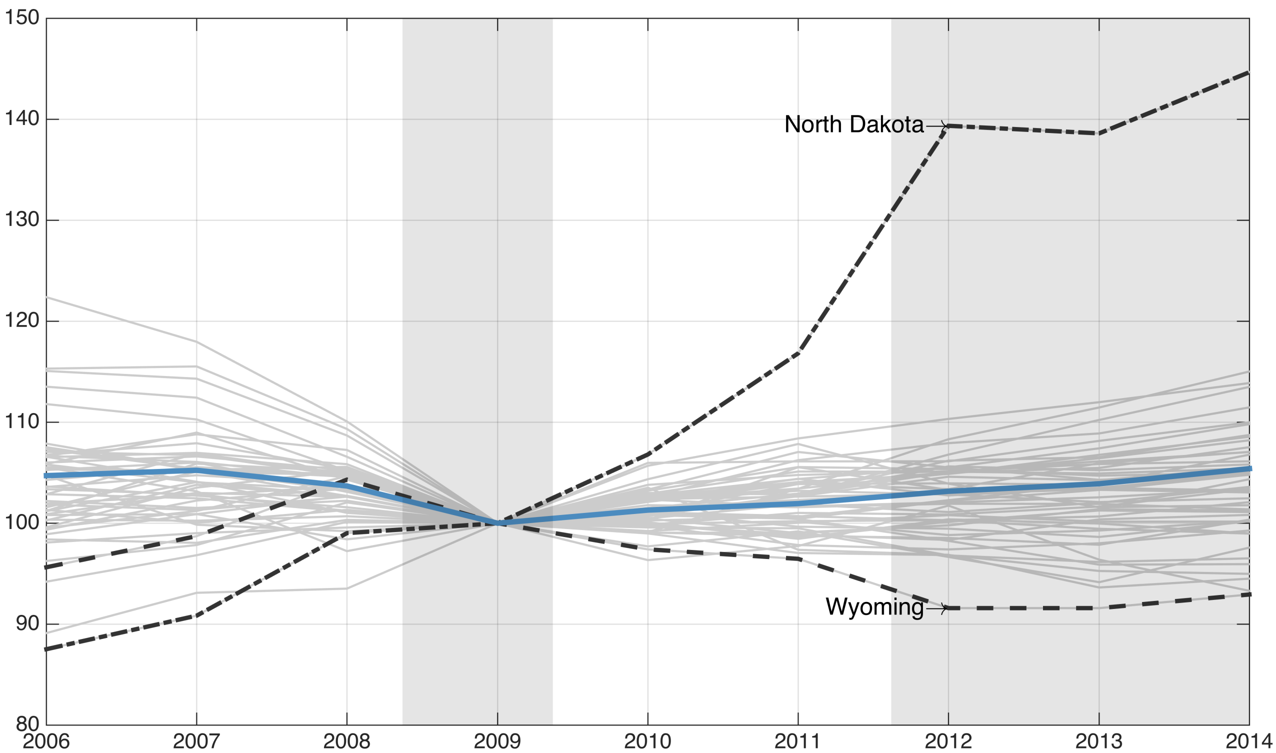


Figure A1: Real per Capita GDP Before, During and After the Crisis: US States

Note: The figure plots the time paths of real per capita GDP for the period 2006-2014 for all US States. The paths are indexed to 100 in 2009. The time path for the US as a whole is marked blue.

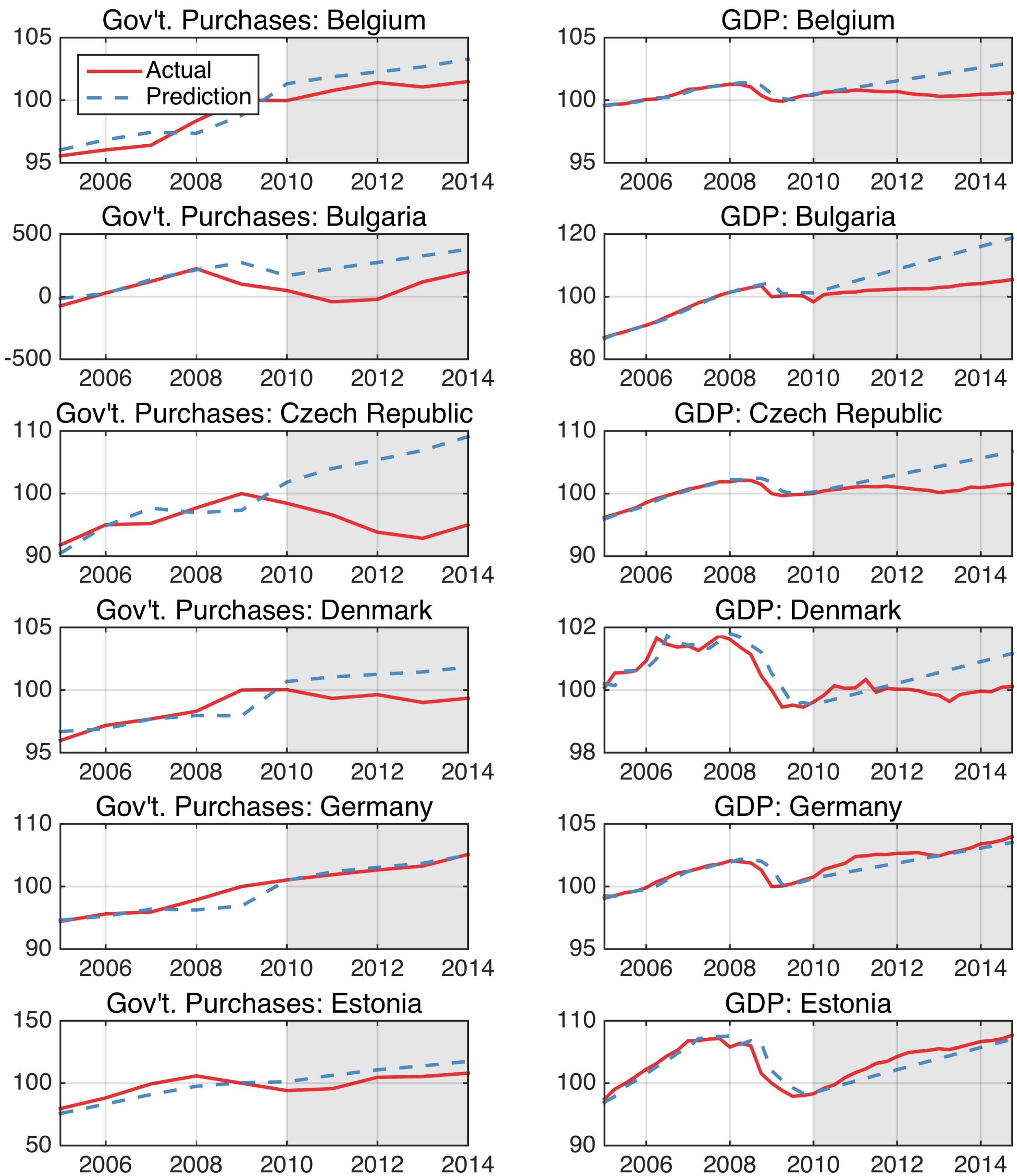


Figure A2a: Government Purchases and GDP

Note: Left column panels display real government purchases for various countries on a log scale (normalized to 2009=100), together with their predicted values. Right column panels display the corresponding series for real GDP per capita.

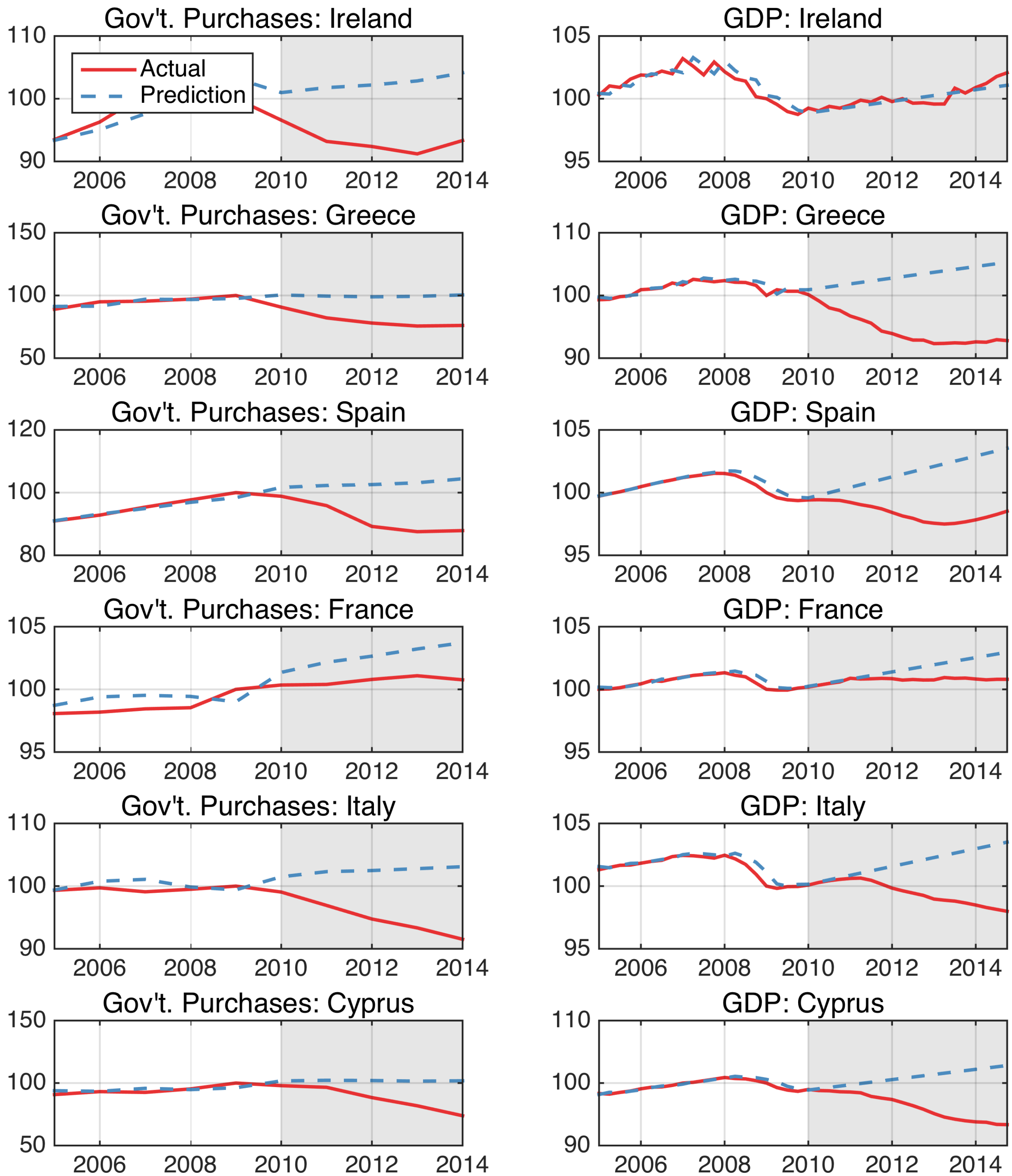


Figure A2b: Government Purchases and GDP

Note: Left column panels display real government purchases for various countries on a log scale (normalized to 2009=100), together with their predicted values. Right column panels display the corresponding series for real GDP per capita.

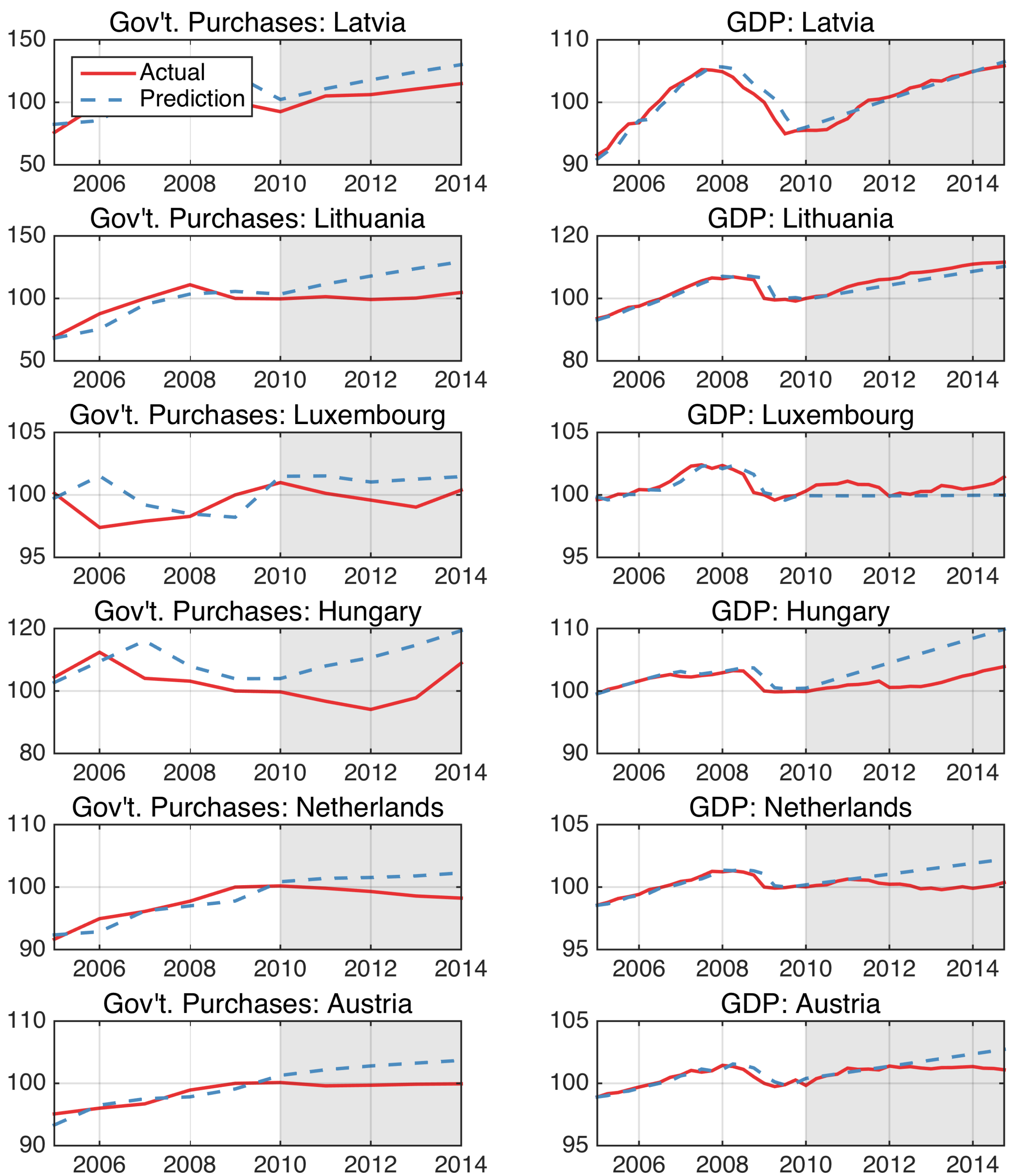


Figure A2c: Government Purchases and GDP

Note: Left column panels display real government purchases for various countries on a log scale (normalized to 2009=100), together with their predicted values. Right column panels display the corresponding series for real GDP per capita.

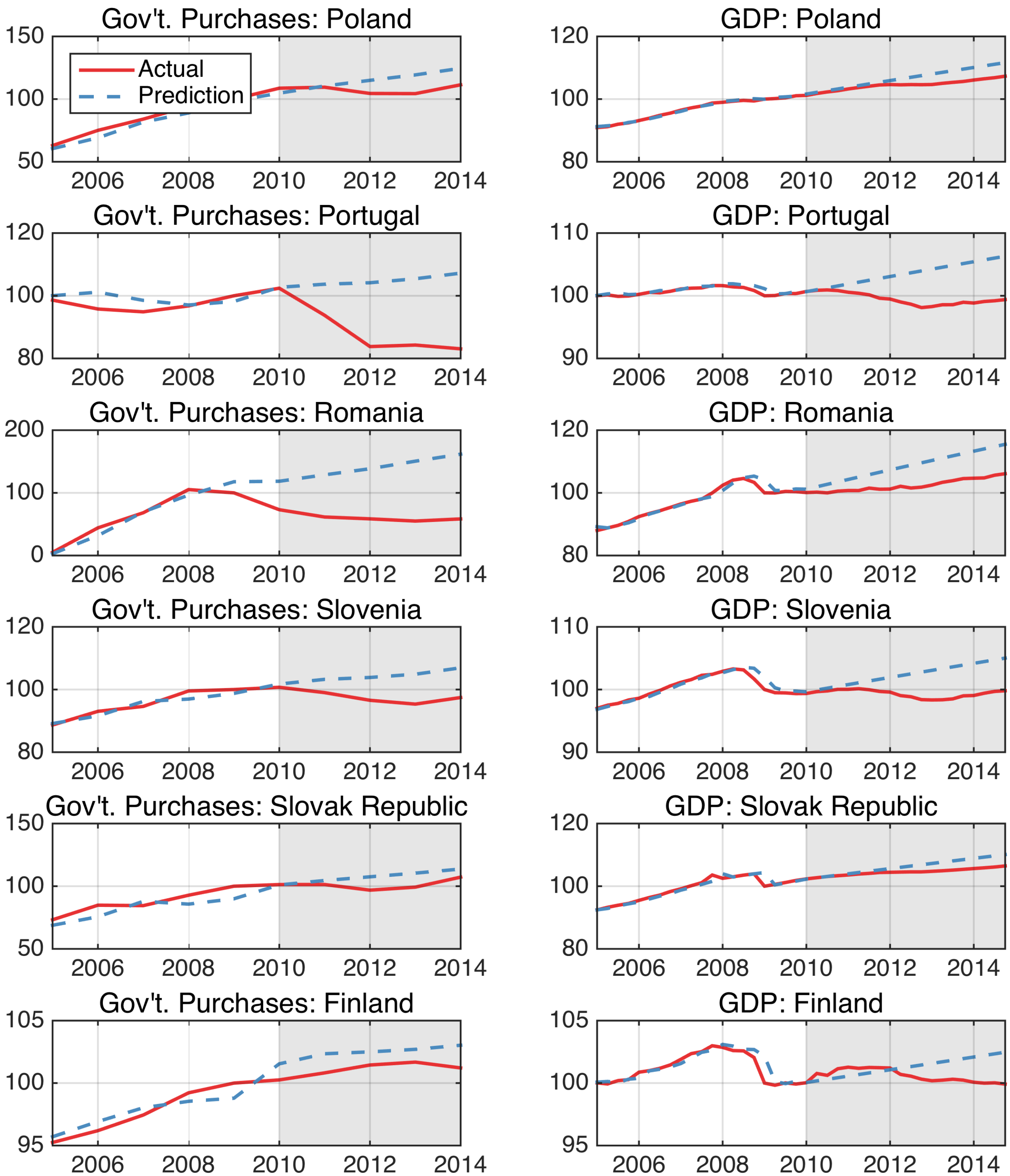


Figure A2d: Government Purchases and GDP

Note: Left column panels display real government purchases for various countries on a log scale (normalized to 2009=100), together with their predicted values. Right column panels display the corresponding series for real GDP per capita.

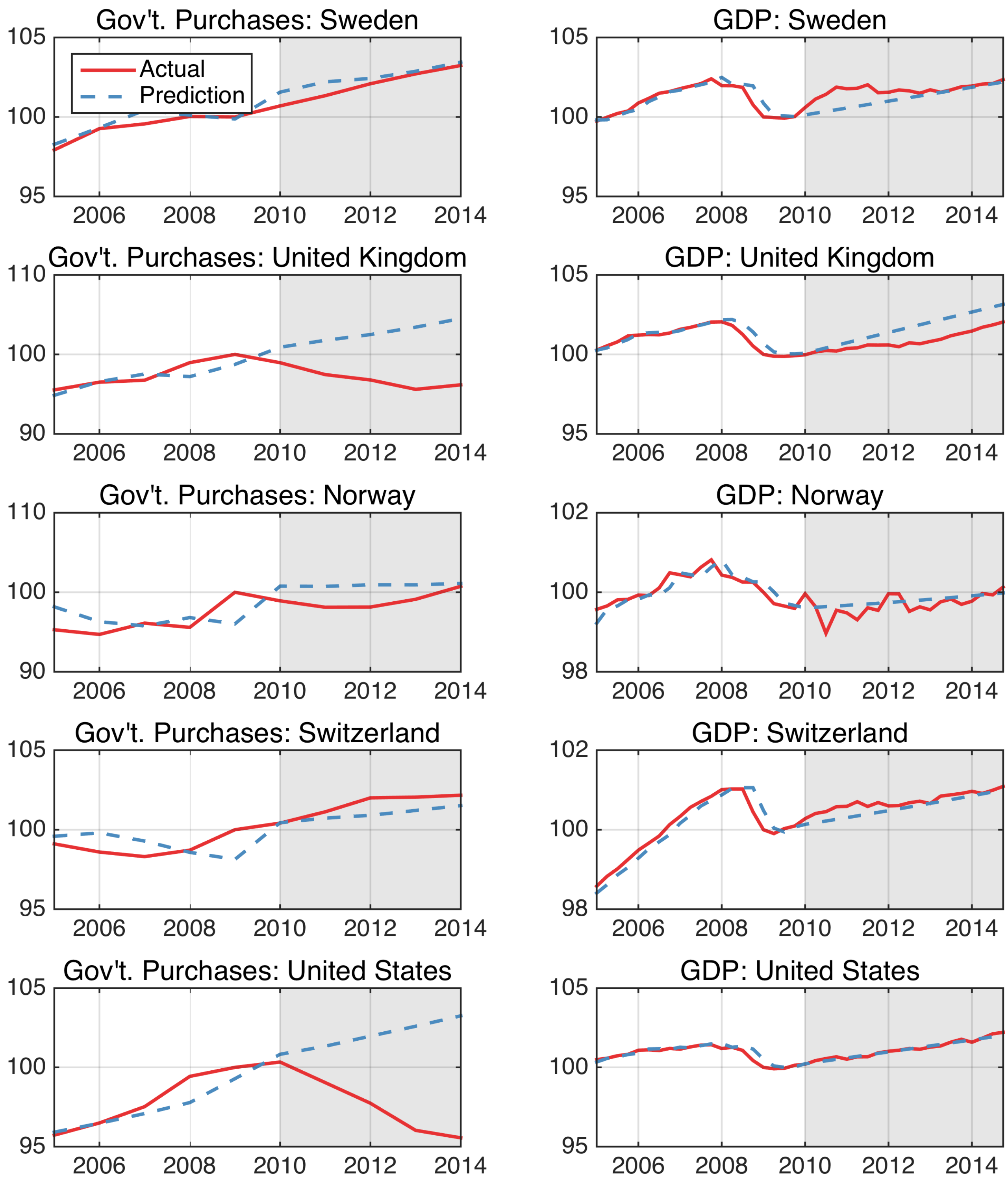


Figure A2e: GOVERNMENT PURCHASES AND GDP

Note: Left column panels display real government purchases for various countries on a log scale (normalized to 2009=100), together with their predicted values. Right column panels display the corresponding series for real GDP per capita.

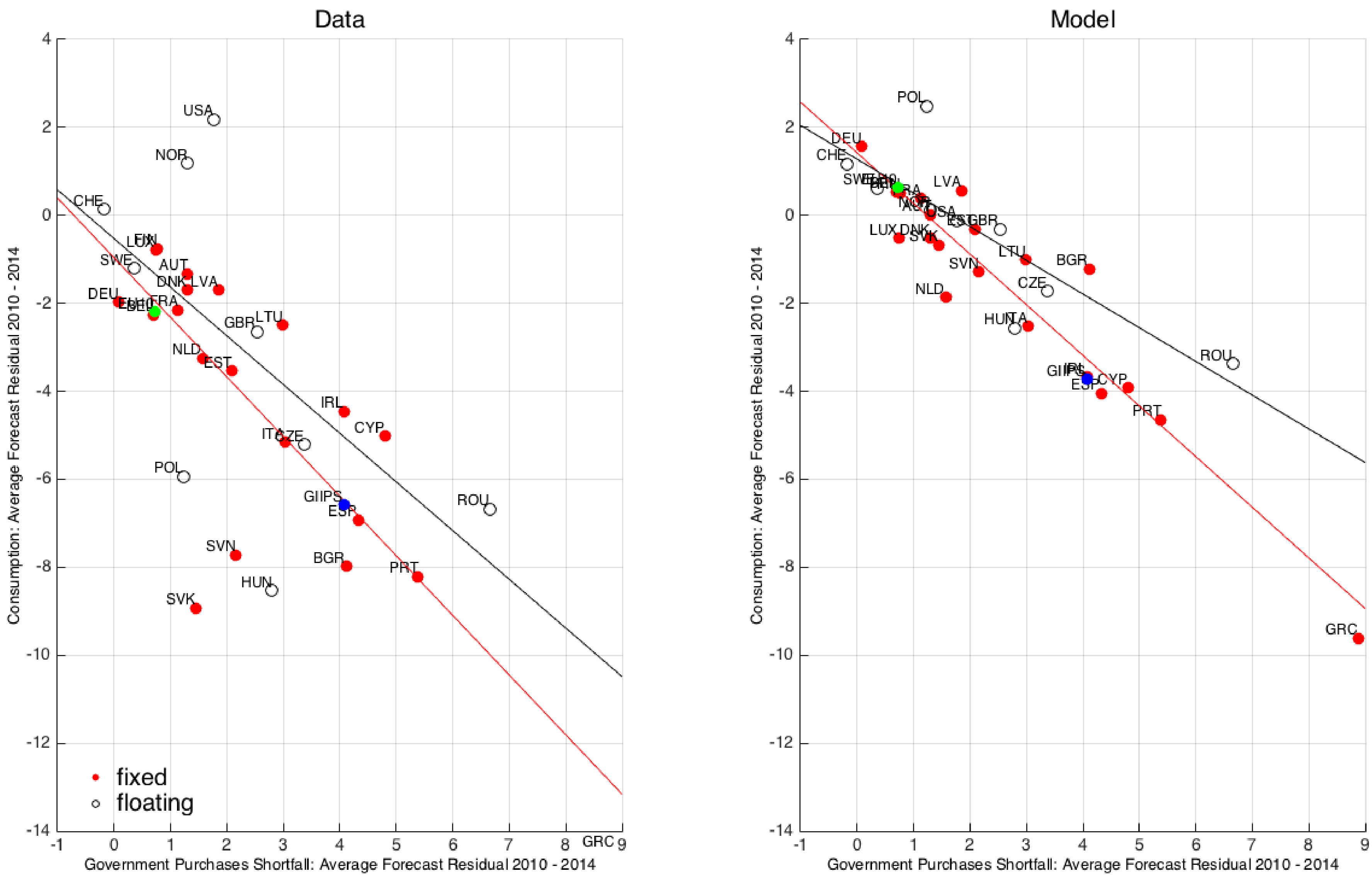


Figure A3a: Consumption and Austerity: Data vs. Model

Note: See Figure 3a.

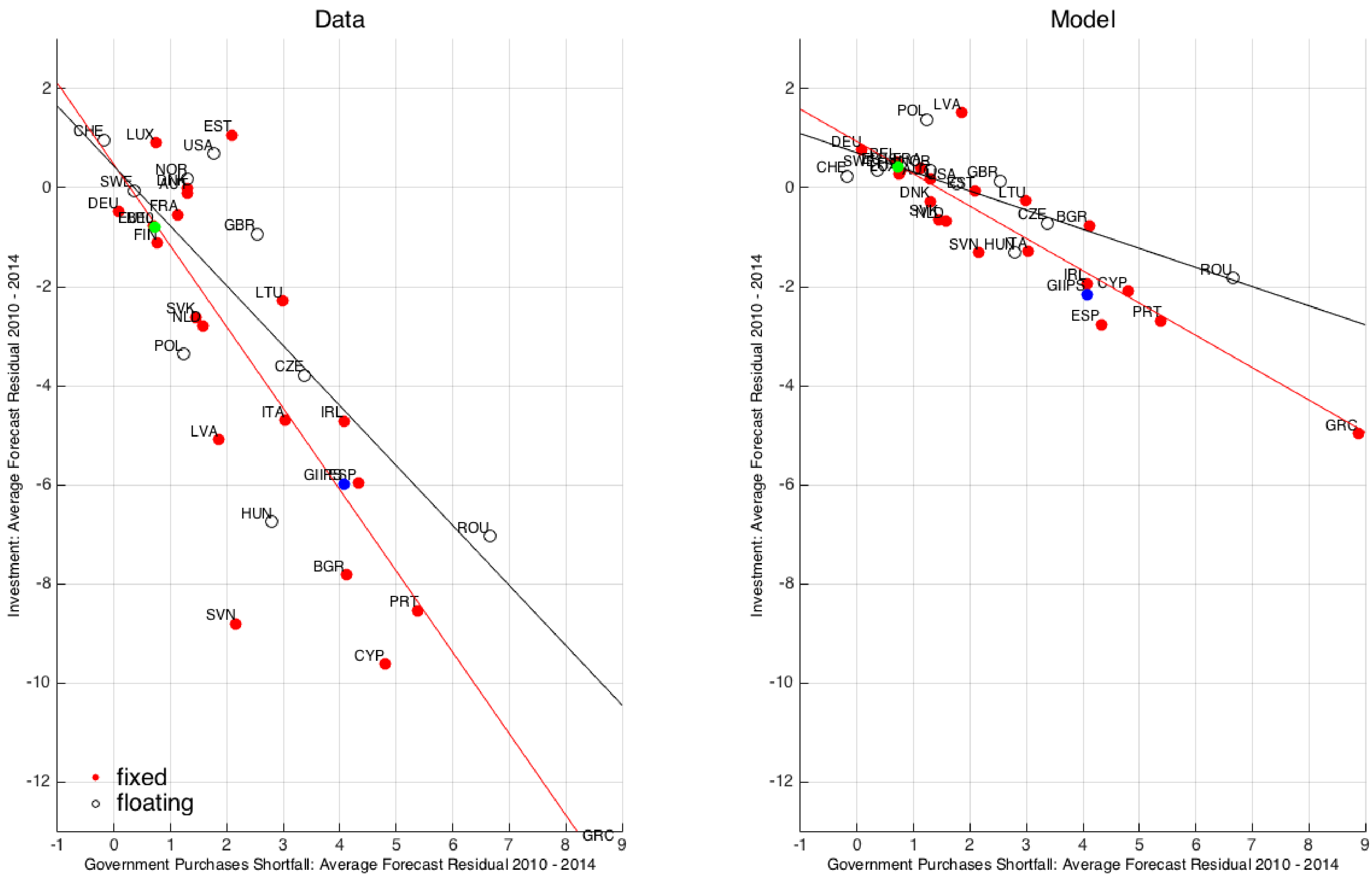


Figure A3b: Investment and Austerity: Data vs. Model

Note: See Figure 3a.

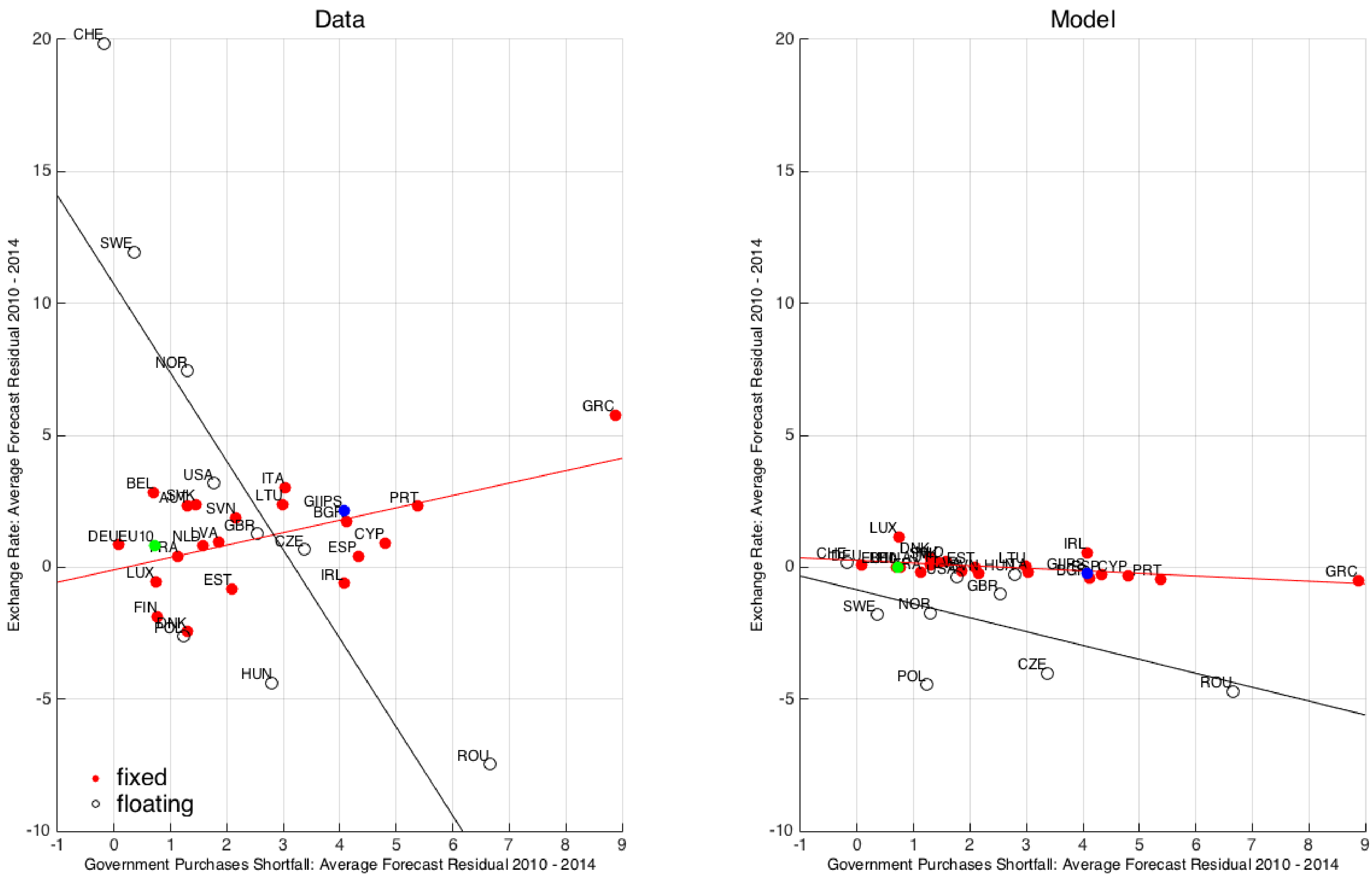


Figure A3c: Nominal Effective Exchange Rate and Austerity: Data vs. Model

Note: See Figure 3a.

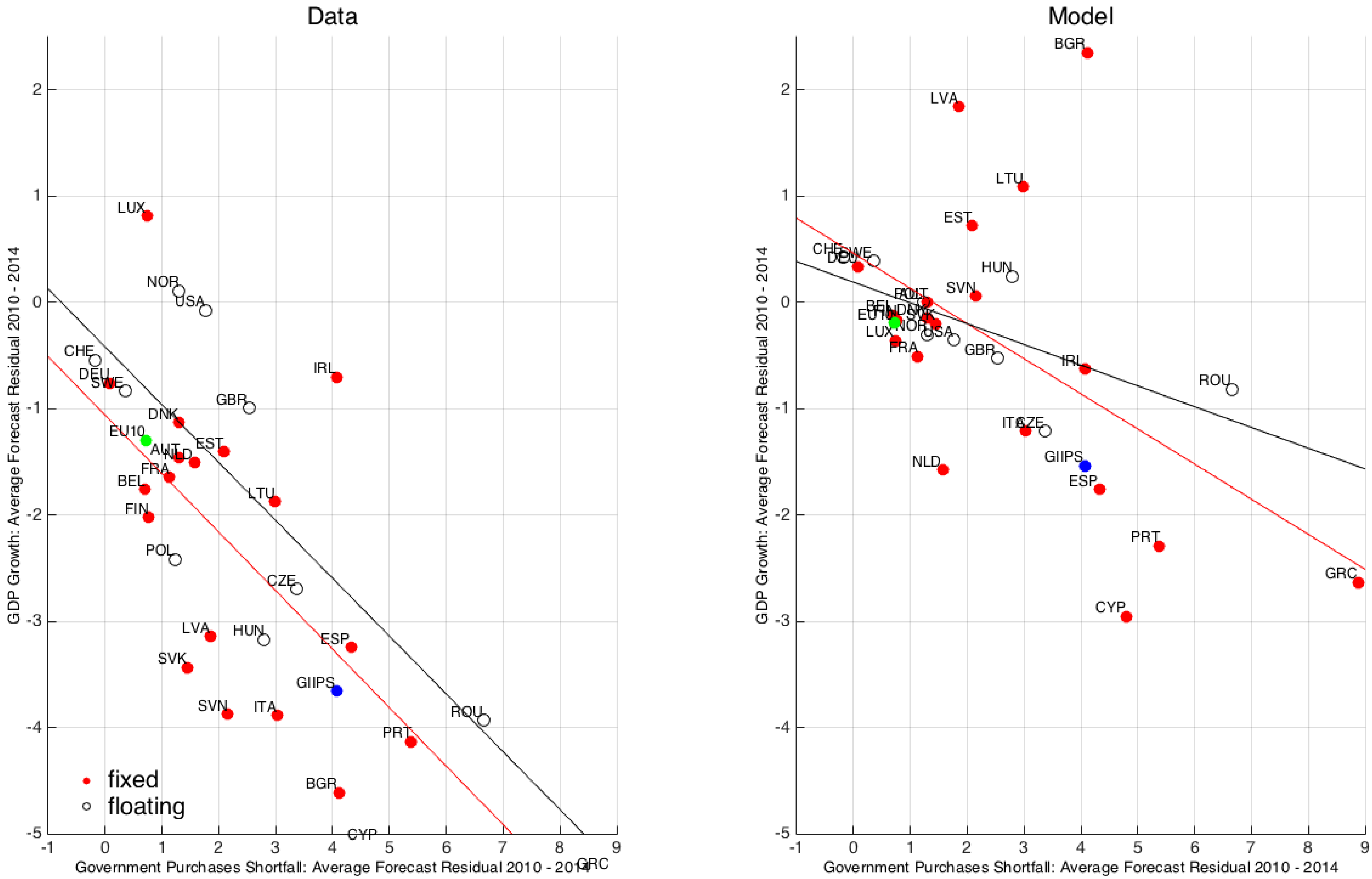


Figure A3d: GDP Growth and Austerity: Data vs. Model

Note: See Figure 3a.

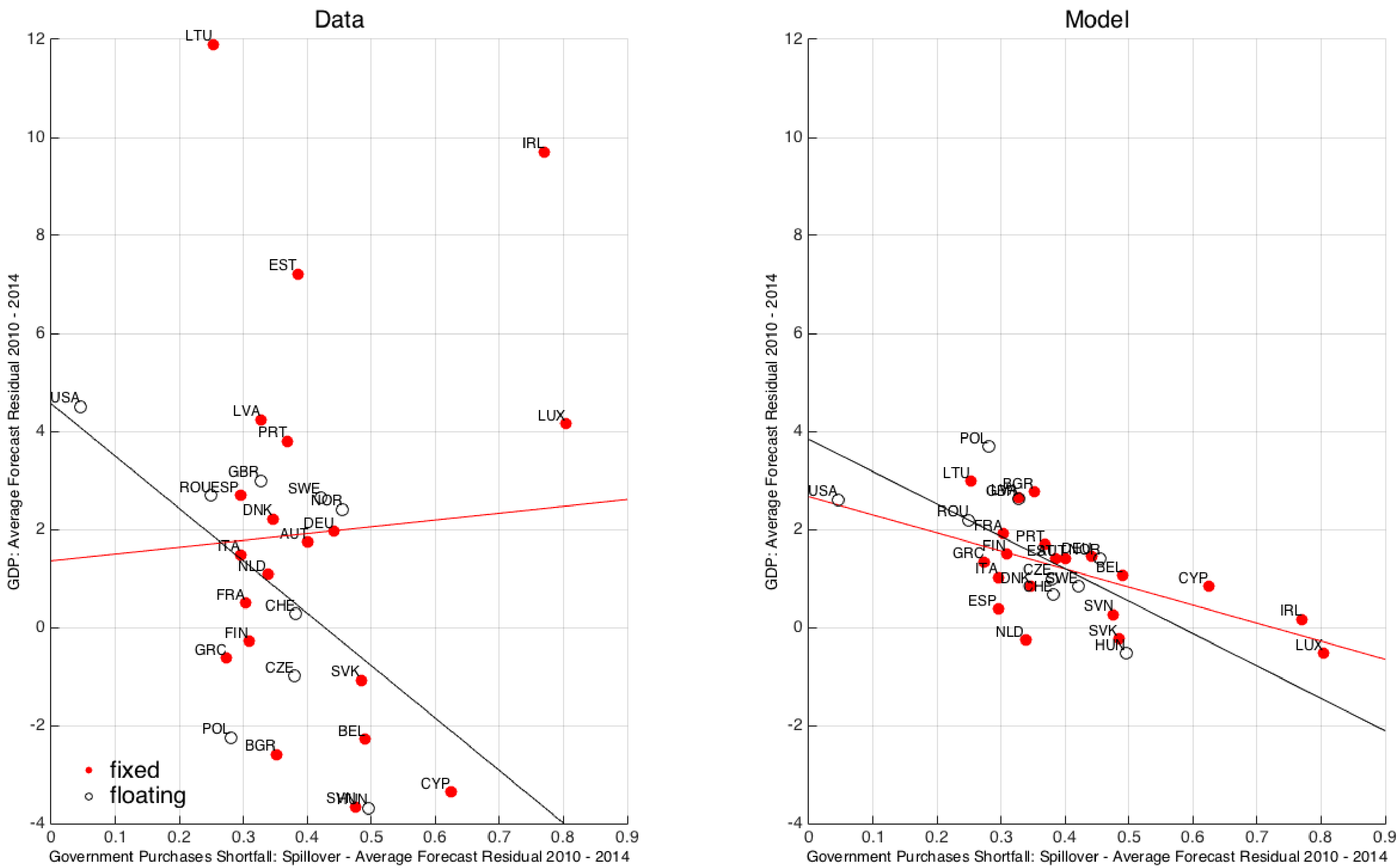
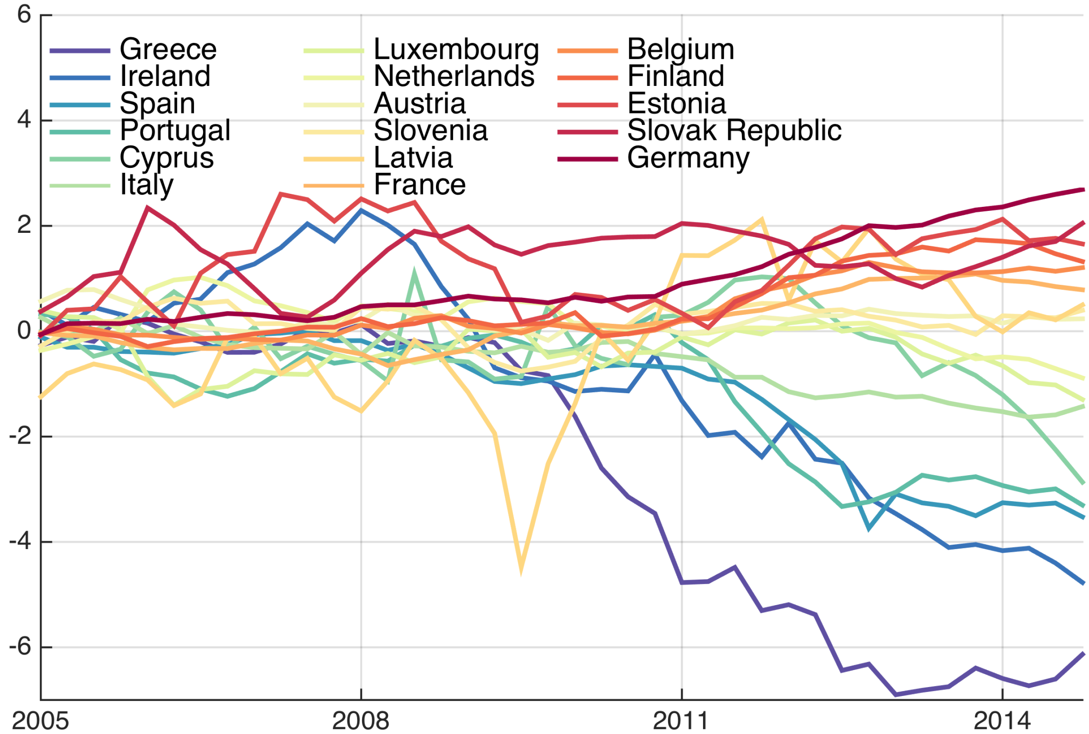
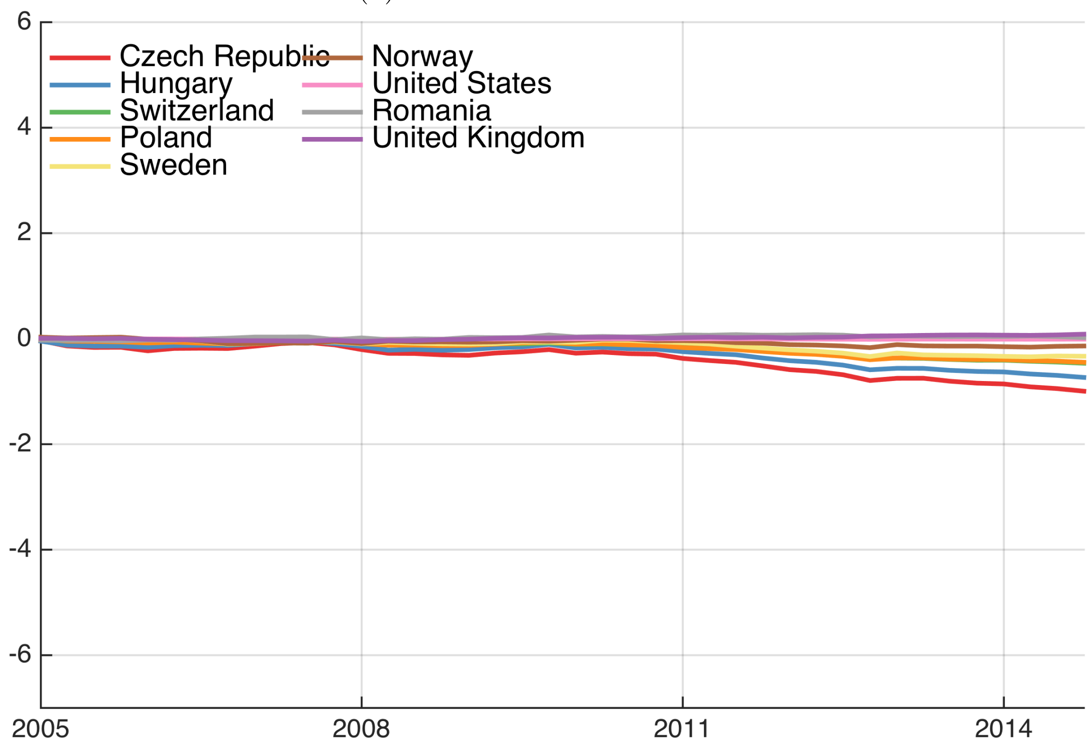


Figure A4: GDP and Austerity in Data: Domestic and Spillover Effect

Note: Figure displays a scatter plot of the average forecast residual of GDP over 2010 - 2014, in log points, versus the average forecast residual for the shortfall in foreign government purchases, expressed in terms of a country's GDP and multiplied by a scaling factor, *Gshock***. The displayed GDP residual is calculated after controling for the domestic government purchase shock, *Gshock*. Left panel is based on actually observed data; right panel refers to data from the simulated model. Countries are classified by their exchange rate regime (red: euro / pegged to euro; black: floating currency). See text for details on the forecast specification.



(a) Eurozone Countries



(a) Floating Countries

Figure A5: Nominal Effective Exchange Rate: 'No Euro' Relative to Benchmark

Note: Figures display effective nominal exchange rates under the 'No Euro' experiment relative to the benchmark (in percent). Positive values mean that the nominal effective exchange is stronger relative to the benchmark.

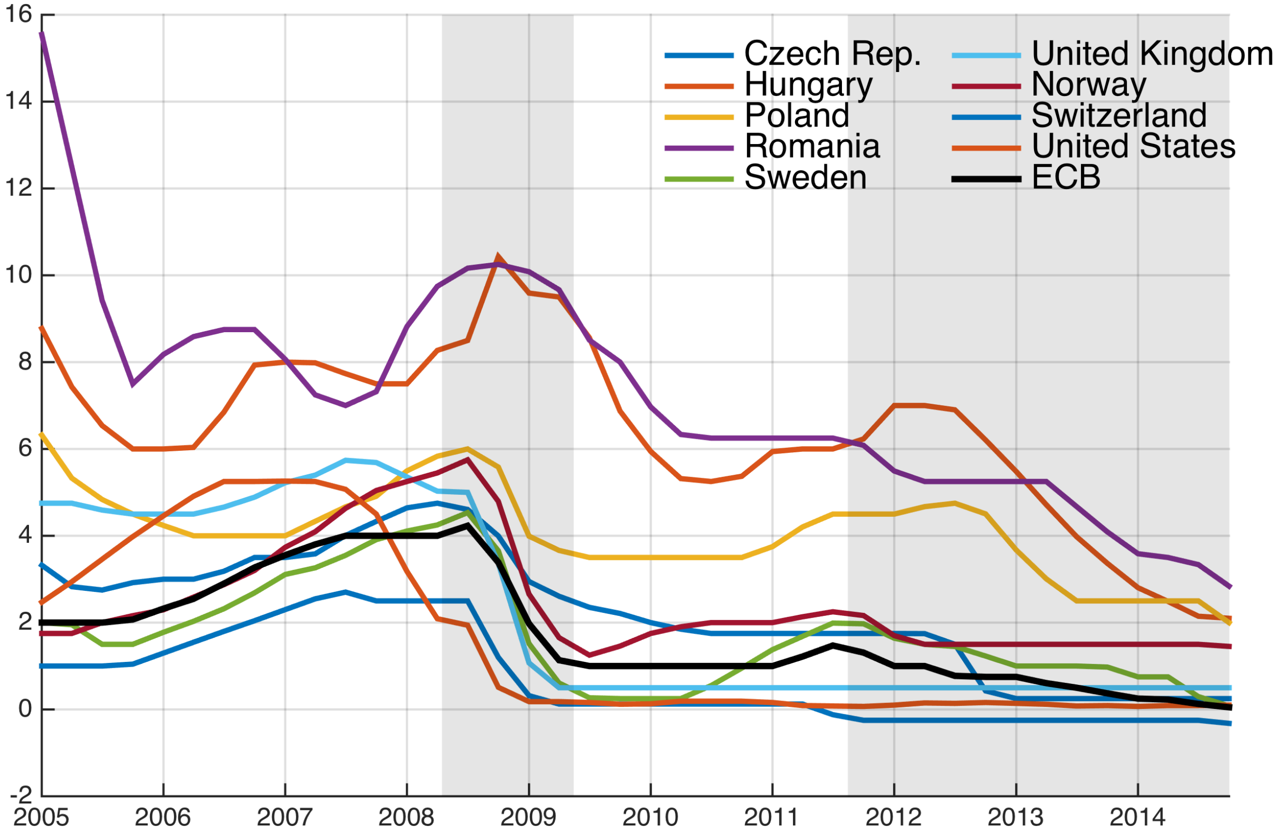
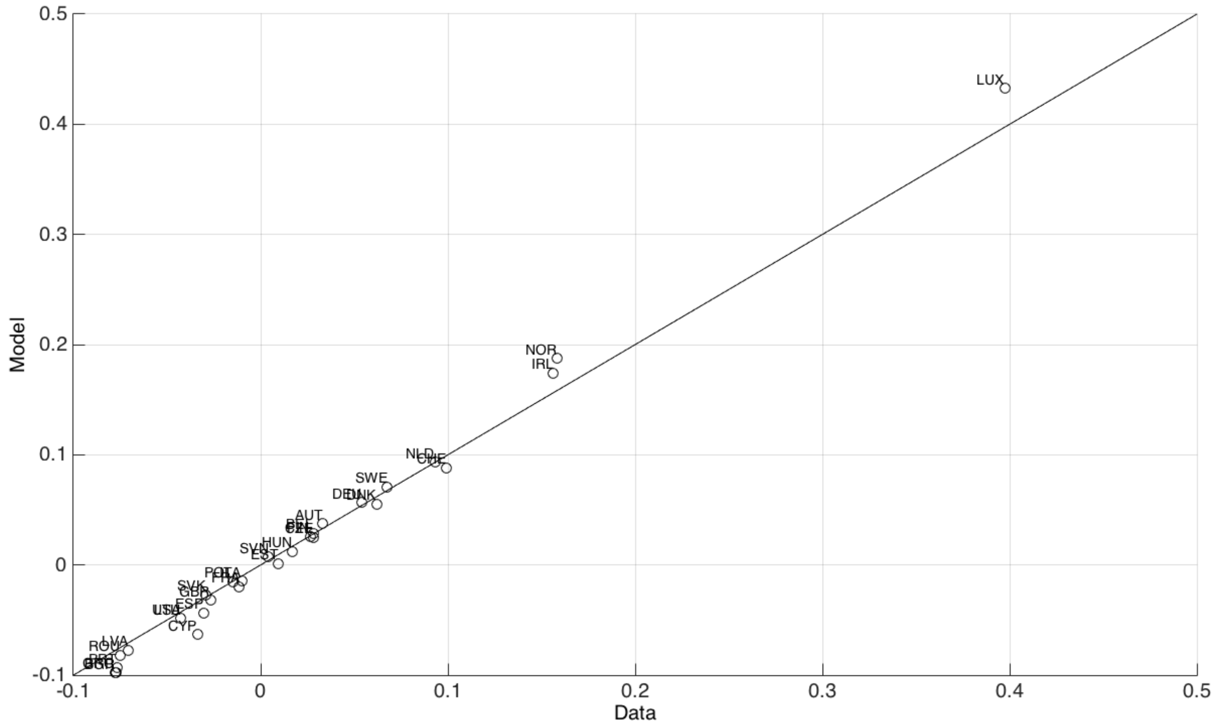
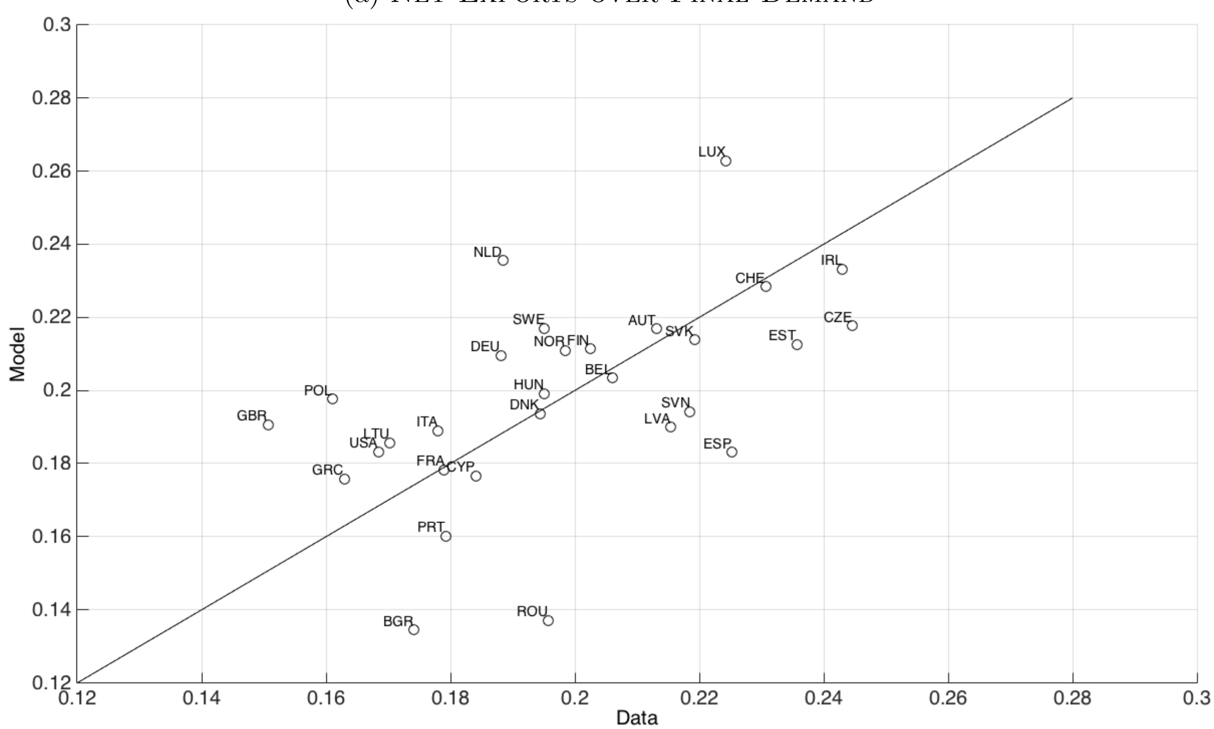


Figure A6: Central Bank Policy Interest Rates

Note: The figure plots the policy interest rates of the central banks in Europe and the U.S.



(a) Net Exports over Final Demand



(b) Investment over Final Demand

Figure A7: Non-Targeted Steady-State Shares

Note: Table displays the non-target steady-state shares of net exports to final demand, NX_n/Y_n, and investment to final demand, X_n/Y_n. Data period is 2000 - 2010. The correlation between data and model is 0.9975 for net exports and 0.53 for investment.