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Austerity in the Aftermath of the Great Recession

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Austerity in the Aftermath of the Great Recession[☆]

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Abstract

Cross-country differences in austerity, defined as government purchases below forecast, account for 75 percent of the observed cross-sectional variation in GDP in advanced economies during 2010-2014. Statistically, austerity is associated with lower GDP, lower inflation and higher net exports. A multi-country DSGE model calibrated to 29 advanced economies generates effects of austerity consistent with the data. Counterfactuals suggest that eliminating austerity would have substantially reduced output losses in Europe. Austerity was so contractionary that debt-to-GDP ratios in some countries increased as a result of endogenous reductions in GDP and tax revenue.

Keywords: Austerity, Fiscal Policy, Multi-Country DSGE Model

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1. Introduction

The economies in Europe contracted sharply and almost synchronously during the global financial crisis. Economic performance after the crisis, however, varied widely. Figure 1 plots real per-capita GDP for 29 countries including the United States, the European Union, Switzerland, and Norway. Taken as a whole, the recovery in Europe is similar to that of the United States. This similarity, however, masks a tremendous amount of variation across Europe. At one end of the spectrum is Greece, where per capita income at the end of 2014 is almost 25 percent below its 2009 level. While Greece's GDP performance is exceptionally poor, a persistent contraction in GDP over this period is not unique. About a third of the countries have end-2014 levels of real per-capita GDP at or below their 2009 levels. At the other end of the spectrum is Lithuania. Like Greece, Lithuania experienced a strong contraction during the Great Recession. However, it then returned to a rapid rate of growth quickly thereafter.

We find that cross-country differences in austerity, defined as government purchases below forecast, account for roughly three quarters of the cross-sectional variation in GDP during the 2010-2014 period. At a time when faltering economies required stimulus, most countries in Europe cut government spending. Other austerity policies—such as cutting transfer payments or increasing taxes—do not explain the cross-sectional variation in output. There is little evidence that austerity is a consequence of the run-up of government debt during the Great Recession. Austerity policies were pursued by almost all of Europe regardless of their debt to GDP ratios in 2009.

The stark negative relationship between austerity in government pur-

chases and GDP is robust to the method used to forecast both GDP and government purchases in the 2010-2014 period, and holds for countries with fixed as well as flexible exchange rates. The cross-sectional relationship between austerity and GDP is statistically robust to the inclusion of other variables such as TFP, household debt, sovereign risk premia and taxes. Austerity in government purchases is negatively associated with consumption, investment, GDP growth, and inflation. In addition, austerity is associated with an increase in net exports. This effect is larger for countries within the euro area and those with exchange rates fixed to the euro. Regressing GDP on austerity yields a slope coefficient of 1.75 – slightly higher than the "open-economy relative multiplier" for U.S. states reported by Nakamura and Steinsson (2014). Our estimate is in line with other studies that suggest that government spending multipliers are substantially higher during recessions (see e.g. Auerbach and Gorodnichenko, 2012) and during periods in which nominal interest rates are at the ZLB (e.g. Miyamoto et al., 2018).

We develop a multi-country DSGE model that generates cross-sectional patterns in macroeconomic variables that are consistent with the data. The model features trade in intermediate goods, sticky prices, hand-to-mouth consumers, and financial frictions. The model is calibrated to reflect relative country size, observed trade flows and financial linkages, as well as the country's exchange rate regime. The model incorporates shocks to government purchases and monetary policy. Consistent with our empirical findings, the model generates a positive relationship between austerity and net exports, and a strong negative relationship between austerity and inflation. In the model, a cut in government spending reduces aggregate demand; because

prices do not adjust in the short run, there is downward pressure on wages and employment. Facing a reduction in income, hand-to-mouth consumers further reduce spending, amplifying the fall in aggregate demand. The reduction in aggregate demand also reduces the net worth of firms, raising leverage ratios and increasing the cost of capital. At the same time, a low elasticity of substitution between domestic and foreign goods limits the extent to which any excess supply of the home good can be exported. These effects combine to produce a fall in wages, deflation, a fall in consumption and output. The zero lower bound (ZLB) plays an important role in generating large effects of government spending *within* countries but has little influence on the magnitude of the *cross-sectional* impact of austerity for countries in a currency union.

One of the advantages of the model relative to the existing literature is that it adds realistic heterogeneity in terms of country size, trade openness and monetary policy regime. The model shows that the impact of austerity is weaker when the trade elasticity is high, and when the share of imports in government spending is high. For countries in a currency union, domestic spending has a smaller influence on production if the country is more open to trade. Quantitatively, spillover effects from austerity in other countries in Europe are large enough to reduce domestic production and increase debt-to-GDP. The magnitude of this effect varies substantially across countries.

Overall, our model corroborates the empirical finding that austerity played a major role in explaining the cross-sectional patterns of macroeconomic variables observed in Europe during the 2010-2014 period. In addition, we use our model to conduct a number of counterfactual experiments. We first use

the model to generate macroeconomic outcomes in the absence of austerity. For the EU10, the model generates a seven percent drop in production relative to the non-austerity counterfactual.[1] Austerity resulted in even greater losses in the GIIPS economies (Greece, Ireland, Italy, Portugal and Spain). The model suggests that austerity fully accounts for the large drop in output for these countries.

Allowing European nations to pursue independent monetary policy in the face of austerity helps limit the drop in GDP. Relative to the benchmark model, the flexibility of independent monetary policy raises output for the GIIPS economies but reduces output for the EU10. This is because the nominal exchange rate depreciates in the GIIPS region, stimulating exports and output. In contrast, under the euro, the EU10 already enjoys the export advantage of a relatively weak currency.

Finally, the model allows us to consider the dynamics of the debt-to-GDP ratio under different conditions. The main rationale for austerity was to reduce debt and bring debt-to-GDP ratios back to historical norms. However, our model suggests that reductions in government spending had such a severe contractionary effect on economic activity that debt-to-GDP ratios in several countries actually increased as a result. In addition, the model reveals that the austerity measures undertaken by countries' trading partners also contributed importantly to rising domestic debt-to-GDP ratios.

[1]The EU10 consists of Belgium, Germany, Estonia, France, Luxembourg, Netherlands, Austria, Slovenia, Slovak Republic, and Finland.

2. Related Literature

Our research relates to a large and growing body of work on the economic consequences of fiscal austerity and tax and spending multipliers in open economy settings. Perhaps the most closely related paper is Blanchard and Leigh (2013). They regress errors from institutional sector forecasts of real GDP growth on forecasts of fiscal consolidation for the 2010 – 2011 period to argue that most analysts underestimated the size of the fiscal multiplier. They find that a $1 rise in fiscal consolidation (either through revenue or outlays) was associated with a $1 real GDP loss relative to forecast and conclude that actual fiscal "multipliers were substantially above 1", with the exact size depending on the assumed multipliers in the GDP forecasts.[2]

Our approach differs in that we use a DSGE model to consider what would happen if the measured forecast errors were structural shocks. As Blanchard and Leigh point out, such forecast errors "are unlikely to be orthogonal to economic developments" and thus may not provide direct evidence on the magnitude of government spending multipliers. While Blanchard and Leigh are correct, examining the time series and covariance patterns in forecast errors does provide meaningful information regarding the type of underlying shocks experienced by European economies. Three points are worth emphasizing in this regard. First, unlike Blanchard and Leigh, we examine many indicators of economic performance, not just GDP. Austerity shocks should

[2]The forecasts of GDP used by Blanchard and Leigh already incorporate the expected effects of planned fiscal consolidation. Blanchard and Leigh believe that "a reasonable case can be made that [assumed] multipliers [were] about 0.5." In other words, had forecasters assumed a multiplier of zero, Blanchard and Leigh would have found a $1.5 GDP loss for every $1 of fiscal consolidation, close to our benchmark finding of a $1.77 loss.

presumably be associated with negative forecast errors in inflation and positive forecast errors in net exports. If one did not find such associated forecast errors then this would be evidence against the view that government spending shocks played an important role in the European economic experience of 2010-2014.

Second, we control for many other potential sources of economic disturbances. We directly include measured tax changes, debt levels, interest rate spreads, and productivity in our cross-sectional regressions. To the extent that these alternative disturbances were actually to blame for limiting the European recovery, one should expect that the additional explanatory power of government spending shocks would disappear once we include the other forcing variables. As shall be seen, this is not the case.

Finally, our objective is not to argue that the headline relationship between forecast errors in government spending and forecast errors in GDP provides an econometric estimate of a multiplier. Rather, we show that the measured shortfalls in government spending in 2010-2014 are sufficiently large, and are distributed across Europe in such a way, as to generate the changes in output, inflation and net exports as observed in the data. This conclusion is supported both by reduced-form empirical estimates as well as model simulations.

Alesina et al. (2015) and Alesina et al. (2016) follow the 'narrative' approach pioneered by Romer and Romer (2010) to examine the economic consequences of planned, multi-year, fiscal adjustments in OECD economies. According to their analysis, spending-based fiscal consolidations entail relatively small economic costs while tax-based consolidations are substantially

more costly. Our analysis differs from theirs in several ways. While Alesina et al. (2015) base their conclusions on data since 1978, our paper focuses exclusively on the post-crisis period of 2010-2014, which was characterized by large contractions in government spending, a preexisting currency union, interest rates close to the ZLB, and financial market failures. We also focus on *actual* changes in spending and taxes rather than preannounced plans for fiscal consolidation. By measuring the cumulated effect of austerity over five years, we capture the full effect of any policy that was actually implemented, including anticipated or lagged effects of the policy. Finally, our conclusions are based on the wide variation in austerity observed *across countries* during this time period, rather than time-series variation.

The setup of our model is similar to Martin and Philippon (2017) who examine business cycle dynamics in eleven euro area countries around the time of the financial crisis. In their model, fiscal consolidations are a consequence of the buildup in public debt prior to the crisis and the associated increase in credit spreads. Our results are similar to the extent that contractions in government spending are associated with large reductions in economic activity in the aftermath of the Great Recession. However, we find only a weak connection between pre-existing government debt and austerity in 2010-2014 in the full sample of European economies. Furthermore, we find clear evidence of negative effects of austerity, controlling for the level of debt and credit spreads. The data indicate that austerity was pursued across Europe, even in countries with relatively low levels of public debt. It is not debt that drives austerity in the aftermath of the Great Recession, but rather austerity that depresses GDP and generates rising debt-to-GDP ratios.

Several papers have studied fiscal policy in a two-country framework: Blanchard et al. (2016) study how changes in spending by the core economies in Europe affect countries on the periphery. Consistent with our findings, their model produces sizeable spillover effects when monetary policy is constrained by the ZLB. Our model highlight that these spillover effects (and the effects of domestic fiscal policy) substantially vary in size and sign across countries in our multi-country model that is calibrated to match relative country size, trade linkages, heterogeneous fiscal policy and actual differences in monetary policy regimes. Kollmann et al. (2016) estimate a three-region model to tease out the factors that explain the different recovery paths observed in the United States and the euro area as a whole. As is clear from Figure 1, differences between the two regions are smaller than the underlying differences between European countries. Hence, it is not surprising that fiscal policy is found to play a limited role in their analysis. In contrast, Engler and Tervala (2018) show in a framework that allows for hysteresis effects of fiscal policy that austerity can account for about 80 percent of the overall euro area's output deviation from trend in 2013. Our study is complementary to these studies in that we focus on the cross-sectional heterogeneity in economic performance across Europe.

3. The Empirical Relationship between Austerity and Economic Performance

The data set includes the 28 largest economies in Europe and the United States (see the data appendix for details regarding primary sources and definition of variables). Twenty countries in the sample are formally in the euro

area or are pegged to the euro (EU10, GIIPS, Bulgaria, Cyprus, Denmark, Latvia and Lithuania) and the remaining nine have floating exchange rates. Country size varies from less than one percent of the European aggregate (e.g. Cyprus and Luxembourg) to almost 100 percent (the United States is roughly the same size as the European aggregate). The import share varies from a low of 13 percent in the United States to very high shares in Ireland and Luxembourg (44 percent and 57 percent, respectively). The average import share in our sample of European countries is 32 percent. The model in Section 4 will capture the extent of bilateral trade linkages between country pairs, as well as the overall openness to trade.

3.1. Measuring Austerity

We measure austerity as a shortfall in government purchases relative to forecast. Our empirical approach borrows heavily from Blanchard and Leigh (2013), as discussed in the previous section. In contrast to Blanchard and Leigh (2013), rather than relying on forecasts generated by the IMF or national governments, we produce our own forecast measures. This has several advantages: First, institutional forecasts are typically not available for a horizon of five years. Second, we will understand the key driving factors in producing the forecasts themselves. Third, we see how the results change with different forecast specification.[3] And fourth, we can consider additional variables for which institutional forecasts are not available, in terms of both

[3]Our results are essentially invariant to the forecast specification. The paper presents the results only for a single forecast specification that in our view is representative of the set of forecast specifications considered. Interested readers can contact the authors for details on the other specifications.

fiscal and macroeconomic variables.

To illustrate our approach, the left column of Figure 2 shows real government purchases since 1996 for four countries: Germany, France, Greece and the United States. The years 2010-2014—our period of interest—is shaded. It is clear from the plots that government purchases declined significantly in Greece and, to a lesser extent, the United States. The decline was more modest in France and there is no discernable decline in Germany. This characterization of the data does not depend on a particular forecast method—a simple linear trend would yield essentially the same conclusion regarding the extent of austerity in government purchases.

We adopt the following forecast specification:

$$\ln G_{i,t} = \ln G_{i,t-1} + \hat{g}_{EU} + \hat{\gamma}\left(\ln \widehat{Y}_{EU,t-1} - \ln Y_{i,t-1}\right) + \varepsilon^{G}_{i,t}. \tag{1}$$

Here $\ln G_{i,t}$ is the log of real government purchases per capita in country i (deflated by the GDP deflator) at time t, $\ln Y_{i,t}$ is the log of real GDP per capita for country i at time t, and $g_{i,t}$ is the corresponding growth rate, calculated as the difference in log GDP. The "hat" indicates a predicted value of the variable. This forecast specification accounts for both average growth in GDP (the parameter g_{EU}) and convergence dynamics (through the parameter γ). This forecast method assumes that all countries are converging to a common growth rate g_{EU} and that growth rates in Central and Eastern European countries are expected to decline as their per-capita GDP approaches Western European levels. For countries other than Central and Eastern Europe, the inclusion of the convergence effect has a very small impact on the forecast.

The forecasting equation (1) requires estimates of the average growth rate of GDP in Europe, g_{EU}, the convergence parameter γ and predicted values for average log real per capita output in Europe $\hat{Y}_{EU,t}$. These estimates are based on annual data for twelve advanced euro area economies [4] over 1993-2005 using the specification

$$\ln Y_{EU,t} = \beta_{EU} + g_{EU} \cdot t + \varepsilon_{EU,t}. \tag{2}$$

The estimated value for g_{EU} is 0.018 (i.e., 1.8 percent annual growth) with a standard error of 0.0016. $\ln \widehat{Y}_{EU,t}$ are the fitted values from (2).

The convergence parameter γ is estimated from the regression

$$g_{i,t} - \hat{g}_{EU} = \gamma \left(\ln \hat{Y}_{EU,t-1} - \ln Y_{i,t-1} \right) + \varepsilon^{\gamma}_{i,t} \tag{3}$$

using a sample that includes all countries in Central and Eastern Europe[5] for the same time period. The estimated value for γ is 0.024 with a standard error of 0.002.

The forecast errors for 2010 through 2014 are the difference between predicted values based on (1) and the actual values. The predicted values are based on the forecasting parameters as well as information on government purchases up to 2009. For the year 2010, we therefore use the actual realizations of $\ln G_{i,2009}$ and $\ln Y_{i,2009}$ in (1). Starting from $t = 2011$, we replace $\ln G_{i,t-1}$ and $\ln Y_{i,t-1}$ with their predicted values (we describe the forecasts for

[4] Belgium, Denmark, Germany, Ireland, Spain, France, Italy, Luxembourg, Austria, Netherlands, Portugal, and Finland.

[5] Bulgaria, Czech Republic, Estonia, Greece, Cyprus, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia, and the Slovak Republic.

$Y_{i,t-1}$ below). Thus, for 2010-2014, our forecasts use actual data on government purchases and GDP up to 2009. The predicted paths for government purchases and GDP are dotted lines in Figure 2. The cumulated forecast errors are consistent with the view that the fiscal stance was austere in Greece, somewhat austere in the United States and France, and neutral in Germany.

Forecasts for other fiscal policy measures are constructed as follows: Forecasts for social benefits and total revenue are based on a modified version of equation (1) that includes contemporaneous GDP to control for the mechanical link with income. These feedback parameters are estimated using data up to 2005. For statutory tax rates (the VAT, the top income tax rate, the top corporate tax rate) and for the ratio of primary balances to GDP, we adopt a random-walk specification. To reduce the sensitivity to the last observation, the forecast for each country takes the average value for 2008 and 2009 as the "last observation." That is, for dates t after 2009 the forecast for these variables is

$$\hat{x}_{i,t} = \frac{1}{2} \sum_{s=2008}^{2009} x_{i,s}, \tag{4}$$

where $x_{i,t}$ is either a statutory tax rate or the ratio of primary balances relative to GDP.

3.2. Measures of Economic Performance

Forecasts of economic performance measures follow the procedure for government purchases. The right column of Figure 2 shows the time paths of GDP for Germany, France, Greece and the United States. GDP declines sharply in 2007-2009 in all four countries (and indeed in almost all countries in our sample—see the Appendix). Our focus is on the role of austerity in

the aftermath of the Great Recession. As is clear from the figure, Germany and the United States experienced a drop in GDP in the recession and then reverted back to their pre-recession trend (albeit at a lower level). On the other hand, GDP growth in France and Greece remained well below trend.

We adopt the following forecast specification for real GDP based on (3), which again allows for a convergence factor to capture the medium-run growth dynamics of the Central and Eastern European economies:

$$\ln Y_{i,t} = \ln Y_{i,t-1} + \hat{g}_{EU} + \hat{\gamma}\left(\ln \widehat{Y}_{EU,t-1} - \ln Y_{i,t-1}\right) + \varepsilon^{Y}_{i,t}. \tag{5}$$

As with the forecasts for government purchases, this specification accounts for both average GDP growth (the parameter g_{EU}) and convergence dynamics (the parameter γ). The parameters g_{EU} and γ are estimated over the time period 1993-2005 just as they were in Section 3.1 and $\ln \widehat{Y}_{EU,t-1}$ is the fitted value from (2). As before, up to t = 2010:1, we use actual GDP data for $\ln Y_{i,t-1}$ in (5), and replace it by its forecast $\ln \widehat{Y}_{i,t-1}$ thereafter. We use the same procedure to forecast real consumption and investment. To construct forecasts for GDP growth, we use the estimated growth rate $\hat{g}_{i,t} \equiv \hat{g}_{EU} + \hat{\gamma}\left(\ln \widehat{Y}_{EU,t-1} - \ln Y_{i,t-1}\right)$.

Forecasts for the remaining performance indicators (inflation, net exports and the nominal effective exchange rate) are based on the random-walk specification as in (4). Plots for all series, actual and forecasts, are provided in Figures A2a to A8e in the Appendix.

3.3. Austerity and Economic Performance in the Cross Section

Figure 3 is a scatter plot of austerity and the decline in GDP in our cross section of countries. Austerity (along the x-axis) is the shortfall in government purchases relative to forecast, expressed as a share of GDP and averaged over 2010-2014. The y-axis is the shortfall in GDP relative to forecast, again averaged over 2010-2014. Dark circles indicate countries within the euro area or with a fixed exchange rate to the euro, while the open circles are countries with floating exchange rates. There is a strong negative relationship between the two variables: the more severe the austerity, the greater the decline in output. A regression line fitted through the points in Figure 3 delivers a slope coefficient of -2.22 with a standard error of 0.25. This suggests that a shortfall in government purchases of one percent of GDP is associated with a decline in real GDP of 2.22 percent relative to forecast. The relationship between austerity and output is invariant to the exchange rate regime. Greece stands out as having both the sharpest decline in government purchases and the steepest fall in GDP. However, the relationship between austerity and economic activity is not driven by Greece. The estimated coefficient is -1.96 (standard error 0.33) when we exclude Greece and -2.05 (standard error 0.36) when we exclude all GIIPS economies.

The data indicate that it is austerity in the form of reductions in government purchases, and not increases in taxes or cuts to social benefits, that explains the decline in output. To establish this fact, we regress a number of alternative policy variables (each as a deviation from forecast and, if

necessary, scaled by GDP) on the 2010-2014 decline in GDP:

$$\tilde{Y}_{i,2010-2014} = \alpha_0 + \alpha \tilde{G}_{i,2010-2014} + \varepsilon_i. \tag{6}$$

Here $\tilde{Y}_{i,2010-2014}$ denotes the average forecast error for GDP, $\frac{1}{20}\sum_{t=2010:1}^{2014:4}\left(\ln Y_{i,t} - \ln \hat{Y}_{i,t}\right)$. Similarly, $\tilde{G}_{i,2010-2014}$ is the average forecast error for government purchases (or any of the other policy variables) expressed as a percent of GDP. By expressing policy variables as a share of output, the coefficient α can be compared to estimates of the multiplier in the literature.[6] Note that the estimates are based on cross-sectional variation in the data rather than time-series variation.

The first column in Table 1a reflects the slope coefficient in Figure 3 of -2.22. Reductions in social benefits and increases in the VAT have a comparable coefficient to government purchases, but the coefficients are estimated with large standard errors and explain little of the cross-country variation in GDP. We conclude that austerity, in the form of a shortfall in government purchases is the most significant fiscal policy for explaining output in the 2010-2014 period.[7] Based on these results, in what follows we use "austerity" to refer exclusively to reductions in government purchases.

One concern about these estimates is the possibility that the drop in government spending was a result of a contraction in economic activity caused by some third variable. To partially address these endogeneity concerns, Ta-

[6]Transfers and total revenues are also expressed in percent of GDP. The primary balance is expressed in percent of GDP and tax rates are expressed in percentage points.

[7]In the Appendix, we show that this conclusion is robust to different forecast specifications, allowing, for instance, for a linear time-trend specification or an AR(1) structure of economic and fiscal variables (see Table A3).

ble 1b provides evidence on the significance of austerity after controlling for other variables in regression (6). The table reports estimates of the effect of austerity on real GDP for eleven different econometric specifications when controlling for changes in total revenue, total factor productivity (TFP), and four measures of credit market conditions: the household debt-to-GDP ratio, the government debt-to-GDP ratio, the private credit spread and the government bond spread. Controlling for total revenue decreases the coefficient on austerity slightly. Controlling for TFP also weakens the coefficient to -1.79. Including credit measures (columns (4) through (7)) has very little impact on the estimates, including the specification controling for government debt. Columns (8) through (11) include total revenue and TFP together with each of the credit measures. Depending on the controls, the estimated coefficient on austerity is between -2.22 (specification 1) and -1.64 (specification 8). The coefficients change only slightly when the GIIPS countries are dropped from the sample (see Appendix Table A4b). We take specification (11) and the coefficient of -1.77 as our benchmark for assessing the performance of the model in Section 4. This specification has the virtue of producing an estimate roughly in the middle of the range of estimates and includes controls for productivity, taxes and credit market stress.

An additional concern is that austerity policies during this period were motivated by the need to reduce debt, and therefore it is debt, not austerity, that depresses output. To evaluate this hypothesis, we regress the debt-to-GDP ratio in 2009 on our 2010-2014 average forecast errors for a number of fiscal policy measures, such as government purchases and tax rates. The coefficients reported in Table 2 are small and generally insignificantly dif-

ferent from zero, suggesting that in the cross-section, austerity policies are not correlated with the 2009 debt-to-GDP ratio. Put another way, austerity policies were pursued by most countries in Europe, including those that had not accumulated high levels of public debt.

We next extend our analysis to include additional macroeconomic variables. While these empirical results are interesting in and of themselves, they also provide additional information that we later use to evaluate the performance of our model. Table 3 reports the impact of austerity on these other macroeconomic variables.[8] In each regression, we include all of the control variables from specification (11) of Table 1b, though the table reports only the coefficients on government purchases shortfalls. The table also shows the results for subsamples of fixed and floating exchange rates. In particular, we interact the average forecast deviation of government purchases with a dummy for fixed exchange rate countries and report estimates of the corresponding coefficients α^{fix} and α^{fl}.

The results in the table indicate that austerity is associated with declines in consumption, investment and GDP growth. These estimates are roughly the same across countries with fixed and floating exchange rates. This is somewhat surprising because models—including our own—typically predict that fiscal policy is more effective in currency unions (see e.g. Farhi and Werning, 2016), and will be discussed below. The decrease in investment is noteworthy because many textbook models would predict a crowding-out

[8]For consumption and investment, we express the average forecast error in terms of GDP by pre-multiplying it by the average share of consumption and investment in GDP over the 2000-2010 period.

effect where decreases in government purchases would lead to an increase in investment. Austerity is also associated with lower inflation. Interestingly, this effect is independent of the exchange rate regime although the effect is stronger for fixed exchange rate countries. One possible interpretation of this finding is as evidence for a cross-sectional Phillips-Curve relationship similar to the findings in Beraja et al. (2016), and Nakamura and Steinsson (2014). There is also a strong positive association between net exports and austerity, which, for floating exchange rate countries, is associated with a depreciation of the nominal effective exchange rate. The last six columns of Table 3 will be discussed in Section 5.

In summary, we find a robust relationship between austerity, measured as cuts in government spending relative to forecast, and a decline in GDP. The cross-sectional pattern in GDP cannot be explained by TFP, changes in taxes, interest rates or household debt. Austerity is also negatively associated with declines in consumption and investment and with an increase in net exports.

4. Model

Next we develop a multi-country business cycle model that can explain the associations between austerity and various macroeconomic variables found in Section 3 for fixed and floating exchange rate countries. The model is calibrated to match the economic size and bilateral trade flows of the 29 countries in our sample and incorporates many features from modern monetary business cycle models (e.g. Smets and Wouters, 2007; Christiano et al., 2005), international business cycles models (e.g. Chari et al., 2000), and financial accelerator models (e.g. Bernanke et al., 1999; Brave et al., 2012). The main

ingredients of the model are (i) price rigidity, (ii) international trade, (iii) hand-to-mouth consumers, (iv) a net worth channel for business investment, and (v) government purchases and monetary policy shocks.

4.1. Households

The world economy is populated by $n = 1...N$ countries. Every country has a representative household, firms that produce the country-specific intermediate good, and firms that produce the final good. As in Heathcote and Perri (2002), intermediate goods are tradable across countries, but final goods are nontradable. In each country, the representative household owns all of the domestic firms.

All variables in the model are written in per-capita terms. To convert any variable to a national total, we scale by the population of country n, $\mathbb{N}_n$. In each period t the economy experiences one event s_t from a potentially infinite set of states. We denote by s^t the history of events up to and including date t. The probability at date 0 of any particular history s^t is given by $\pi\left(s^t\right)$.[9]

At date 0, the expected discounted sum of future period utilities for a household in country n is given by

$$\sum_{t=0}^{\infty} \sum_{s^t} \pi\left(s^t\right) \beta^t U\left(c_{n,t}, L_{n,t}\right), \tag{7}$$

where $c_{n,t}$ and $L_{n,t}$ denote (state-contingent) consumption and labor alloca-

[9]Unless confusion arises, we write $X_{n,t}$ for $X_n(s^t)$.

tions, respectively. We set the flow utility function $U(\cdot)$ to

$$U(c_n, L_n) = \frac{1}{1-\frac{1}{\sigma}} \left(c_n - \kappa_n \frac{L_n^{1+\frac{1}{\eta}}}{1+\frac{1}{\eta}} \right)^{1-\frac{1}{\sigma}}, \tag{8}$$

where $\beta < 1$ is the subjective time discount factor, σ is the intertemporal elasticity of substitution for consumption, η is the Frisch labor supply elasticity, and κ_n is a country-specific weight on the disutility of labor. This specification follows Greenwood et al. (1988) (GHH hereafter) and assumes that consumption and labor are complements for the household. As shown by Nakamura and Steinsson (2014) among others, GHH preferences play an important role for the transmission of austerity shocks by eliminating the reaction of labor supply to changes in household income and creating complementarities between consumption and labor.

A key feature of the model is a hand-to-mouth restriction on a fraction χ of a household's members in the economy. These household members receive income in proportion to their consumption share of total income and spend the entire amount on current consumption. That is, hand-to-mouth consumption each period is given by $c_{n,t}^{htm} \equiv \frac{\bar{C}_n}{\bar{Y}_n} Y_{n,t}$ where the bars indicate steady-state values.[10] The remaining $1-\chi$ members of the representative household choose consumption optimally and thus behave in accordance with

[10] Technically, our specification for the hand-to-mouth consumers assumes that they spend a fixed share of domestic absorption $Y_{n,t}$ rather than a fixed share of nominal national income $p_{n,t}Q_{n,t}$. Quantitatively there is only a small difference between these specifications.

the permanent income hypothesis. *Aggregate* consumption is then given by

$$C_{n,t} = (1-\chi)\, c_{n,t} + \chi c_{n,t}^{htm}. \tag{9}$$

This specification allows us to introduce hand-to-mouth behavior while leaving the other first-order conditions unchanged.

Households in each country own the capital stock in their country. They supply labor to the intermediate goods producing firms and capital to the entrepreneurs. Households choose consumption $c_{n,t}$, labor $L_{n,t}$, next period's capital stock $K_{n,t}$ and current investment $X_{n,t}$ to maximize the expected discounted sum of future period utilities subject to a sequence of budget constraints.

The budget constraint for country n's representative household is

$$\begin{aligned} &P_{n,t}\left[(1+\tau_n^c)c_{n,t} + X_{n,t}\right] + (1-\delta)\,\mu_{n,t}K_{n,t-1} + \sum_{j=1}^{N}\frac{E_{j,t}S_{n,t}^j}{E_{n,t}} + \sum_{s^{t+1}}\frac{\varrho\,(s^t, s_{t+1})\,b_n(s^t, s_{t+1})}{E_{n,t}} \\ &= \mu_{n,t}K_{n,t} + (1-\tau_n^L)W_{n,t}L_{n,t} + (1-\tau_n^{\Pi})\Pi_{n,t}^f + \sum_{j=1}^{N}\frac{E_{j,t}\,(1+i_{j,t-1})\,S_{n,t-1}^j}{E_{n,t}} + \frac{b_n(s^{t-1}, s_t)}{E_{n,t}} + \mathbb{T}_{n,t}. \end{aligned} \tag{10}$$

The left side of the budget constraint reflects household expenditures on the final consumption good, inclusive of a constant value-added consumption tax τ_n^c, and on investment. The household also participates in international financial markets and has access to both state-contingent and non-contingent bonds. Let $b_n(s^t, s_{t+1})$ be the quantity of state-contingent bonds purchased by the household in country n after history s^t. These bonds pay off in units of a reserve currency which we take to be U.S. dollars. Let $\varrho\,(s^t, s_{t+1})$ be the nominal price of one unit of the state-contingent bond which pays off in state

s^{t+1}. Each country has non-contingent nominal bonds that can be traded. Let $S^j_{n,t}$ be the number of bonds denominated in country j's currency and held by the representative agent in country n. The gross nominal interest rate for country n's bonds is $1 + i_{n,t}$. The nominal exchange rate to convert country n's currency into the reserve currency is $E_{n,t}$.

The right side of the budget constraint reflects the household's income. The household earns nominal wages net of labor taxes $(1 - \tau^L_n)W_{n,t}L_{n,t}$, nominal payments for sales of capital $\mu_{n,t}K_{n,t-1}$ and profits from intermediate good firms net of taxes on profits, $(1-\tau^{\Pi}_n)\Pi^f_{n,t}$. Here $W_{n,t}$ is the nominal wage, τ^L_n is a constant labor tax rate, $\mu_{n,t}$ is the nominal price of capital, $\Pi^f_{n,t}$ are nominal profits of intermediate goods firms and τ^{Π}_n is the constant tax rate on profits. We assume that households sell capital to entrepreneurs and then subsequently repurchase the undepreciated capital. This assumption is convenient for introducing financial market imperfections later. The household also receives lump-sum transfers $\mathbb{T}_{n,t}$. This transfer includes nominal lump-sum taxes or transfers $T_{n,t}$, profits from the financial sector and entrepreneurs, $\Pi^{fin}_{n,t} + \Pi^e_{n,t}$, and the nominal amount consumed by hand-to-mouth consumers, $P_{n,t}c^{htm}_{n,t}$ where $P_{n,t}$ is the nominal price of the final good.[11] Thus,

$$\mathbb{T}_{n,t} \equiv -T_{n,t} + \Pi^e_{n,t} + \Pi^{fin}_{n,t} - P_{n,t}c^{htm}_{n,t}. \tag{11}$$

[11] In addition to lending to other countries, households extend domestic loans to financial intermediaries, who in turn lend to domestic entrepreneurs at a risky interest rate $(1 + i_{n,t})F(\lambda_{n,t})$. Profits or losses on these loans are returned to the household as a lump sum transfer. We discuss the loans to the entrepreneurs in greater detail below.

The household also faces the capital accumulation constraint:

$$K_{n,t} = K_{n,t-1}\left(1-\delta\right) + \left[1 - f\left(\frac{X_{n,t}}{X_{n,t-1}}\right)\right] X_{n,t}, \tag{12}$$

with $f(1) = f'(1) = 0$ and $f''(1) \geq 0$, as in Christiano et al. (2005).

The first-order conditions for an optimum are as follows. The optimizing household's Euler equation for purchases of state contingent bonds $b_n(s^t, s_{t+1})$ requires

$$\varrho\left(s^t, s_{t+1}\right) \frac{U_{1,n,t}}{E_{n,t}P_{n,t}} = \beta\pi(s^{t+1}|s^t)\frac{U_{1,n,t+1}}{E_{n,t+1}P_{n,t+1}} \tag{13}$$

and

$$\frac{U_{1,n,t}}{E_{n,t}P_{n,t}} = \frac{U_{1,m,t}}{E_{m,t}P_{m,t}}, \tag{14}$$

where $U_{j,n,t}$ denotes the derivative of $U\left(c_{n,t}, L_{n,t}\right)$ with respect to its j^{th} argument.

The labor supply condition is

$$-\frac{U_{2,n,t}}{U_{1,n,t}} = \left(\frac{1-\tau_n^L}{1+\tau_n^c}\right)\frac{W_{n,t}}{P_{n,t}}. \tag{15}$$

Finally, the optimal choice for investment and capital requires

$$1 = \frac{\mu_{n,t}}{P_{n,t}}\left\{1 - f_{n,t} - \frac{X_{n,t}}{X_{n,t-1}}f'_{n,t}\right\} + \beta\frac{U_{1,n,t+1}}{U_{1,n,t}}\frac{\mu_{n,t+1}}{P_{n,t+1}}\left(\frac{X_{n,t+1}}{X_{n,t}}\right)^2 f'_{n,t+1}, \tag{16}$$

where we write $f_{n,t} = f\left(\frac{X_{n,t}}{X_{n,t-1}}\right)$.

4.2. Firms

There are three types of firms in the model. The first type, referred to as "final goods producers", are firms that combine tradable intermediate inputs

to produce a final nontraded good for private consumption and investment and for government purchases. The two other types of firms produce tradable intermediate goods in a two-stage process. In the first stage, monopolistically competitive domestic firms use capital and labor to produce input varieties. Prices of the input varieties are set according to a Calvo pricing mechanism. In the second stage, competitive firms combine the input varieties into the tradable intermediate good. Neither capital nor labor can be moved across countries. Below, we describe the production chain of these three types of firms in detail, beginning with the production of the tradable intermediate goods.

4.2.1. Tradable Intermediate Goods

Each country produces a single (country-specific) type of tradable intermediate good in two stages.

Second-Stage Intermediate Producers. The second-stage producers assemble the tradable intermediate good from domestically-produced input varieties. The second-stage producers solve

$$\max_{q_{n,t}(\xi)} \left\{ p_{n,t} Q_{n,t} - \int_0^1 \varphi_{n,t}(\xi)\, q_{n,t}(\xi)\, d\xi \right\} \tag{17}$$

subject to the CES production function

$$Q_{n,t} = \left[\int_0^1 q_{n,t}(\xi)^{\frac{\psi_q - 1}{\psi_q}} d\xi \right]^{\frac{\psi_q}{\psi_q - 1}}. \tag{18}$$

Here $Q_{n,t}$ is the real quantity of country n's tradable intermediate good produced at time t. The variable ξ indexes the continuum of differentiated

varieties and the parameter $\psi_q > 1$ governs the degree of substitutability across varieties. The nominal price of each variety is $\varphi_{n,t}(\xi)$ and its quantity is $q_{n,t}(\xi)$. Demand for each variety has an iso-elastic form

$$q_{n,t}(\xi) = Q_{n,t}\left(\frac{\varphi_{n,t}(\xi)}{p_{n,t}}\right)^{-\psi_q}. \tag{19}$$

The competitive price of the intermediate $p_{n,t}$ is a combination of the prices of the varieties,

$$p_{n,t} = \left[\int_0^1 \varphi_{n,t}^{1-\psi_q} d\xi\right]^{\frac{1}{1-\psi_q}}. \tag{20}$$

First-Stage Intermediate Producers. The varieties $q_{n,t}(\xi)$ are produced by first-stage intermediate producers that hire workers at the nominal wage $W_{n,t}$ and rent capital at the nominal rental price $R_{n,t}$. These firms have Cobb-Douglas production functions

$$q_{n,t}(\xi) = Z_n\left[k_{n,t}(\xi)\right]^{\alpha}\left[l_{n,t}(\xi)\right]^{1-\alpha}, \tag{21}$$

where Z_n measures (constant) total factor productivity. Because first-stage producers are monopolistically competitive, they typically charge a markup for their products. The desired price naturally depends on the demand curve (19). Each variety good producer ξ freely chooses capital and labor each period. Cost minimization implies that the nominal marginal cost is

$$MC_{n,t} = \frac{W_{n,t}^{1-\alpha} R_{n,t}^{\alpha}}{Z_n}\left(\frac{1}{1-\alpha}\right)^{1-\alpha}\left(\frac{1}{\alpha}\right)^{\alpha}. \tag{22}$$

Pricing. The nominal prices of input varieties are adjusted only infrequently according to the standard Calvo mechanism. For any firm, there is a proba-

bility θ that the firm cannot change its price that period. When a firm can reset its price it chooses an optimal reset price. Formally, the maximization problem of a firm that can reset its price at date t is

$$\max_{\varphi^*_{n,t}} \sum_{j=0}^{\infty} (\theta\beta)^j \sum_{s^{t+j}} \pi(s^{t+j}|s^t) \frac{U_{1,t+j}}{(1+\tau^c_n)P_{n,t+j}} \left(\varphi^*_{n,t} - MC_{n,t+j}\right) Q_{n,t+j} \left(\frac{\varphi^*_{n,t}}{p_{n,t+j}}\right)^{-\psi_q}. \tag{23}$$

We denote the optimal reset price as $\varphi^*_{n,t}$. Because the first-stage intermediate producers adjust their prices infrequently, the nominal price of the tradable intermediate goods is sticky. In particular, using (20), the nominal price of the tradable intermediate good evolves according to

$$p_{n,t} = \left[\theta p_{n,t-1}^{1-\psi_q} + (1-\theta)\left(\varphi^*_{n,t}\right)^{1-\psi_q}\right]^{\frac{1}{1-\psi_q}}. \tag{24}$$

Our specification of price setting assumes that firms set prices in their own currency. As a result, when exchange rates move, the implied import price moves automatically (there is complete pass-through).

4.2.2. Final Goods Producers

Final goods are assembled from a (country-specific) constant-returns-to-scale CES combination of tradable intermediates produced by the various countries in the model. The final good producers are competitive in both the global input markets and the final goods market and therefore make zero profits. The final goods producers solve

$$\max_{y^j_{n,t}} \left\{ P_{n,t}Y_{n,t} - \sum_{j=1}^{N} \frac{E_{j,t}}{E_{n,t}} p_{j,t} y^j_{n,t} \right\} \tag{25}$$

subject to the CES production function

$$Y_{n,t} = \left(\sum_{j=1}^{N} \left(\omega_n^j\right)^{\frac{1}{\psi_y}} \left(y_{n,t}^j\right)^{\frac{\psi_y - 1}{\psi_y}} \right)^{\frac{\psi_y}{\psi_y - 1}}. \tag{26}$$

Here, $y_{n,t}^j$ is the amount of country-j intermediate good used in production by country n. The parameter ψ_y governs the degree of substitutability across the tradable intermediate goods and the preference weights satisfy $\omega_n^j \geq 0$ with $\sum_{j=1}^{N} \omega_n^j = 1$ for each country n. The country-pair-specific ω_n^j parameters are later calibrated to match data on bilateral import shares.

Demand for country-specific intermediate goods is isoelastic:

$$y_{n,t}^j = Y_{n,t} \omega_n^j \left[\frac{E_{j,t}}{E_{n,t}} \frac{p_{j,t}}{P_{n,t}} \right]^{-\psi_y}. \tag{27}$$

The implied nominal price of the final good is

$$P_{n,t} = \left(\sum_{j=1}^{N} \omega_n^j \left(\frac{E_{j,t}}{E_{n,t}} p_{j,t} \right)^{1-\psi_y} \right)^{\frac{1}{1-\psi_y}}. \tag{28}$$

Unlike the intermediate goods, the final good cannot be traded and must be used for either investment, consumption or government purchases in the period in which it is produced.

4.3. Financial Market Imperfections and the Supply of Capital

The model incorporates a financial accelerator mechanism similar to Carlstrom and Fuerst (1997) and Bernanke et al. (1999). Entrepreneurs buy capital goods from households using a mix of internal and external funds

(borrowing). The entrepreneurs rent purchased capital to the first-stage intermediate good producers in their own country and then sell it back to the household the following period. The interest rate that entrepreneurs face for borrowed funds is a function of their financial leverage ratio. As a consequence, fluctuations in net worth cause changes in the effective rate of return on capital and thus directly affect real economic activity (see also Brave et al., 2012, for the same approach).

Formally, at the end of period t, entrepreneurs purchase capital $K_{n,t}$ from the households at the nominal price $\mu_{n,t}$ per unit. Entrepreneurs finance these purchases with their own internal funds (net worth) and intermediated borrowing. Let end-of-period nominal net worth be $P_{n,t}NW_{n,t}$, denominated in country n's currency. Then, to purchase capital, the entrepreneur borrows $B_{n,t} = \mu_{n,t}K_{n,t} - P_{n,t}NW_{n,t}$ units from the households in their country. The nominal interest rate on business loans equals the nominal interest rate on government bonds times an external finance premium $F(\lambda_{n,t}) \equiv F_{n,t}$ with F' and $F'' > 0$. Here, $\lambda_{n,t} = \frac{\mu_{n,t}K_{n,t}}{P_{n,t}NW_{n,t}}$ is the leverage ratio.[12] The interest rate is then $(1 + i_{n,t})\, F_{n,t}$. The function $F(\cdot)$ implies that entrepreneurs who are more highly leveraged pay a higher interest rate.

At the beginning of period $t+1$, entrepreneurs earn a utilization-adjusted rental price of capital net of capital taxes $(1 - \tau_n^K)u_{n,t+1}R_{n,t+1}$ and then sell the undepreciated capital back to the households at the capital price $\mu_{n,t+1}$. Depreciation costs are tax deductible. Varying the utilization of

[12] We assume that $F(1) = 1$. Technically, it also assumed that for any $\lambda < 1$, $F(\lambda) = 1$ so there is no interest rate premium or discount for an entrepreneur who chooses to have positive net saving. Since the return on capital exceeds the safe rate in equilibrium, all entrepreneurs are net borrowers.

capital requires $K_{n,t}a\left(u_{n,t+1}\right)$ units of the final good. Each period, a fraction $(1-\gamma_n)$ of the entrepreneurs' net worth is transferred to the households. We set $\gamma_n = \frac{\beta}{F_n}$ so that net worth is constant in a stationary equilibrium.

Each period, entrepreneurs choose $K_{n,t+1}$ and utilization $u_{n,t+1}$ to maximize expected net worth $NW_{n,t+1}$. Net worth evolves over time according to

$$\frac{NW_{n,t+1}}{\gamma_n} = K_{n,t}\left[(1-\tau_n^K)u_{n,t+1}\frac{R_{n,t+1}}{P_{n,t+1}} + \frac{\mu_{n,t+1}}{P_{n,t+1}}(1-\delta(1-\tau_n^K)) - a\left(u_{n,t+1}\right)\right] - \frac{(1+i_{n,t})F_{n,t}}{P_{n,t+1}}B_{n,t}. \tag{29}$$

The utilization choice requires the first-order condition

$$(1-\tau_n^K)\frac{R_{n,t}}{P_{n,t}} = a'\left(u_{n,t}\right). \tag{30}$$

Following Christiano et al. (2005) it is assumed that the utilization cost function is $a\left(u\right) = \frac{\bar{R}}{P}\left[\exp\left\{h\left(u-1\right)\right\}-1\right]\frac{1}{h}$ where the curvature parameter h governs how costly it is to increase or decrease utilization from its steady state value of $\bar{u}=1$.

The first-order condition for the choice of $K_{n,t}$ requires

$$\frac{\mu_{n,t}(1+i_{n,t})F_{n,t}}{P_{n,t+1}} = \sum_{s^{t+1}}\pi(s^{t+1}|s_t)\left[(1-\tau_n^K)u_{n,t+1}\frac{R_{n,t+1}}{P_{n,t+1}} + \frac{\mu_{n,t+1}}{P_{n,t+1}}\left(1-\delta(1-\tau_n^K)\right) - a\left(u_{n,t+1}\right)\right]. \tag{31}$$

As is standard in financial accelerator models, the external finance premium $F_{n,t}$ drives a wedge between the nominal interest rate on bonds and the expected nominal return on capital. Notice that if $F_{n,t}=1$ then we obtain the standard efficient outcome in which the market price of capital is the discounted stream of rental prices.

4.4. Government Policy

Government purchases follow an auto-regressive process

$$G_{n,t} = (1 - \rho_G)\,\bar{G}_n + \rho_G G_{n,t-1} + \varepsilon^G_{n,t}, \tag{32}$$

where $\bar{G}_n$ indicates the steady-state level of government purchases. The government raises revenue by imposing taxes on consumption, labor income, capital income and monopoly profits at constant rates. In periods where revenue falls short of expenditures, the government imposes a lump sum tax on households.[13]

The government splits its purchases across the final good and the domestically produced intermediate good. We denote by υ_n the share of government purchases that falls on the intermediate good. If $\upsilon_n > 0$, government purchases exhibit a stronger home bias than private consumption and investment. Below, υ_n is calibrated to match the oberseved (country-specific) home bias of government purchases.

Monetary policy is conducted through a Taylor Rule which stipulates that in each country, a monetary authority conducts open market operations in its own currency to target the nominal interest rate. The Taylor Rule has

[13] According to our specification for hand-to-mouth consumers, a fall in government spending is not directly offset by lower taxes for hand-to-mouth consumers. We believe that this is a reasonable depiction of fiscal policy during the austerity period in Europe 2010-2014. Table A2a in the Appendix shows that forecast errors of government purchases were not positively, and if anything, were negatively correlated with forecast errors of tax rates.

the form

$$1 + i_{n,t} = \phi_i \left(1 + i_{n,t-1}\right) + \left(1 - \phi_i\right) \left[\left(\frac{GDP_{n,t}}{\overline{GDP}_n} \right)^{\phi_{GDP}} \left(\pi_{n,t}\right)^{\phi_\pi} + \bar{\imath}_n \right] + \varepsilon^i_{n,t}, \quad (33)$$

where $GDP_{n,t}$ is country n's real GDP, $\overline{GDP}_n$ its steady-state value, $\pi_{n,t}$ is country n's inflation and $\bar{\imath}_n$ is the steady-state nominal interest rate. For simplicity the reaction parameters ϕ_{GDP}, ϕ_π and ϕ_i are assumed to be common across countries.

Countries in the euro area have a fixed nominal exchange rate for every country in the union and a common nominal interest rate. The monetary authority for the countries within the euro area (the ECB) has a Taylor Rule similar to (33) with the exception that monetary policy reacts to the GDP-weighted average of innovations in GDP and inflation for the countries in the union. By definition, the countries that peg their exchange rate to the euro adjust their policy to keep the bilateral exchange rate towards the euro constant.

4.5. Aggregation and Market Clearing

For each country n, aggregate production of the tradable intermediate goods is (up to a first-order approximation) given by

$$Q_{n,t} = Z_n \left(u_{n,t} K_{n,t-1}\right)^\alpha L_{n,t}^{1-\alpha}. \quad (34)$$

Market clearing for the intermediate goods produced by country n is

$$Q_{n,t} = \left(\sum_{j=1}^{N} \frac{\mathbb{N}_j}{\mathbb{N}_n} y^n_{j,t} \right) + \upsilon_n G_{n,t}. \quad (35)$$

The market clearing condition for the final good is

$$Y_{n,t} = C_{n,t} + X_{n,t} + (1 - \upsilon_n)G_{n,t} + a\left(u_{n,t}\right)K_{n,t-1}. \tag{36}$$

Finally, the bond market clearing conditions require

$$\sum_{n=1}^{N} \mathbb{N}_n S_{n,t}^{j} = \sum_{n=1}^{N} \mathbb{N}_n b_n(s^t, s_{t+1}) = 0 \qquad \forall j, s_{t+1}. \tag{37}$$

Since final goods are not traded, net exports are comprised entirely of intermediate goods. For each country n, nominal net exports are the value of production less the value of domestic absorption:

$$NX_{n,t} = p_{n,t}\left(Q_{n,t} - \upsilon_n G_{n,t}\right) - P_{n,t}Y_{n,t}, \tag{38}$$

where the second equality follows from the zero profit condition for the final goods producers. Then, nominal GDP can be written as

$$NGDP_{n,t} = p_{n,t}Q_{n,t} = NX_{n,t} + P_{n,t}\left[C_{n,t} + X_{n,t} + G_{n,t} + a\left(u_{n,t}\right)K_{n,t}\right]. \tag{39}$$

Real GDP is $GDP_{n,t} = \bar{p}_n Q_{n,t}$, i.e. it is calculated using a fixed price deflator in which the base year prices are chosen as corresponding to the steady state).

4.6. Steady state and Calibration

The model is solved with a first-order approximation of the equilibrium conditions around the model's non-stochastic steady state with zero inflation. Table 4 provides a summary of the benchmark parameters.

Preferences. The subjective time discount factor β is set to imply a long run real annual interest rate of four percent. We set the intertemporal elasticity of substitution σ to 0.50 and the Frisch elasticity of labor supply η to 1. These values are comparable to findings in the microeconomic literature on preference parameters (e.g. Barsky et al., 1997) and are fairly standard in the macroeconomic literature (e.g. Nakamura and Steinsson, 2014; Hall, 2009). We set the share of hand-to-mouth consumers to $\chi = 0.5$. This is the value proposed in the original study by Campbell and Mankiw (1989) and is consistent with the calibration in Martin and Philippon (2017).

Technology. The capital share parameter α is set to 0.38, as in Trabandt and Uhlig (2011) who match data for 14 European countries and the US. The quarterly depreciation rate is set to 2.8 percent to match the share of private investment in final demand, X_n/Y_n.

The form of the investment adjustment cost $f(\cdot)$ implies a relationship between investment growth and Tobin's Q. We adopt the value $f''(1) = 2.48$ from Christiano et al. (2005) which implies that a one percent increase in Q causes investment to increase by roughly 0.4 percent. For the utilization cost function the elasticity of utilization with respect to the real rental price of capital is governed by the parameter $h = \frac{a''(1)}{a'(1)}$. We follow Del Negro et al. (2013) by setting $h = 0.286$. This implies that a one percent increase in the real rental price R_n/P_n causes an increase in the capital utilization rate of 0.286 percent.

Financial Market Imperfections. In the steady state, the nominal prices of capital and the final consumption good are equal. The entrepreneurs' optimal

choice for capital implies that

$$\frac{1}{\beta}\bar{F}_n = \left(1-\tau_n^K\right)\frac{\bar{R}_n}{\bar{P}_n} + \left(1-\delta\left(1-\tau_n^K\right)\right), \tag{40}$$

where steady state interest rate spreads are $\bar{F}_n \equiv F_n\left(\bar{\lambda}_n\right)$. These external finance premia are calculated as the average spread between lending rates (to non-financial corporations) and central bank interest rates. For every country, we calculate an average for 2005. The data source for the spread data is the ECB for euro area countries, the Global Financial Database and national central banks for the remaining countries.Given values for $\bar{F}_n$, the equation above determines the real rental price of capital $\bar{R}_n/\bar{P}_n$ in each country.

The elasticity of the external finance premium with respect to leverage F_ϵ is 0.025, implying that an increase in the leverage ratio of 10 percent raises the annual spread by 1 percentage point. This value is in the middle range of values used in the literature.[14] The calibration for the leverage ratio lev_n adopts the value from Brave et al. (2012) for the U.S ($lev = 2.11$).

Trade and Country Size. We choose parameters to ensure that all real exchange rates $\bar{e}_{j,n} \equiv \frac{\bar{E}_j}{\bar{E}_n}\frac{\bar{p}_j}{\bar{p}_n}$ are 1 in steady state. With $\bar{e}_{j,n} = 1$ for all j, n it is straightforward to show that the price of the final consumption good and the price of the tradable intermediate good are equal, $\bar{P}_n = \bar{p}_n$. With zero inflation, the price of intermediates is a constant markup over nominal

[14] In Bernanke et al. (1999), the calibration of parameters implies an elasticity of 0.05. Del Negro et al. (2013) estimate an elasticity of 0.08, whereas Brave et al. (2012) estimate an elasticity of 0.002.

marginal cost, $\bar{p}_n = \frac{\psi_q}{\psi_q - 1}\overline{MC}_n$. Bilateral import ratios satisfy $\frac{\bar{y}_n^j}{\bar{Y}_n} = \omega_n^j$, and are calibrated to the share of imports y_n^j in the production of the final good, Y_n. We use data from the OECD on trade in value added (TiVA). TiVA has information on the value added content of final demand by source country for all country pairs in our data sample. We directly use these values for y_n^j and the implied final demand value for Y_n to calculate ω_n^j for all country pairs using averages for 2005 and 2010.

In addition to matching the import ratios, we also calibrate the model to match observed relative country sizes, $\frac{\mathbb{N}_j \bar{Y}_j}{\mathbb{N}_n \bar{Y}_n}$ taken from the TiVA tables. Taken together this ensures that the shares of net exports relative to domestic absorbtion $\overline{NX}_n/\bar{Y}_n$ are matched.

The elasticity of substitution between home and foreign goods, ψ_y, is set to 0.5. This is comparable to parameter values used in international business cycle models with trade. In their original paper, Heathcote and Perri (2002) estimated $\psi_y = 0.90$. Using firm-level data, Cravino (2017) and Proebsting (2015) find elasticities close to 1.5. We consider higher elasticities in the sensitivity analysis below.

Price Rigidity. The Calvo price setting hazard is set to roughly match observed frequencies of price adjustment in the micro data. In their sample of European countries, Alvarez et al. (2006) find that the average duration of prices is 13 months. This corresponds to $\theta = 0.80$ for a quarterly model.

Fiscal and Monetary Policy. Steady-state values of government purchases, $\bar{G}_n$, are set to match each country's average value from 2000-2010. The share of government purchases that directly falls on the intermediate good, υ_n, is

chosen to match the observed import shares of government purchases. We take these shares from the World Input Output Database (it is not available in the TiVA database). On average, the value for υ_n is 0.86, indicating that government purchases exhibit a stronger home bias than private purchases.

The persistence of the government purchase shock is set to 0.93, which corresponds to a half life of 2.5 years. This is in line with fiscal consolidation plans laid out by governments around 2009, where most consolidation measures were to be implemented until 2012 (see Forthun et al., 2011).

We use implicit tax rates to calibrate the values for τ_n^C, τ_n^L and τ_n^K, and set the profit tax rate equal to the capital tax rate, $\tau_n^\Pi = \tau_n^K$. Calculation of tax rates for consumption, labor and capital builds on Mendoza et al. (1994) and Eurostat (2014) and are based on data from the National Tax Lists. Compared to statutory tax rates, the advantages of these rates are that they take into account the net effect of existing rules regarding exemptions and deductions. We use the average over 2005 through 2009. Table A9 in the Appendix includes a list of all countries, implicit tax rates, shares of government purchases in GDP, import shares of government purchases and financial market spreads.

We choose our Taylor rule parameters to be $\phi_\pi = 1.5$, $\phi_{GDP} = 0.5$ and $\phi_i = 0.75$, which is in line with estimates by Clarida et al. (2000).

4.7. Forcing Variables

Our approach is to treat the austerity forecast deviations calculated in Section 3 as structural shocks. In addition to the austerity shocks, the model features monetary policy shocks.

Austerity Shocks. Government purchase shocks are based on forecast errors from equation (1). Annual forecast errors are interpolated to quarterly series using the Chow-Lin method (Chow and Lin, 1971).

Monetary Policy Shocks. To measure monetary policy shocks we estimate a generalized Taylor rule of the form suggested by Clarida et al. (2000):

$$i_{n,t} = \phi_i i_{t-1} + (1-\phi_i)\left[r_n + \phi_\pi\left(\pi_{n,t} - \pi_n^*\right) + \phi_{GDP}\left(\ln GDP_{n,t} - \ln \overline{GDP}_{n,t}\right)\right] + \varepsilon_{n,t}^i, \quad (41)$$

where $i_{n,t}$ is the nominal (annualized) interest rate, r_n is the long-run (annualized) interest rate, $\pi_{n,t}$ is (annualized) inflation, π_n^* is the inflation target, $\ln GDP_{n,t} - \ln \overline{GDP}_{n,t}$ is the log deviation of real GDP from its trend, and $\varepsilon_{n,t}^i$ is a structural shock. We impose the values $\phi_i = 0.75$, $\phi_\pi = 1.5$ and $\phi_{GDP} = 0.5$ from our calibration and then estimate the intercept for each of the central banks in our model that have an independent monetary policy. Given our estimates of the intercepts, the monetary policy shocks can then be recovered as $\hat{\varepsilon}_{n,t}^i = i_{n,t} - \hat{i}_{n,t}$.

5. Model and Data Comparison

In this section, we feed the estimated structural shocks for the 2005-2014 period into the model and compare the simulated data with the actual data. Throughout, simulated data and actual data are treated in the same way (in terms of detrending, scaling and definitions of variables, etc.).

5.1. Benchmark Model Performance

The benchmark model includes austerity shocks and monetary policy shocks for the baseline calibration given in Table 4. Table 3 shows a compar-

ison of the cross-sectional OLS estimates on austerity for the period 2010-2014 generated by the model and the data. Overall, the coefficients from the model (the middle set of columns labeled "Benchmark") are consistent with the estimates from the data in terms of magnitude and sign. Empirically, the coefficient on GDP is 1.77; the corresponding coefficient in the model is 1.94. Both in the data and the model the response of GDP to austerity is somewhat weaker for floating exchange rate countries. The response of inflation to government purchases is 0.44 in the data and 0.39 in the model (that is, austerity is associated with deflation). The inflation response is somewhat greater for fixed exchange rate countries and weaker for floating exchange rate countries in both the data and the model. The model also does a reasonable job at explaining consumption and investment behavior, although the magnitudes in the model fall a bit short of the empirical estimate for investment. In both the model and the data, austerity shocks generate a positive response of net exports.[15]

Figure 4 compares scatterplots of actual data for GDP, net exports and inflation (the left panels) with scatterplots of the corresponding simulated data (the right panels).[16] In each panel, the austerity shocks (i.e., forecast

[15]The coefficients on the components of GDP—consumption, investment, government spending and net exports—do not perfectly add up to the coefficient for GDP. In the data, the sum is 2.04 (vs. 1.77); in the model, the sum is 1.92 (vs. 1.94). For the actual data, we construct separate forecasts for all demand components and we do not impose that they must be consistent with our forecast for GDP. For the simulated data, the sum of the coefficients is somewhat smaller because part of output is used for utilization costs, which we do not count towards investment.

[16]Note, the plot of the actual data conditions on total revenue, TFP and government debt to GDP (i.e., specification 11 in Table 1b). That is, we plot $\left(\tilde{G}_n, \tilde{Y}_n - \hat{\Gamma} \cdot \text{controls}_n\right)$. We do not include the controls in the model regressions because the model does not include shocks to TFP, shocks to tax rates, or endogenous responses of policy to debt-to-GDP

errors) are on the horizontal axis. The units of both axes are log points times 100, so they can be interpreted as roughly corresponding to percent changes. The panels include the regression line for the entire sample.

The scatterplots reveal several differences between the actual data and the simulated data. First, the actual data have more noise than the simulated data. This is due to the fact that the model includes only a limited number of shocks. Given this limited number of shocks, it is almost surprising that our model can generate dispersion in inflation, especially across countries that share the same currency. Part of this dispersion stems from the household's and particularly the government's home bias in their domestic final good, which breaks the law of one price; part of it can also be attributed to asymmetries in steady-state relationships across countries (e.g. tax rates and bilateral trade flows).

Second, while our model does a reasonably good job replicating the *cross-sectional* dispersion in GDP—as illustrated by the same slope of the regression line in the data and the model—it underestimates the overall drop in GDP in Europe observed in the data: In other words, while the slope of the regression line is the same in the data and the model, the intercept in Figure 4 is higher for the data generated by the model. One possible reason for this difference could be due to the monetary policy response in the model. The model assumes that monetary authorities lower nominal interest rates in response to falling GDP and prices, thereby counteracting austerity. If instead, monetary authorities were bound by a zero lower bound (ZLB) on interest rates, they could not implement this policy to offset the impact of the

ratios.

austerity shock. Such a ZLB constraint would amplify the effects of austerity on GDP, as discussed e.g. by Eggertsson (2011), Christiano et al. (2011) and Blanchard et al. (2016). We return to the issue of the ZLB later. Alternatively, the general fall in GDP across European countries could be attributed to faltering economic conditions outside of Europe or other conditions that affected all European countries across the board, but are not captured by our model (see e.g. Kollmann et al., 2016).

The last three columns of Table 3 report the results when monetary policy shocks are removed. This leaves the coefficients virtually unchanged for countries in the euro area. Removing monetary shocks for floating exchange rate countries, however, reduces the cross-sectional coefficient on output for this country group by more than a third. This indicates that countries with floating exchange rates that implemented austere policies also conducted contractionary monetary policy, further deepening the recessionary effect. Without monetary policy shocks, the coefficient for floating exchange rate countries falls to 1.00, half the size of the coefficient for fixed exchange rate countries. This is in line with studies emphasizing the strong effects of fiscal policy in currency unions (see e.g. Farhi and Werning, 2016).

As emphasized in the discussion of the empirical results in Section 2, it is possible that the observed relationship between spending and output is driven by some third variable that is correlated with both. Here we consider the effects of several other potential shocks that could drive changes in economic activity. We examine shocks to monetary policy, financial markets, consumption taxes (VAT), labor taxes, capital taxes and TFP. For each shock, we simulate the model and compare the model-generated variables with the

data. Table 5 reports pseudo-R^2 measures of fit, given by

$$\text{pseudo-}R^2 = 1 - \frac{\sum_{i=1}^{N} \left(\tilde{x}^{\text{data}}_{i,2010-2014} - \tilde{x}^{\text{model}}_{i,2010-2014}\right)^2}{\sum_{i=1}^{N} \left(\tilde{x}^{\text{data}}_{i,2010-2014}\right)^2} \tag{42}$$

for each variable x. If any one of the shocks in the table, such as TFP, were responsible for the economic performance in Europe, one would expect the fit of the model-generated data to actual data to be good. A perfect fit would result in a pseudo-R^2 measure of 1.00. Column (1) in the table reports the fit for the benchmark model which includes two shocks: austerity shocks and monetary shocks. For most variables the fit is quite good with the main exception being the fit for GDP growth and the exchange rate. Column (2) shows that the fit remains good if we confine our attention to austerity shocks alone. Columns (3)–(8) consider the fit for other shocks. These measures are uniformly poor indicating that none of these other shocks would produce patterns like those observed in the data. Perhaps the most consequential of these shocks is the financial market shock which has an R^2 with GDP of 0.22. This is still not as informative as the austerity shocks which have an R^2 of 0.67. Surprisingly, the tax shocks and TFP shocks actually have negative pseudo-R^2's indicating that they produce results that are at odds with the observations. The high pseudo-R^2 measures for austerity shocks gives us confidence that, while we cannot claim to have econometrically identified exogenous shocks to government spending, austerity seems to be the most likely cause of the variation in recovery paths observed across Europe.

Summing up our results so far, our benchmark model including both austerity shocks and monetary policy shocks can replicate the cross-sectional

patterns of observed macroeconomic aggregates and prices. Monetary policy shocks are only important for explaining the variation among floating exchange rate countries. The model underestimates the general fall in GDP observed in Europe between 2010 and 2014.

5.2. Inspecting the Mechanism

Several features of the model work together to generate the relatively large effects of austerity observed in the data. Here we analyze the mechanisms in the model that produce this effect. Table 6 reports results for nine different model specifications and compares the results with the data. The table reports results for all countries as well as results for fixed and floating exchange rate countries separately. The empirical estimates are reported in column (1) in the table. Column (2) reports the results for our benchmark model. Columns (3) - (9) report results for other model specifications.

A reduction in government purchases reduces demand for the domestic final good. In many models, reductions in government purchases cause output to fall by less than the reduction in spending; i.e., the spending multiplier is often less than one. Here, several mechanisms act to magnify the reaction of output to a change in government spending. These mechanisms include the share of hand-to-mouth consumers, the financial accelerator, the trade elasticity and the trade share of government purchases. In the table, we examine how each of these features changes the effects of austerity in the model.

Column (3) shows the results when we relax the assumption of GHH preferences, and instead assume preferences that are separable in consumption and leisure. Under separable preferences the cross-sectional coefficient falls from 1.94 to 1.60, with most of the difference due to a weaker response of con-

sumption spending. GHH preferences play a somewhat less prominent role in our setting relative to Nakamura and Steinsson (2014) for two reasons. First, the labor-consumption complementarities are weakened by steady-state distortions in the form of taxes on consumption and labor. These taxes reduce the fall in consumption demand by households in response to the drop in employment, as emphasized most recently by Auclert and Rognlie (2017).[17] Second, labor-consumption complementarieties have a weaker effect in our model because aggregate demand also depends on the response of investment while in Nakamura and Steinsson (2014) all of net output is used for consumption.

Like GHH preferences, the hand-to-mouth restriction helps the model produce a negative response of consumption to austerity. In the model, a decrease in government purchases leads to a drop in income, which directly reduces hand-to-mouth consumption (see also Galí et al., 2007). Eliminating the hand-to-mouth constraint (column (4)) lowers the coefficient for output to 1.38, again mainly due to a weak response in consumption.[18]

The financial accelerator allows us to match the observed fall in invest-

[17] Auclert and Rognlie (2017) show that in a closed-economy New Keynesian model without capital, the government spending multiplier under a constant real interest rate rule equals the inverse of the labor wedge. In our model, the labor wedge equals $1-\frac{1-\tau_n^l}{1-\tau_n^c}\frac{\psi_q-1}{\psi_q}$, which, for the average country in our model, equals 0.5. This implies a multiplier of 2. Adding capital and adopting a Taylor rule as in our model would yield a multiplier significantly smaller than 1.

[18] We assume the same share of hand-to-mouth consumers across countries. Martin and Philippon (2017) report country-specific hand-to-mouth ratios for eleven countries in the euro area. Using these country-specific shares increases the estimated coefficient for the fixed exchange rate countries somewhat, mostly because the estimates by Martin and Philippon (2017) suggest that austere countries had particularly high shares of hand-to-mouth consumers.

ment. As output falls, entrepreneurs' net worth declines, which in turn increases the external finance premium they face for purchases of new capital. Column (5) shows that investment is nearly unresponsive to austerity shocks in the absence of the financial accelerator mechanism. Without the financial accelerator, the coefficient on investment would be -0.09 instead of -0.93 in our benchmark specification.

Columns (6) and (7) illustrate the influence of monetary policy on the cross-sectional effects of austerity. Column (6) shows results for a case of more accomodative monetary policy in which Taylor rule parameters are reduced to $\phi_{GDP} = \phi_{\pi} - 1 = 0.1$. The effects of austerity for the fixed exchange rate countries change only slightly. As emphasized by Nakamura and Steinsson (2014), the stance of monetary policy has little effect on the cross-sectional coefficient *in a monetary union*. For countries outside the currency union, the change to the Taylor rule increases the output coefficient from 1.56 to 2.55. This is because the monetary authorities outside the euro area are now less responsive to country-specific austerity shocks; this results in larger output losses and more deflation.

Column (7) examines the case where the ECB is constrained by a zero lower bound (ZLB) on the nominal interest rate. To introduce a constant nominal interest rate for the ECB, we add a (large) fictional country to the model. This fictional country does not participate in the market for tradable goods but it does have a fixed exchange rate with the euro. Importantly, this external economy follows a Taylor rule and sets interest rates for itself and all the countries in the euro area. This country is sufficiently large to ensure that changes in inflation and output within the euro area do not

have a perceptible feedback on the interest rate, thus even though there are significant fiscal shocks in the euro area, the interest rate for the euro does not react.[19] The monetary policy rules for the countries outside the euro remain the same. The ZLB specification has essentially no effect on the cross-sectional output coefficients for the countries within the euro. On the other hand, the ZLB does imply that the countries in the euro area suffer greater output losses as a group. Figure 5 shows scatter plots of austerity and GDP for both our benchmark model (solid dots) and the specification with the ZLB (open dots) for the fixed exchange rate countries. The reaction of GDP to austerity in each country is indeed greater under the ZLB. For instance, Portugal (PRT) experienced a reduction in government spending of roughly 6 percent of GDP. Away from the ZLB, Portugal's GDP falls by about 10 percent. At the ZLB, the decline is roughly 16 percent. In contrast, the cross-sectional relationship is unchanged.

To summarize, several amplification mechanisms generate large effects of austerity in the cross-section. Labor-consumption complementarities, hand-to-mouth consumers, and the financial accelerator make aggregate consumption and investment demand more responsive to changes in current income. Because monetary policy is the same across the euro area, variations in monetary policy (including the ZLB) leave the implied cross-sectional effect of

[19] We set the size of this fictional country to be 1 million times the size of Europe. As discussed in Nakamura and Steinsson (2014), this specification is not the same as a ZLB in a closed economy model. While the fictional external economy does eliminate movements in the nominal interest rate across countries, it does not feature a long-run drop in the nominal price level. That is, prices in the euro area must return to the steady state after the shocks have subsided. In a specification of the ZLB that did allow for long-run deflation, the effects of the ZLB would be even more pronounced.

934 austerity unchanged.

935 *5.3. The Effects of Austerity in Integrated Economies*

936 The countries in our model are linked by trade, capital markets, and, for
937 some countries, a shared monetary policy. The extent of these international
938 linkages has important consequences for the impact of austerity on economic
939 activity. In a closed economy, all of the adjustment to changes in govern-
940 ment spending must be borne by domestic firms and consumers. In an open
941 economy, some of the adjustment is absorbed by foreign trading partners
942 and exchange rate adjustments, both of which serve to reduce the impact of
943 austerity. Indeed, to the extent that the economy is open, there will also be
944 spillover effects from economies with large changes in government spending
945 to their trading partners. Because our model is calibrated to observed trade
946 shares, there will be cross-country heterogeneity in the impact of austerity
947 on economic activity and the magnitude of spillover effects.

948 Column (8) of Table 6 considers the consequences of a higher elasticity of
949 substitution between home and foreign goods ($\psi_y = 2$ instead of $\psi_y = 0.5$).
950 The higher elasticity makes it easier to export excess supply of the home good,
951 reducing the effect on GDP and increasing the effect on net exports. Our
952 benchmark specification assumes that government purchases are primarily
953 comprised of domestic goods and services while private consumption and
954 investment goods have higher import shares. In column (9), the home bias
955 of government expenditures is assumed to be the same as for consumption
956 and investment ($\upsilon = 0$), while overall import shares are kept constant. With
957 the change in composition, the output coefficient falls from 1.94 to 1.63.

958 The multi-country model reveals that there is a strong negative relation-

ship between the effect of austerity on domestic production and import shares within the currency union. Figure 6 illustrates this relationship by plotting domestic multipliers against each country's import share. We calculate a multipliers as the change in a country's GDP in response to an increase of domestic government purchases by 1 percent of GDP during the 2010 - 2014 period, holding spending in other countries constant. (For this illustration, we assume that the euro is at the ZLB.) This figures makes three points. First, the figure shows that there is substantial variation in domestic multipliers across Europe. Second, for countries with fixed exchange rates, there is an inverse relationship between the impact of government spending and the import share. Larger import shares imply that part of the increased demand due to stimulus would be met by an increase in imports.[20] Third, holding import shares fixed, there remains a clear difference between the economies within the euro and economies with floating exchange rates. Countries with floating exchange rates experience offsetting adjustments to monetary policy, weakening the effect of austerity. There is an adjustment in monetary policy in the euro area but, since it is responding to euro-area wide GDP, the offsetting effects are much smaller and thus the impact of austerity remains large.

Openness to trade is also important for spillover effects from austerity. To illustrate the extent of spillovers we consider the impact of changes in government spending in the rest of Europe assuming that there is no change in domestic government spending. Figure 7 includes results both with (the dark

[20]For floating exchange rate countries, the relationship is less clear and might even be positive, similar to the finding in Cacciatore and Traum (2018).

heavy bar) and without the ZLB (the thin light bar). For example, assuming the euro is at the ZLB, if the rest of Europe increased spending by 1 percent of European GDP, Greek GDP would increase by 0.8 percent. This occurs because demand for Greek exports increases with European demand. On the other hand, if monetary policy in Europe adjusts to the increase in government spending, then output falls by nearly 1.5 percent (the thick dark bar). This is because the contractionary effects of monetary policy outweigh the spillover effects operating through trade. (Recall that Greece has a relatively small import share.) For countries with higher trade shares, such as Luxembourg, the spillover effect through trade becomes stronger. This finding is consistent with estimated regional spillover effects of government spending, particularly during recessions (see e.g. Auerbach and Gorodnichenko, 2013). Finally, the economies with floating exchange rates all experience contractions. The increased demand in Europe causes input prices to rise across the region. For the floating exchange rate economies, monetary policy reacts to this imported inflation by raising interest rates, which reduces GDP.

6. Counterfactual Policy Simulations

We next use the model to analyze two counterfactual scenarios. The first experiment considers the effect of eliminating austerity in Europe. The second examines the effect of eliminating the common currency and instead having country specific monetary policy with floating exchange rates.

Europe Without Austerity. We begin by examining the case in which there is no austerity in Europe. Specifically, this "No Austerity" experiment removes

all negative government spending shocks from our benchmark model.[21] For this experiment, we impose the ZLB in both the benchmark model and the counterfactual simulation. We do this because, while the ZLB has only a minimal impact on the cross-sectional performance of the model, it has a much larger impact on the simulated time series paths.

The two leftmost panels of Figure 8 show the actual and simulated time paths for GDP for the EU10 (the upper panel) and GIIPS (the lower panel). We include results for both the benchmark specification and the "No Austerity" counterfactual. The figure underscores our main result that fiscal austerity has large contractionary effects on output. The benchmark model under the ZLB tracks the data for the GIIPS economies quite well but less so for the EU10. Actual GDP falls by almost 17 percent in the GIIPS economies and by 18 percent in the benchmark model. In contrast, when austerity is eliminated, output in the GIIPS group would have increased by roughly one percent.[22] EU10 output in the "No Austerity" counterfactual exceeds EU10 output in the benchmark by roughly 8 percent.

Notice that in the figures, the actual data display sharp downturns in GDP in 2008-2009 while the model predicts expansions. The expansion in the model is due to stimulative monetary and fiscal policy shocks which are reflected in the forcing variables we feed in to the simulation. The model

[21] During the 2010-2014 period, with the exception of Switzerland, there were virtually no positive fiscal shocks in Europe. For the "No Austerity" experiment, we retain the positive government spending shocks in Switzerland and set the other spending shocks to zero.

[22] While we do not include an explicit sovereign risk premium in the model, the financial accelerator creates interest rate spreads in the countries that experienced austerity, exacerbating any reductions in output.

does not include the collapse in house prices, and credit market failures that caused the Great Recession. Our focus is on the post-crisis period starting in 2010.

A significant motivation for austerity policies was to slow the escalation of debt-to-GDP ratios that occurred across the euro area. While reductions in government expenditures should, all else equal, reduce deficits and debt levels over time, the impact on the debt-to-GDP *ratio* is not obvious. As our previous analysis shows, reductions in government expenditures have a considerable negative impact on economic activity, and this will in turn reduce tax revenues. Furthermore, trade linkages and shared monetary policy in Europe mean that fiscal actions in one country will be transmitted to neighboring countries, affecting their fiscal positions.

Strictly speaking, the model does not feature any government debt because we assume that the government balances its budget through lump-sum taxes every period. We can however, calculate the cumulative change in tax liabilities implied by the model during the 2010-2014 period. Debt in each period is the difference between government expenditures and tax revenue collected through the VAT, the labor tax and the capital tax. For the average country in our sample, these tax rates—reported in Table A9 in the Appendix—are 21 percent, 33 percent and 26 percent, respectively. For each period, we cumulate all of the debt from the start of the simulation and report it as a ratio to GDP. Notice that this is the debt-to-GDP ratio *excluding* interest payments. A potential limitation of this approach is that we abstract from endogenous changes in sovereign risk premia. To the extent that some countries faced escalating interest rate premia in 2010-2014 our exclusion of

interest payments on the debt may be understating the full impact of austerity on a nation's debt trajectory. Whether investors took austerity measures as a positive or a negative signal with regard to debt sustainability remains an open question (see e.g. Born et al., 2014).

The middle panels in Figure 8 show the actual and simulated time paths for the debt-to-GDP ratio for the EU10 (the upper panel) and GIIPS (the lower panel). These figures report changes in the debt-to-GDP ratio relative to its end of 2009 value. The grey line shows the actual path of the debt-to-GDP ratio in the data. The light, dotted line is a "static" estimate that assumes that GDP and tax revenue are unaffected by changes in government purchases, and thus reflects only reductions in debt associated with reduced government spending. According to this static measure, austerity undertaken by the GIIPS countries should have resulted in a decline in the debt-to-GDP ratio by more than 20 percentage points from 2009 to 2014 for the GIIPS region. In contrast, our benchmark model with the ZLB predicts an *increase* in the debt-to-GDP ratio in the GIIPS region (17 percentage points), basically as large as that observed in the data.

The strong discrepancy between the "static" debt-to-GDP ratio and the benchmark debt-to-GDP ratio by the end of 2014 is driven by three endogenous responses captured by our model: First, fiscal consolidations cause reductions in GDP. Second, at the ZLB, austerity abroad further reduces GDP. Third, these reductions in GDP lead to lower tax revenues. All these effects lead to an increase in the debt-to-GDP ratio.

Looking at the euro area as a whole, our model suggests that austerity during the 2010-2014 period was "self-defeating" in the sense that debt-to-

GDP ratios rose in response to the observed cuts in government spending. This is reminiscent of DeLong and Summers (2012) and Denes et al. (2013) who argue that a cut in government spending can perversely boost debt levels during a liquidity trap. Indeed, the empirical analysis in Fatás and Summers (2018) suggests that austerity in Europe caused debt-to-gdp ratios to rise as they do in our quantitative framework.

Figure 8 shows that debt-to-GDP ratios would have been lower in the euro area had no country implemented austerity. A separate question is whether austerity implemented by *individual* countries was self-defeating. To get at this question, we simulate our benchmark model (with the ZLB) for each country assuming that all other countries pursue austerity but the country itself does not. E.g., for Greece we would eliminate austerity in Greece but continue to have austerity in all other countries. The dark bars in Figure 9 correspond to the change in the debt-to-GDP ratio for each country for the benchmark simulation with austerity across Europe. The light bars correspond to the change in the debt-to-GDP ratio for each country when all other countries pursue austerity.

The figure reveals that spillovers coming from other countries' austerity measures led to an increase of the debt-to-GDP ratio of about 8 percentage points for the typical country in the euro area. For some countries, these spillovers—as opposed to domestic austerity—were the main reason why debt ratios went up. For other countries, domestic austerity also played a role: For Greece, the model indicates that domestic austerity raised Greece's debt-to-GDP ratio by 35 percentage points, whereas domestic austerity in Ireland reduced Ireland's debt-to-GDP ratio by about 8 percentage points. Austerity

was therefore self-defeating for only some countries (like Greece), but not all. This large variation across countries partially reflects the size of the austerity packages, but also initial debt-to-GDP positions and the size of the domestic multipliers depicted in Figure 6.

Europe Without the Euro. The third set of panels in Figure 8 show output trajectories for a "No Euro" experiment. In this counterfactual, the countries experienced austerity shocks but were free to pursue independent monetary policy and allow their currencies to float. Unlike the previous counterfactual, we do not impose the ZLB for this experiment.[23] While there are many ramifications of such an "exit strategy" from the euro that are not captured in our model, the experiment does provide some insight into the opportunity cost of a shared monetary policy. Although the effects of allowing countries to pursue independent monetary policy are more modest than eliminating austerity, they do suggest that both the EU10 and the GIIPS economies in particular would benefit from moving to an independent, unconstrained monetary policy. By the end of 2014, their GDP would have been 3 and 8 percentage points, respectively, higher relative to the benchmark. In this scenario, central banks in both regions would lower their nominal interest rates to counterbalance austerity. The consequent fall in nominal exchange rates would stimulate exports and output.[24]

[23] Although the euro area itself was close the ZLB during the European debt crisis, we assume here that, after a breakup of the euro area, monetary authorities would be able to devalue their currencies. Amador et al. (2017) show that monetary authorities can devalue their currencies at the ZLB by intervening in the foreign exchange market.

[24] See Figure A12 in the Appendix for the path of implied effective exchange rates for this experiment.

7. Conclusion

Since the end of the Great Recession in 2009, advanced economies have experienced radically different recoveries. Some enjoyed a return to normal economic growth following the financial crisis while others have suffered through prolonged periods of low employment and low growth. We have attempted to make sense of this diversity of experiences by examining cross-country variation in economic activity empirically and through the lens of a dynamic general equilibrium model. Despite substantial noise in the data, there are clear patterns that suggest that an important fraction of the differences in economic performance can be attributed to fiscal austerity. In particular, the evidence suggests that contractions in government purchases played a surprisingly large role in reducing output in many countries.

We use a multi-country DSGE model to see whether standard macroeconomic theory can explain the observed changes in economic activity. The model features government purchases shocks and monetary shocks and allows us to make direct comparisons between the observed empirical relationships in the data and the model's predictions. The model is calibrated to match the main features of the European countries in our dataset including country size, trade flows and exchange rate regimes. The model output broadly matches the patterns observed in the data. In particular, the model successfully reproduces the larger estimated impact of austerity on output.

We use the model to conduct a number of counterfactual experiments. Our analysis suggests that austerity was a substantial drag on GDP, especially for the GIIPS countries. Economic integration shaped the GDP response to austerity in opposite ways: on the one hand, trade integration

redistributed its negative consequences across euro area countries, on the other hand, the single monetary policy accentuated the impact of different fiscal policies. Our analysis also suggests that had countries in the euro area abstained from negative fiscal shocks, output would have been substantially higher and may have resulted in lower debt-to-GDP ratios in certain European countries.

This paper emphasizes countries' variation in response to austerity, both implemented at home and abroad, and links this variation to countries' trade exposure, size, and monetary regime, among other factors. While the focus of our paper has been on fiscal policy, we believe that this variation in countries' sensitivity to economic shocks is particularly pertinent for monetary policy in a currency union, which is substantially harder to tailor to national needs. To be sure, there are other features we have ignored that could play an important role in how shocks affect countries and their neighbors. Foremost among these is the potential role of migration. In response to shocks, migration is likely to exacerbate output losses but mitigate welfare losses and smooth out unemployment rate differentials across countries.[25] It is also possible that there might be important differences in debt tolerance across countries that we abstract from here, but that could potentially exacerbate cross-country differences in response to austerity. We leave these issues to future analysis.

[25] House et al. (2018) consider an extension of this model which allows for unemployment and migration. Their model is used to analyze demand shocks in a currency union.

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Table 1a: Austerity and GDP (1)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Gov't. Purchases	−2.22						
	(0.25)						
Social Benefits		−2.60					
		(1.29)					
Primary Balance			−0.41				
			(0.62)				
Total Revenue				−1.55			
				(0.93)			
Stand. VAT					−2.42		
					(0.74)		
Top Income Tax Rate						−0.36	
						(0.24)	
Top Corp. Tax Rate							0.97
							(0.43)
R^2	0.74	0.13	0.02	0.09	0.29	0.08	0.16
Obs.	29	29	29	29	28	29	29

Notes: Table displays the regression coefficient α of univariate regressions (6). Each column represents a separate regression. The dependent variable is the average deviation of real GDP per capita from its forecast over 2010 - 2014. The independent variables are the average deviations of various fiscal variables from their forecast over 2010 - 2014. Sample includes all countries (U.S. missing for regression on VAT rates). All variables are expressed in percent. Untreated OLS standard errors in parentheses.

Table 1b: Austerity and GDP (2)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Gov't. Purchases	−2.22	−2.15	−1.79	−2.20	−2.06	−2.19	−2.10	−1.64	−1.76	−1.93	−1.77
	(0.25)	(0.24)	(0.24)	(0.26)	(0.24)	(0.47)	(0.25)	(0.22)	(0.24)	(0.40)	(0.24)
Total Revenue		−0.90						−0.82	−0.64	−0.58	−0.68
		(0.48)						(0.38)	(0.41)	(0.45)	(0.48)
TFP			0.39					0.42	0.31	0.36	0.37
			(0.11)					(0.10)	(0.12)	(0.11)	(0.12)
HH Debt to GDP				0.02				0.04			
				(0.02)				(0.01)			
Credit Spread					−1.00				−0.43		
					(0.43)				(0.42)		
Gov't. Bond Rate						−0.02				0.21	
						(0.54)				(0.46)	
Gov't Debt to GDP							−0.04				0.00
							(0.02)				(0.02)
R^2	0.74	0.77	0.83	0.75	0.79	0.75	0.77	0.88	0.85	0.84	0.84
Obs.	29	29	29	29	29	28	29	29	29	28	29

Notes: Table displays the regression coefficients of a multivariate regression along the lines of (6). Each column represents a separate regression. The dependent variable is the average deviation of real GDP per capita from its forecast over 2010 - 2014. For the independent variables: 'Gov't Purchases' is the average deviation of real government purchases per capita (deflated by the GDP deflator) from its forecast over 2010 - 2014, 'Total Revenue' is the average deviation of real government revenue per capita (deflated by the GDP deflator) from its forecast over 2010 - 2014, 'TFP' is the change in TFP between 2009 and 2014, 'HH Debt to GDP' is the level of nominal household debt at the end of 2007 over 2005 nominal GDP, 'Credit Spread' is the spread of lending rates to non-financial corporations and the central bank interest rates, averaged over 2010 - 2014, less its average over 2000 - 2005, 'Gov't Bond Rate' is the nominal interest rate on 10-year government bonds, averaged over 2010 - 2014, less its average over 2000 - 2005 (no data for Estonia), and 'Gov't Debt' is the end-of-2009 nominal government debt level (normalized by 2005 nominal GDP). All variables are expressed in percent. Untreated OLS standard errors in parentheses.

Table 2: FISCAL POLICY AND DEBT TO GDP

	Debt to GDP 2009					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
Gov't. Purchases	0.02	0.07	0.03	0.17	−0.03	0.07
	(0.02)		(0.02)		(0.03)	
Social Benefits	0.00	0.00	0.00	0.01	−0.01	0.05
	(0.01)		(0.01)		(0.01)	
Total Revenue	0.02	0.27	0.02	0.34	0.01	0.10
	(0.01)		(0.01)		(0.02)	
Stand. VAT	0.01	0.02	0.01	0.04	0.04	0.09
	(0.01)		(0.01)		(0.05)	
Top Income Tax Rate	0.03	0.03	0.05	0.18	−0.05	0.04
	(0.03)		(0.02)		(0.10)	
Top Corp. Tax Rate	−0.02	0.06	−0.03	0.08	0.00	0.00
	(0.02)		(0.02)		(0.02)	

Notes: Table displays the estimated coefficient of regression along the lines of (6) without any controls, as well as its R^2. The independent variable is the government debt to GDP ratio at the end of 2009. The dependent variables are forecast errors of government purchases, social benefits, total revenue, VAT, top income tax rates and top corporate tax rates. 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 3: COMPARISON OF MODEL AND DATA

	Data			Benchmark			Only aust. shocks		
	All	Fix	Float	All	Fix	Float	All	Fix	Float
GDP	-1.77	-1.79	-1.70	-1.93	-2.03	-1.55	-1.76	-2.03	-1.00
	(0.20)	(0.24)	(0.40)						
Inflation	-0.44	-0.57	-0.17	-0.39	-0.50	-0.11	-0.35	-0.50	0.06
	(0.10)	(0.12)	(0.20)						
Consumption	-1.18	-1.20	-1.04	-1.19	-1.22	-1.02	-1.08	-1.22	-0.71
	(0.18)	(0.21)	(0.36)						
Investment	-1.29	-1.43	-0.92	-0.93	-0.98	-0.72	-0.79	-0.99	-0.27
	(0.16)	(0.19)	(0.31)						
Net Exports over GDP	1.43	1.61	0.91	1.20	1.19	1.19	1.13	1.19	0.97
	(0.20)	(0.22)	(0.37)						
Exchange Rate	-0.77	0.44	-2.92	-0.21	-0.11	-0.56	-0.30	-0.10	-0.90
	(0.36)	(0.30)	(0.50)						
GDP Growth	-0.52	-0.50	-0.51	-0.41	-0.49	-0.18	-0.38	-0.50	-0.07
	(0.08)	(0.10)	(0.17)						

Notes: Table displays the regression coefficients on government purchases (α in regression (6) and for the coefficients α^{Fix} and α^{Fl} for the regression with separate coefficients for fixed and floating exchange rate countries, after controlling for government revenue, government debt and TFP as is done in specification (11) of Table 1b. Each row represents a separate regression. The dependent variables are average forecast errors in real GDP per capita, the inflation rate based on the Harmonized Index for Consumer Prices excluding Food and Energy, real consumption per capita, real investment per capita, real net exports, the nominal effective exchange rate and the real per capita GDP growth rate. The net export measure is real exports in date t, less real imports in date t divided by 2005:1 nominal GDP. We multiply real exports and real imports by their respective deflators for 2005:1, so that for 2005:1 our measure of net exports equals nominal net exports over nominal GDP. The coefficients α^{Fix} and α^{Fl} are estimated in a single regression, which also allows intercepts to differ across currency regimes, but forces the coefficients on the control variables to be the same across currency regimes. The benchmark calibration includes shocks to government spending and the Taylor rule. The last three columns display the results if only government spending shocks are fed into the model

Table 4: Calibration

Description	Parameter	Value	Source / Target
Preferences			
Discount factor (quarterly)	β	0.99	Standard value
Intertemporal elasticity of substitution	σ	0.5	Standard value
Frisch elasticity of labor supply	η	1	Barsky et al. (1997)
Share of hand-to-mouth consumers	χ	0.5	Campbell and Mankiw (1989), Martin and Philippon (2017)
Trade and Country Size			
Trade preference weights	ω_n^j	x	OECD Trade in Value Added Dataset
Elasticity of substitution for intermediates	ψ_y	0.5	e.g. Heathcote and Perri (2002), Cravino (2017), Proebsting (2015)
Country size	$\mathbb{N}_n Y_n$	x	OECD Input-Output Tables
Technology			
Capital share	α	0.38	Trabandt and Uhlig (2011)
Depreciation (quarterly)	δ	0.028	Average private investment share, $X/Y = 0.197$, 2000 - 2010
Utilization cost	a''	0.286	Del Negro et al. (2013)
Investment adjustment cost	f''	2.48	Christiano et al. (2005)
Elasticity of substitution for varieties	ψ_q	10	Standard value
Price Rigidity			
Sticky price probability	θ	0.80	Alvarez et al. (2006)
Financial Market Imperfections			
SS External finance premium	$F_n(\lambda_{ss})$	x	ECB, Global Financial Database and national sources
Elasitcity external finance premium	F_ϵ	0.025	Spread increases by 1 pp for 10% higher leverage
SS Leverage ratio	$\lambda - 1$	2.11	Brave et al. (2012)
Fiscal and Monetary Policy			
Gov't spending over final demand	$\frac{G_n}{Y_n}$	x	OECD and Eurostat
Persistence government spending shock	ρ_G	0.93	Half-life of 2.5 years
Import share of gov't purchases	υ_n	x	World-Input Output Database
Consumption, Labor, Capital tax rates	τ^C, τ^L, τ^K	x	Authors' calculations based on Eurostat's National Tax Lists
Taylor rule persistence	ϕ_i	0.75	Clarida et al. (2000)
Taylor rule GDP coefficient	ϕ_{GDP}	0.5	Clarida et al. (2000)
Taylor rule inflation coefficient	ϕ_π	1.5	Clarida et al. (2000)

Notes: Values marked with x are country- or country-pair specific.

Table 5: Goodness of Fit: Alternative Shocks

	(1) Bench-mark	(2) Aust. shocks	(3) Mon. pol. shocks	(4) Financ. shocks	(5) Cons. tax shocks	(6) Lab. tax shocks	(7) Cap. tax shocks	(8) TFP shocks
GDP	0.66	0.67	0.03	0.22	0.02	0.01	0.01	−0.19
Inflation	0.51	0.53	−0.12	0.02	−0.66	−0.19	0.07	−1.94
Consumption	0.58	0.57	0.05	0.16	0.02	0.01	0.01	−0.46
Investment	0.39	0.36	0.06	0.33	−0.05	−0.04	0.06	−0.84
Net Exports over GDP	0.72	0.72	0.06	0.20	−0.05	−0.07	0.06	−1.49
Exchange Rate	0.15	0.22	−0.12	0.01	−0.00	−0.01	0.01	−0.36
GDP Growth	0.13	0.08	0.05	−0.09	0.06	0.08	0.02	−0.10

Notes: Table presents the goodness of fit of the model for various shocks and outcome variables. The benchmark model (column 1) includes both austerity and monetary policy shocks. The remaining columns refer to model simulations with only one type of shock at a time. Financial shocks are shocks to the interest rate spreads for loans extended to entrepreneurs (i.e., interest rates paid by entrepreneurs are now given by $(1+i_n(s^t))F(\lambda_n(s^t))e^{\epsilon_n^F(s^t)}$, where $\epsilon_n^F(s^t)$ is a shock to the interest rate spread). The tax shocks refer to consumption taxes (τ_C), labor taxes (τ_L) and capital taxes (τ_K). TFP shocks are shocks to total factor productivity (Z). The goodness of fit reported for each outcome variable and each simulation is calculated as pseudo-$R^2 = 1 - \frac{\sum_{i=1}^{N}\left(\bar{x}^{\text{data}}_{i,2010-2014} - \bar{x}^{\text{model}}_{i,2010-2014}\right)^2}{\sum_{i=1}^{N}\left(\bar{x}^{\text{data}}_{i,2010-2014}\right)^2}$

Table 6: Alternative Model Specifications

								International Dimension	
	(1) Data	(2) Bench-mark	(3) Separable preferences	(4) No rule of thumb	(5) No financial accelerator	(6) Passive mone-tary policy	(7) ECB at ZLB	(8) High trade elasticity	(9) High trade share for G
All									
GDP	−1.77	−1.94	−1.60	−1.38	−1.15	−2.19	−2.04	−1.16	−1.63
Inflation	−0.44	−0.39	−0.11	−0.27	−0.39	−0.79	−0.43	−0.12	−0.43
Consumption	−1.18	−1.20	−0.54	−0.36	−0.70	−1.37	−1.30	−0.93	−1.04
Investment	−1.29	−0.93	−0.72	−0.67	−0.09	−1.11	−1.00	−0.65	−0.78
Net Exports over GDP	1.43	1.21	0.69	0.66	0.67	1.31	1.28	1.44	1.22
Fixed									
GDP	−1.79	−2.03	−1.58	−1.38	−1.17	−1.98	−1.99	−1.10	−1.71
Inflation	−0.57	−0.49	−0.25	−0.32	−0.43	−0.47	−0.47	−0.23	−0.50
Consumption	−1.20	−1.23	−0.52	−0.37	−0.70	−1.24	−1.27	−0.88	−1.07
Investment	−1.43	−0.98	−0.69	−0.65	−0.08	−0.94	−0.92	−0.57	−0.82
Net Exports over GDP	1.61	1.19	0.65	0.64	0.63	1.21	1.22	1.37	1.20
Floaters									
GDP	−1.70	−1.56	−1.50	−1.23	−1.04	−2.55	−1.58	−1.16	−1.27
Inflation	−0.17	−0.12	0.26	−0.15	−0.26	−1.59	−0.12	0.14	−0.27
Consumption	−1.04	−1.03	−0.54	−0.28	−0.70	−1.63	−1.03	−0.99	−0.90
Investment	−0.92	−0.71	−0.69	−0.63	−0.12	−1.41	−0.74	−0.73	−0.60
Net Exports over GDP	0.91	1.19	0.74	0.69	0.78	1.50	1.20	1.57	1.24

Notes: See Table 3. Specifications: (3) separable preferences: $U(c_n, L_n) = \frac{(c_n)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} - \kappa_n \frac{(L_n)^{1+\frac{1}{\eta}}}{1+\frac{1}{\eta}}$. Notice that we maintain our assumption that hand-to-mouth consumers supply the same amount of labor as unrestricted consumers. For the remaining specifications: (4) $\chi = 0$, (5) $F_\varepsilon = 0$, (6) $\phi_{GDP} = 0.1, \phi_\pi = 1.1$, (7) ECB at zero lower bound (see text), (8) $\psi_y = 2$, (9) $\upsilon = 0$

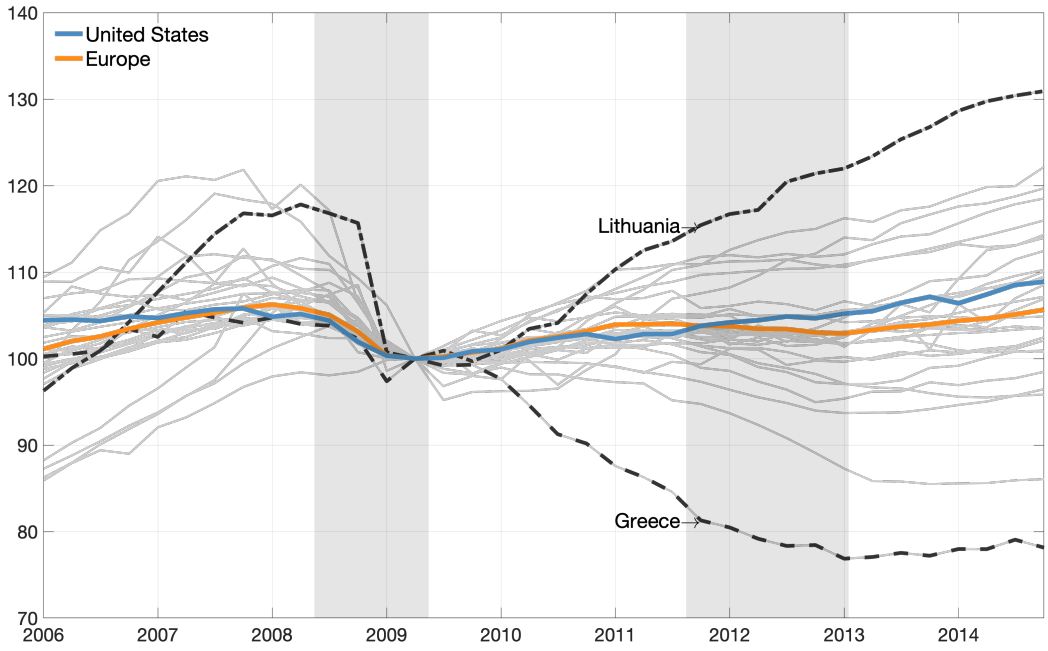

Figure 1: Real per Capita GDP Before, During and After the Crisis

Note: The figure plots the time paths of real per capita GDP for the period 2006:1-2014:4 for the countries in our data set. The paths are indexed to 100 in 2009:2. The two shaded regions indicate recession dates according to the NBER and CEPR.

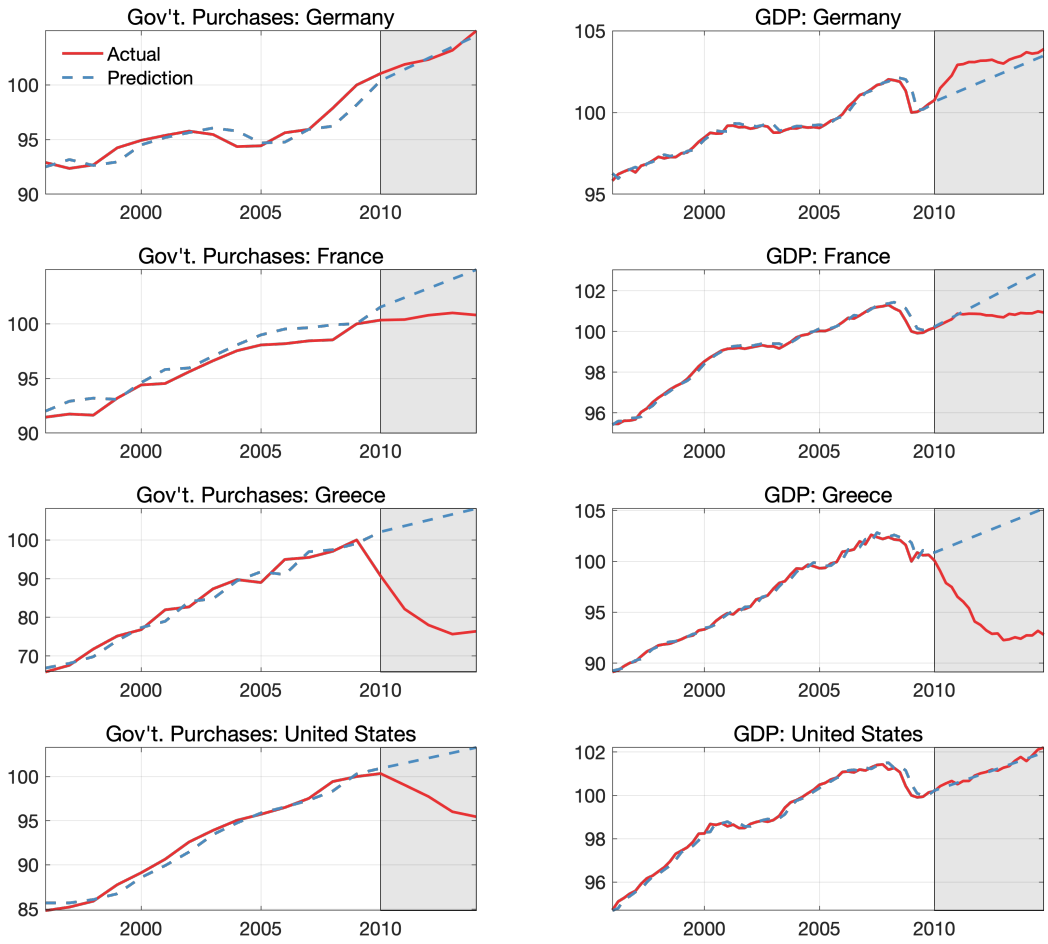

Figure 2: Government Purchases and GDP

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.

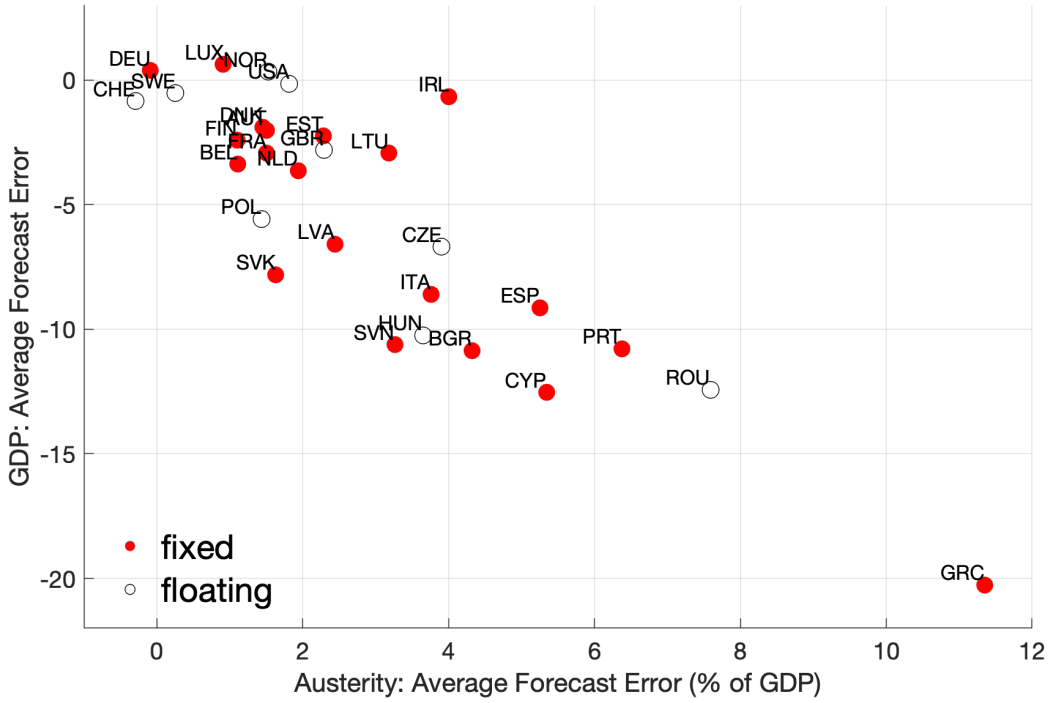

Figure 3: GDP and Austerity: Data

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 austerity, defined as the shortfall in government purchases, also in log points. Countries are classified by their exchange rate regime (red: euro / pegged to euro; black: floating currency). See text for details on the forecast specification.

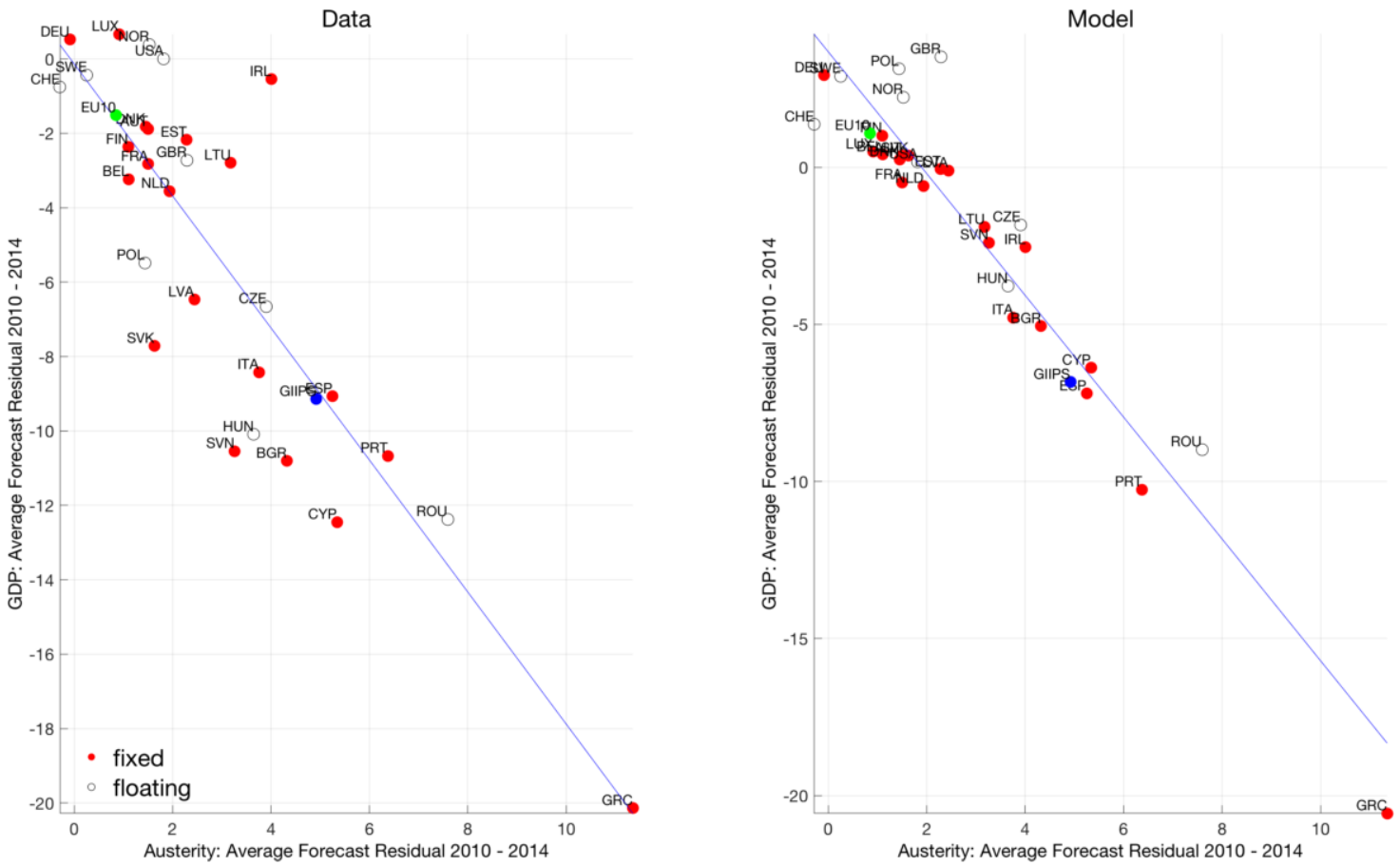

Figure 4: GDP and Austerity: Data vs. Model

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 austerity, defined as the shortfall in government purchases, also in log points. Countries are classified by their exchange rate regime (red: euro / pegged to euro; black: floating currency). Regression lines are based on the overall sample of countries. Left panel is based on actually observed data and displays the GDP residual after controlling for forecast errors of government revenue, initial government debt and changes in TFP as is done in specification (11) of Table 1b; right panel refers to data from the simulated model. See text for details on the forecast specification.

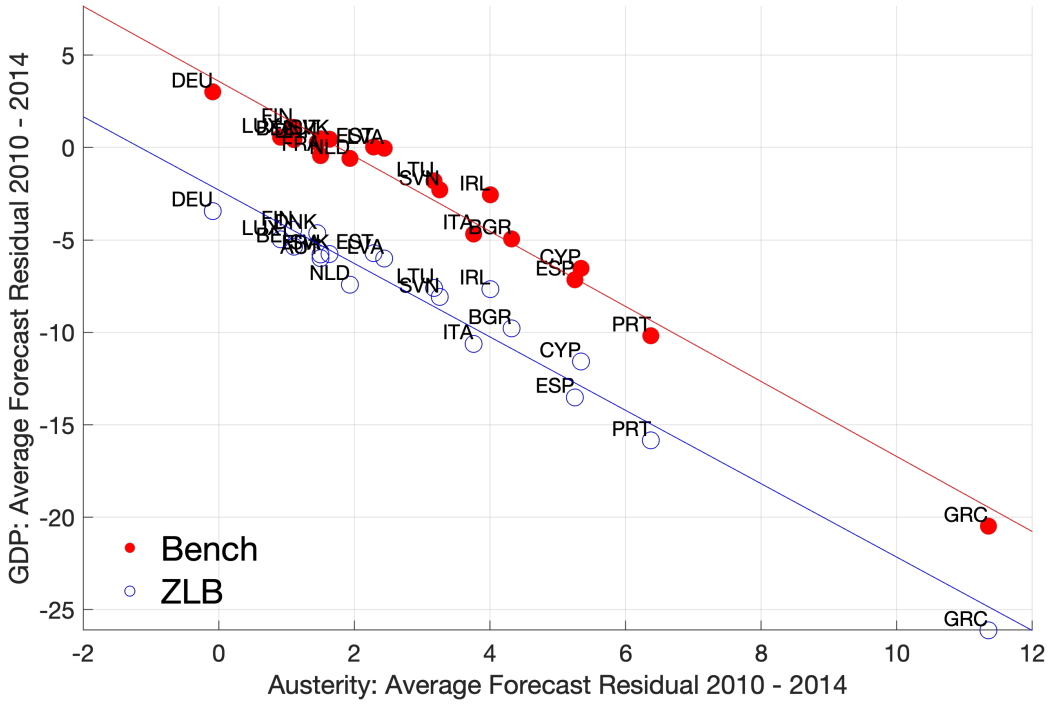

Figure 5: GDP and Austerity: Without and With ZLB

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 austerity, defined as the shortfall in government purchases, also in log points. Sample only includes countries with fixed exchange rates. Red dots refer to simulated data under the benchmark calibration; blue dots refer to simulated data under the benchmark calibration with a ZLB for the ECB.

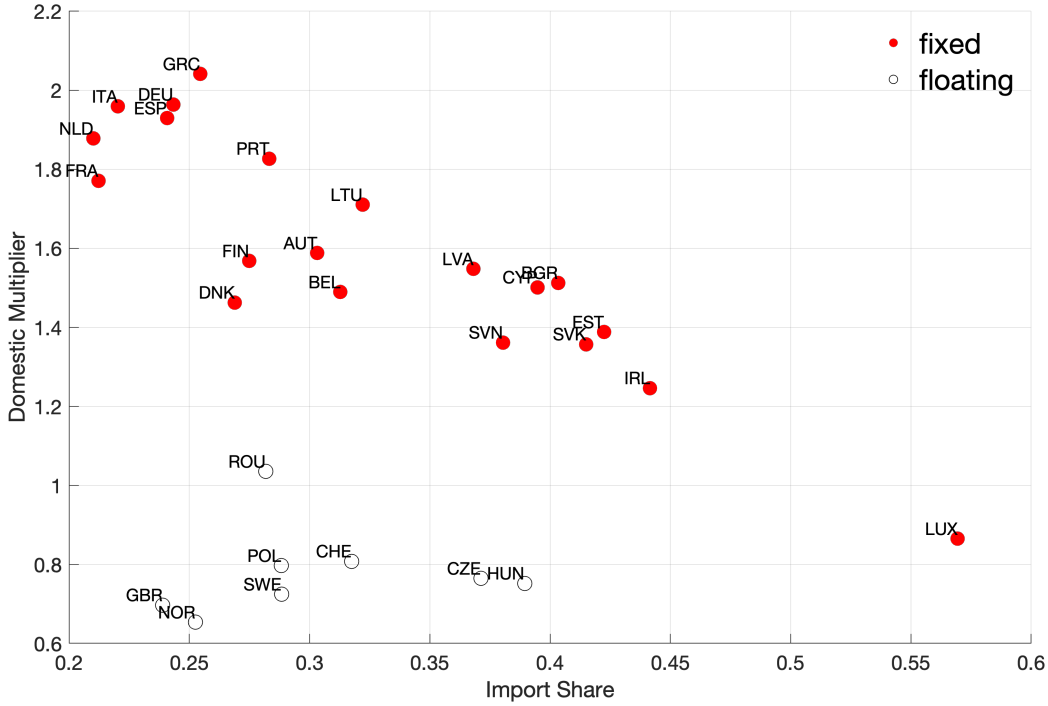

Figure 6: Domestic Multiplier and Import Share

Note: Figure plots domestic multipliers vs. a country's steady-state import share. The domestic multiplier is calculated as the average 2010 - 2014 GDP deviation (relative to the benchmark) in a counterfactual experiment, where the country that is plotted raises its government purchases by 1 percent of GDP. Hence, every dot corresponds to a different simulation. The model includes the ZLB specification for the ECB.

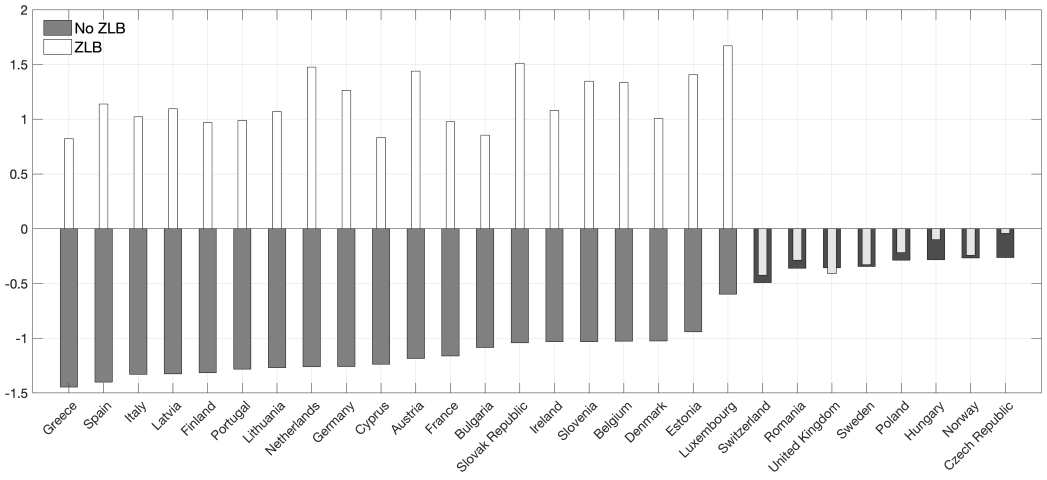

Figure 7: Spillover of Government Purchases

Note: Figure displays the average 2010 - 2014 GDP deviation predicted by the model in a counterfactual experiment relative to the benchmark model. In the counterfactual experiment, all countries in Europe raise their government purchases during the 2010 - 2014 period, except for the country whose GDP is plotted. Hence, every bar corresponds to a different simulation. The total increase in government purchases abroad is always set to 1 percent of European GDP for every year in 2010-2014, implying that countries have to raise their government purchases by more the larger the country that does not raise its government purchases. For a given experiment, the percent increase in government purchases is the same across all foreign countries. The thin light bars correspond to the scenario where a ZLB is imposed for the euro area.

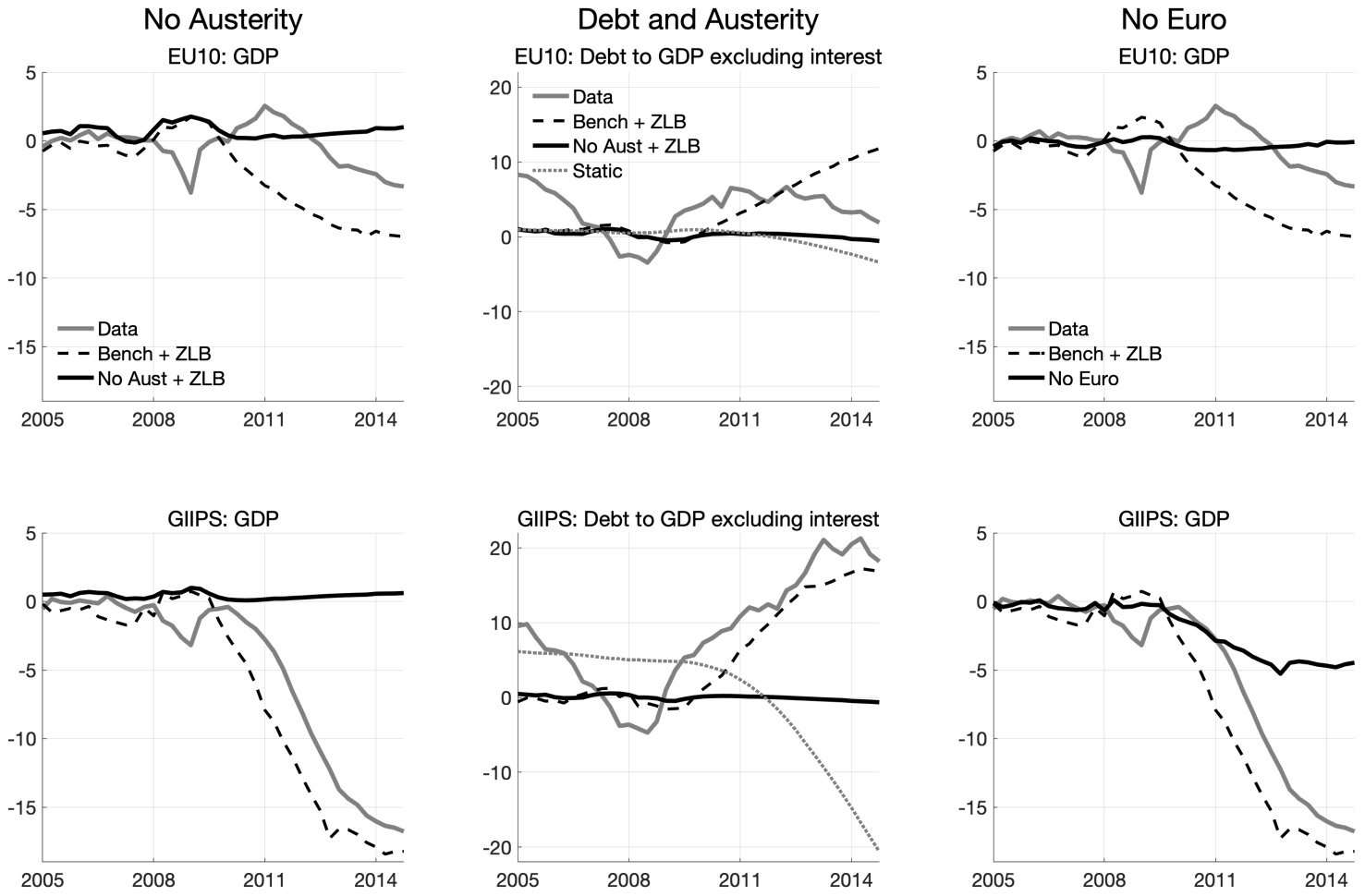

Figure 8: Counterfactual Policy Simulations

Note: Figures display actual and simulated data for GDP (columns 1 and 3) and the debt-to-GDP ratio (column 2) for the EU10 (row 1) and the GIIPS countries (row 2). The debt-to-GDP ratio is calculated as the cumulative primary balance, i.e. excluding interest payments. 'Data' refers to forecast errors from regression (5) for GDP and regression (4) for the debt-to-GDP ratio. Simulated data is expressed in percent deviations from the stationary equilibrium for GDP and in percentage point deviations from the end of 2009 value for the debt-to-GDP ratio.

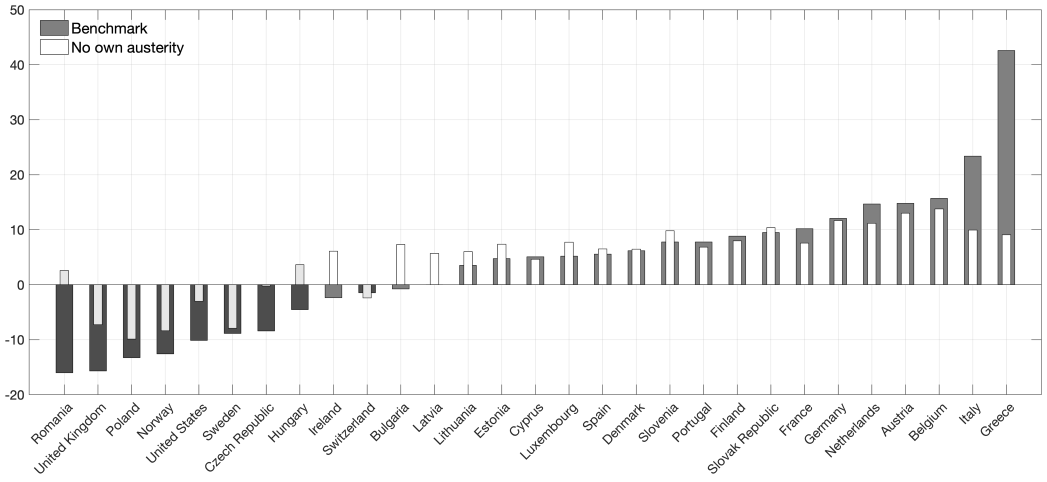

Figure 9: Debt-to-GDP Ratios in Counterfactuals

Note: Figure displays the percentage point change of the debt-to-GDP ratio (excluding interest payments) between the end of 2009 and the end of 2014 based on model simulations. The model includes the ZLB specification for the ECB. The dark heavy bars correspond to the benchmark model. The light thin bars are derived from a model simulation, where all countries receive the same shocks as in our benchmark model, except for the country whose debt-to-GDP ratio is plotted. That country is not hit by any government spending shocks.

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

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A Sample

Table A1 contains the sample of all 29 countries used in the empirical section and the model as well as the Rest of the World. Country size is measured as the country's final demand relative to the sum of all European countries' final demand. Final demand is measured as GDP less net exports. Shares are averaged over 2005 and 2010. The import share is measured as the share of (value added) imports in final demand using the OECD TiVA database. The TiVA dataset is derived from input-output tables, which themselves are based on national account data. We use the data series FD_VA ('Value added content of final demand'). TiVA also has data for a 'rest of the world' aggregate. We combine the TiVA measure of the rest of the world with the sum of the countries not in our sample to construct the preference parameters $\omega_{RoW,j}$ for the rest of the world aggregate for our analysis. The exchange rate regime is as of 2010. Countries with a peg have their currencies pegged to the Euro. Countries with a floating currency are either free or managed floaters or countries with a wide crawling peg. The classification follows Itzetzki, Reinhart and Rogoff (2004), $http://www.carmenreinhart.com/data/browse-by-topic/topics/11/..$

B Details on Estimation Method

B.1 Austerity and Economic Performance

Our main cross-sectional regression (ignoring controls) is

$$\frac{1}{20}\left(\sum_{t=2010:1}^{2014:4}\ln X_{i,t}-\ln\widehat{X}_{i,t}\right)=\alpha_0+\alpha\frac{G_i}{Y_i}\frac{1}{5}\left(\sum_{t=2010}^{2014}\ln G_{i,t}-\ln\widehat{G}_{i,t}\right)+\varepsilon_i. \tag{B.1}$$

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 2000:1 - 2010:4. 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). Note that our left-hand-side variables are at quarterly frequency, whereas the right-hand-side variables are at annual frequency. Now, we discuss how we derive estimates of $\ln\widehat{X}_{i,t}$ and $\ln\widehat{G}_{i,t}$.

B.2 Economic Performance

Our forecasting specification for GDP, consumption and investment is

$$\ln \widehat{X}_{i,t} = \begin{cases} \ln X_{i,t-1} + \hat{g}^X_{EU} + \hat{\gamma}^X \left(\ln \widehat{X}_{EU,t-1} - \ln X_{i,t-1} \right) & \forall t-1 \leq 2009{:}4 \\ \ln \widehat{X}_{i,t-1} + \hat{g}^X_{EU} + \hat{\gamma}^X \left(\ln \widehat{X}_{EU,t-1} - \ln \widehat{X}_{i,t-1} \right) & \forall t-1 > 2009{:}4. \end{cases} \tag{B.2}$$

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, $\gamma^X \left(\ln \widehat{X}_{EU,t-1} - \ln X_{i,t-1} \right)$. Notice that only data up to 2009:4 is used to construct forecasts for $t >$2009:4.

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:

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

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 0.47 percent with a standard deviation of 0.01 percent, i.e. the average annual growth rate over this time period was about 2 percent. The forecasted value of $\ln X_{EU}$, used in (B.2), is the fitted value of this regression.

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:

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

where $\ln \widehat{X}_{EU,t-1} = \hat{\beta}_0 + \hat{g}^X_{EU}(t-1)$. 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 0.58 percent with a standard deviation of 0.04 percent. The positive γ indicates convergence.[1] Figure

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

$$\hat{g}^X_{i,t} = \begin{cases} \hat{g}^X_{EU} + \hat{\gamma}^X \left(\ln \widehat{X}_{EU,t-1} - \ln X_{i,t-1} \right) & \forall t-1 \leq \text{2009:4} \\ \hat{g}^X_{EU} + \hat{\gamma}^X \left(\ln \widehat{X}_{EU,t-1} - \ln \widehat{X}_{i,t-1} \right) & \forall t-1 > \text{2009:4}. \end{cases} \tag{B.3}$$

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:

$$\widehat{X}_{i,t} = \frac{1}{8} \sum_{s=\text{2008:1}}^{\text{2009:4}} X_{i,s}$$

for all dates t. Note that for these variables, we are using the level instead of the log in regression (B.1).

B.3 Austerity

We also use the 'convergence' estimator to predict government purchases, social benefits, and total revenue. In particular, for any of these three variables, we construct our forecast as

$$\ln \widehat{G}_{i,t} = \begin{cases} \ln G_{i,t-1} + \hat{g}^Y_{i,t} + \hat{\theta}^G \left(g^Y_{i,t} - \hat{g}^Y_{i,t} \right) & \forall t-1 \leq 2009 \\ \ln \widehat{G}_{i,t-1} + \hat{g}^Y_{i,t} + \hat{\theta}^G \left(g^Y_{i,t} - \hat{g}^Y_{i,t} \right) & \forall t-1 > 2009 \end{cases} \tag{B.4}$$

[1] We repeat this two-step procedure to forecast private consumption and total investment. The estimated values for g and γ are 0.43 (0.01) percent and 0.77 (0.06) percent for private consumption, and 0.64 (0.03) percent and 1.28 (0.21) percent for total investment.

Here, θ^G is an estimated elasticity of the growth rate of the government finance variable $G_{i,t}$ with respect to deviations of GDP growth from its growth 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 (B.3), but using annual data for GDP.[2] 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, social benefits 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, $\hat{\theta}^G(g^Y_{i,t} - \hat{g}^Y_{i,t})$, adjusts for deviations of GDP growth from its forecast. This is particularly relevant for government revenue variables. For government purchases, we set $\theta^G = 0$, but estimate it for social benefits and total revenue.

Estimation of θ^G: To estimate θ^G, we run the following regression

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

on data up to 2005.

Our forecasts for the primary balance and tax rates are

$$\widehat{G}_{i,t} = \frac{1}{2} \sum_{s=2008}^{2009} G_{i,s}.$$

For these variables, we are using the level instead of the log in regression (B.1).

C Additional Empirical Results

C.1 Different Forecast Specifications

Table A3 displays the results of a univariate cross-sectional regression along the lines of (B.1). The explained variable is the forecast error in GDP. Each column corresponds to a different explanatory variable (forecast errors in government purchases, government transfers, total revenue. Every row corresponds to a different forecast specification for both the explanatory

[2]The estimated values for g and γ are 0.018 and 0.024.

and explained variable. Specification 1 is our benchmark specification. In specification 2, our forecasts are based on a linear time trend:

$$\ln Y_{i,t} = \beta^y_{0,i} + \beta^y_i t + \varepsilon^y_{i,t}$$
$$\ln G_{i,t} = \beta^g_{0,i} + \beta^g_i t + \hat{\theta}^G \left(g^Y_{i,t} - \hat{g}^Y_{i,t}\right) + \varepsilon^g_{i,t}.$$

In specification 3, we assume an AR(1) process with drift:

$$\ln Y_{i,t} = \beta^y_{0,i} + \rho^y_i \ln Y_{i,t-1} + \beta^y_i t + \varepsilon^y_{i,t}$$
$$\ln G_{i,t} = \beta^g_{0,i} + \rho^g_i \ln G_{i,t-1} + \beta^g_i t + \hat{\theta}^G \left(g^Y_{i,t} - \hat{g}^Y_{i,t}\right) + \varepsilon^g_{i,t}.$$

Finally, specification 4 is the same as specification 1, but excluding Greece. For specifications 2 and 3, we set $\hat{\theta}^G = 0$ for government purchases, as in the benchmark, but re-estimate it for social benefits and total revenue along the lines of (B.5). In all specification, the estimated slope coefficient for government purchases is both statistically and economically significant. It is noteworthy that the estimated slope coefficient for social benefits is not robust to the various specifications and that the estimate for revenue even switches signs.

C.2 Austerity and GDP for Different Subsamples

Tables A4a and A4b rerun the regressions underlying Table 1b 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 2.

C.3 Additional Government Finance Variables

Here, we present additional empirical results based on the estimation equation (B.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 A6a), shortfall in social benefits (Table A6b), 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 A6c), total government revenue (Table A6d), the VAT rate (Table

A6e)[3], the statutory income tax rate (Table A6f) and the statutory corporate tax rate (Table A6g). Note that we omit the term G_i/Y_i in regression (B.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 (B.2)).

D Structural Shocks in Model

D.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.

D.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[4] (Czech Repbulic, Hungary, Poland, Romania, Sweden, United Kingdom,

[3]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, 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 over the sample period and set it equal to 8.5 percent.

[4]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).

Norway, Switzerland and the United States) as well as the ECB.

Clarida, Gali and Gertler (2000) (henceforth CGG) propose a generalized Taylor rule that allows for interest rate smoothing:[5]

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

where i_t is the nominal interest rate, r is the long-run real interest rate, π_t is CPI core inflation, 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. Interest rates and inflation are measured at annual rates.

Estimation We set the coefficients slope coefficients to values commonly used in the macro literature and in line with those reported by CGG: $\phi_\pi = 1.5$, $\phi_{GDP} = 0.5$ and $\phi_i = 0.75$. We then estimate the intercept for every central bank separately. We always impose that inflation targets a rate of 2%.[6] Our estimation equation is

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

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, 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 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.

Table A7 displays the estimated coefficients for the intercepts for all central banks in our sample.

[5] 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.

[6] 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.

D.3 Additional Shocks

We use additional structual shocks in our 'goodness of fit' exercise whose results are reported in Table 5. These additional shocks are constructed as follows:

Tax Rates Our tax rate shocks are constructed as deviations in tax rates from their steady-state value. We use the average over 2005 through 2009 as their steady-state value. Since the data is only available annually, we assume that tax rates are the same for all quarters within a year. Since we are looking at effects of tax changes over a 5-year window, this measurement error should only have a small effect on our results.

We use implicit tax rates for consumption, labor and capital taxes based on the method proposed by Mendoza, Razin and Tesar (1994). Table A9 documents their steady-state values. See the Data Appendix for more details regarding data sources and calculations.

Financial Market Shocks Our measure of financial shocks comes from data on spreads between lending rates and central bank interest rates. We construct the spread shocks as deviations in spreads from their steady-state value. Since spreads were likely to be affected by the run-up to the Great Recession and the recession itself, we use the average spread in 2005 as the steady-state value. Table A9 documents the steady-state values.

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.[7] 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

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

rate up to the year they access the euro area.[8] The Data Appendix lists all data series used to calculate the spread shocks.

Total Factor Productivity Data for total factor productivity is provided by the OECD and AMECO. As for spreads, we calculate shocks as deviations in total factor productivity from its 2005 value. Data is only available at an annual frequency. We assume that the TFP values are constant within a year. Since we are looking at effects of tax changes over a 5-year window, this measurement error should only have a small effect on our results. See the Data Appendix for more details regarding data sources.

E Additional Model Results

E.1 Additional Scatter Plots

Figures A10c - A10f illustrate the results from regression (6) 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 4 and shows both the empirical results (a) and the results from the simulated data (b).

E.2 Domestic Multiplier

Figure A11 presents domestic government purchase multipliers for the specifications with and without ZLB. The domestic multiplier based on the ZLB model is plotted against the import share in Figure 6 in the main body of the text.

E.3 Exchange Rates in 'Europe Without a Euro'

Figure A12 presents the exchange rate movements implied by the 'Europe Without the Euro' experiment illustrated in the last two subplots of Figure 8 in the main body of the text.

[8] 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.

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Table A1: Country Size, Import Shares and Exchange Rate Regimes

Country	Size	Import share	XRT regime	Country	Size	Import share	XRT regime
Belgium	2.6%	31.3%	Euro	Bulgaria	0.3%	40.3%	Peg
Germany	18.3%	24.3%	Euro	Denmark	1.7%	26.9%	Peg
Ireland	1.1%	44.2%	Euro	Estonia	0.1%	42.2%	Peg
Greece	1.9%	25.5%	Euro	Latvia	0.1%	36.8%	Peg
Spain	8.4%	24.1%	Euro	Lithuania	0.2%	32.2%	Peg
France	15.3%	21.2%	Euro	Czech Republic	1.0%	37.1%	Floating
Italy	12.5%	22.0%	Euro	Hungary	0.7%	38.9%	Floating
Cyprus	0.1%	39.5%	Euro	Poland	2.5%	28.8%	Floating
Luxembourg	0.2%	56.9%	Euro	Romania	0.9%	28.2%	Floating
Netherlands	4.1%	21.0%	Euro	Sweden	2.4%	28.8%	Floating
Austria	2.1%	30.3%	Euro	United Kingdom	15.4%	23.9%	Floating
Portugal	1.4%	28.3%	Euro	Norway	1.9%	25.3%	Floating
Slovenia	0.3%	38.1%	Euro	Switzerland	2.8%	31.7%	Floating
Slovak Republic	0.4%	41.5%	Euro	United States	91.5%	13.3%	Floating
Finland	1.3%	27.5%	Euro	RoW	162.9%	8.4%	Floating

Notes: See text.

Table A2a: SUMMARY STATISTICS OF DEVIATIONS FROM FORECAST: GOVERNMENT FINANCE VARIABLES

	Gov't. Purchases	Social Benefits	Primary Balance	Total Revenue	Stand. VAT	Top Income Tax Rate	Top Corp. Tax Rate
Average	−12.66	−9.08	0.30	0.23	1.33	0.92	−0.72
Std. deviation	10.75	7.95	1.99	3.86	1.45	4.99	2.65
			Correlation matrix				
Gov't. Purchases	1.00						
Social Benefits	0.55	1.00					
Primary Balance	−0.38	−0.62	1.00				
Total Revenue	−0.12	0.48	0.10	1.00			
Stand. VAT	−0.68	−0.55	0.54	0.05	1.00		
Top Income Tax Rate	−0.34	0.10	0.03	0.42	−0.07	1.00	
Top Corp. Tax Rate	0.36	0.33	−0.19	−0.10	−0.33	−0.14	1.00

Notes: Table displays statistics of the log-difference between the actual time series and the forecast,averaged over 2010 - 2014, for various variables. 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 A2b: Summary Statistics of Deviations from Forecast: Economic Performance Variables

	GDP	Inflation	Con-sumption	Invest-ment	NX to GDP	Exchange Rate	GDP Growth	Debt to GDP
Average	−4.27	−1.38	−6.15	−12.57	3.90	−1.21	−1.57	17.67
Std. deviation	6.43	1.80	6.68	18.80	4.21	5.00	2.05	15.06
				Correlation matrix				
GDP	1.00							
Inflation	0.20	1.00						
Consumption	0.90	0.12	1.00					
Investment	0.94	0.30	0.85	1.00				
NX to GDP	−0.38	−0.60	−0.52	−0.52	1.00			
Exchange Rate	0.26	−0.11	0.32	0.24	−0.11	1.00		
GDP Growth	0.98	0.24	0.86	0.93	−0.39	0.25	1.00	
Debt to GDP	−0.39	0.07	−0.41	−0.51	0.44	−0.32	−0.31	1.00

Notes: Table displays statistics of the log-difference between the actual time series and the forecast,averaged over 2010 - 2014, for various variables. 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 A3: Austerity and GDP: Different Forecast Specifications

	Gov't. Purchases	Social Benefits	Total Revenue
Specification 1			
$\hat{\beta}$	-2.22	-2.60	-1.55
SE	(0.25)	(1.29)	(0.93)
R^2	0.74	0.13	0.09
$Corr.$	-0.86	-0.36	-0.31
Specification 2			
$\hat{\beta}$	-1.79	-0.75	1.72
SE	(0.34)	(0.66)	(0.34)
R^2	0.50	0.05	0.49
$Corr.$	-0.71	-0.21	0.70
Specification 3			
$\hat{\beta}$	-1.83	-0.95	1.24
SE	(0.40)	(0.89)	(0.35)
R^2	0.44	0.04	0.32
$Corr.$	-0.66	-0.20	0.56
Specification 4			
$\hat{\beta}$	-1.96	-0.38	-0.68
SE	(0.33)	(1.23)	(0.77)
R^2	0.58	0.00	0.03
$Corr.$	-0.76	-0.06	-0.17

Notes: Table displays the regression coefficient of a univariate regression. The explained variable is the forecast error in GDP. Each column corresponds to a different explanatory variable (forecast errors in government purchases, government transfers, total revenue. Every row corresponds to a different forecast specification for both the explanatory and explained variable. Specification 1: Benchmark specification. Specification 2: Linear time trend. Specification 3: AR(1) specification with drift. Specification 4: Same as specification 1, but without Greece.

Table A4a: Austerity and GDP: Without Greece

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Gov't. Purchases	−1.96	−1.98	−1.76	−1.92	−1.86	−2.28	−1.99	−1.67	−1.77	−1.97	−1.79
	(0.33)	(0.32)	(0.29)	(0.33)	(0.31)	(0.46)	(0.32)	(0.26)	(0.28)	(0.42)	(0.29)
Total Revenue		−0.80						−0.84	−0.64	−0.55	−0.68
		(0.50)						(0.39)	(0.43)	(0.47)	(0.49)
TFP			0.39					0.43	0.31	0.34	0.37
			(0.12)					(0.11)	(0.13)	(0.12)	(0.13)
HH Debt to GDP				0.02				0.04			
				(0.02)				(0.01)			
Credit Spread 2010-2014					−0.95				−0.43		
					(0.43)				(0.43)		
Gov't. Bond Rate						0.71				0.38	
						(0.69)				(0.62)	
Gov't Debt to GDP							−0.03				0.00
							(0.02)				(0.02)
R^2	0.58	0.62	0.70	0.59	0.65	0.61	0.61	0.79	0.74	0.73	0.73
Obs.	28	28	28	28	28	27	28	28	28	27	28

Notes: See Table 1b. Sample excludes Greece.

Table A4b: Austerity and GDP: Without GIIPS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Gov't. Purchases	−2.05	−2.18	−1.90	−2.02	−2.12	−2.05	−2.23	−1.87	−2.14	−1.70	−2.05
	(0.36)	(0.35)	(0.32)	(0.39)	(0.31)	(0.46)	(0.36)	(0.32)	(0.28)	(0.39)	(0.32)
Total Revenue		−0.93						−0.87	−0.87	−0.88	−0.79
		(0.48)						(0.40)	(0.38)	(0.46)	(0.48)
TFP			0.33					0.36	0.19	0.34	0.31
			(0.12)					(0.11)	(0.11)	(0.11)	(0.12)
HH Debt to GDP				0.00				0.02			
				(0.02)				(0.02)			
Credit Spread 2010-2014					−1.23				−0.90		
					(0.40)				(0.39)		
Gov't. Bond Rate						−0.01				−1.16	
						(1.02)				(0.90)	
Gov't Debt to GDP							−0.04				−0.01
							(0.02)				(0.03)
R^2	0.59	0.65	0.70	0.59	0.72	0.62	0.65	0.78	0.81	0.78	0.76
Obs.	24	24	24	24	24	23	24	24	24	23	24

Notes: See Table 1b. Sample excludes Greece, Ireland, Italy, Portugal and Spain.

Table A5: AVERAGE FORECAST ERRORS

	Gov't. Purchases	Primary Balance	Total Revenue	Stand. VAT	Top Income Tax Rate	Top Corp. Tax Rate	GDP
Belgium	−4.5	−0.8	2.7	0.0	0.0	0.0	−3.7
Bulgaria	−19.1	−0.6	−4.6	0.0	0.0	0.0	−9.2
Czech Republic	−15.6	1.2	4.1	1.4	2.8	−1.5	−6.9
Denmark	−5.2	−1.7	1.9	0.0	−6.8	−0.1	−0.4
Germany	0.4	0.1	−0.8	0.0	−0.0	0.0	3.0
Estonia	−9.8	3.0	−7.0	1.5	0.0	0.0	1.8
Ireland	−19.3	−0.2	0.7	0.9	4.3	0.0	1.8
Greece	−44.8	3.3	5.8	3.7	7.8	−11.8	−26.0
Spain	−23.8	0.4	4.1	3.2	5.8	0.0	−9.9
France	−5.6	0.1	3.9	0.1	3.1	2.1	−3.0
Italy	−16.9	0.7	−0.4	0.9	2.1	0.0	−7.8
Cyprus	−26.6	−3.4	−4.2	1.7	4.0	1.0	−14.2
Latvia	−10.6	4.2	3.1	1.8	0.8	0.0	−0.5
Lithuania	−13.4	2.6	−10.8	2.2	−4.5	−2.5	3.8
Luxembourg	−4.4	−0.2	−2.1	0.0	3.0	−0.2	2.1
Hungary	−14.2	0.9	−4.1	4.9	−17.4	−0.7	−8.4
Netherlands	−7.1	−1.1	1.8	0.9	0.0	−0.4	−3.4
Austria	−6.8	0.7	1.0	0.0	0.0	0.0	−1.5
Poland	−6.5	1.0	2.2	0.8	−4.0	0.0	−4.7
Portugal	−26.1	0.7	2.8	2.2	9.6	4.0	−11.0
Romania	−36.2	4.1	0.2	4.5	0.0	0.0	−11.2
Slovenia	−14.2	−2.7	−0.8	0.6	3.6	−3.1	−8.5
Slovak Republic	−7.2	1.3	1.8	0.8	2.4	1.4	−4.1
Finland	−4.4	−2.6	3.0	1.3	0.4	−1.8	−2.3
Sweden	−0.9	−1.7	−2.8	0.0	0.2	−2.6	2.1
United Kingdom	−10.5	1.3	2.3	3.4	8.0	−4.6	−2.6
Norway	−6.4	−2.3	−1.8	0.0	−0.2	−0.2	−0.2
Switzerland	2.0	−1.4	−1.8	0.3	0.0	−0.0	0.9
United States	−9.4	1.6	6.3	NaN	1.7	−0.1	0.2

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

Table A6a: Univariate Regressions: Government Purchases (Shortfall)

	Government Purchases (Shortfall)					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	−2.22	0.74	−2.39	0.74	−1.78	0.81
	(0.25)		(0.33)		(0.32)	
Inflation	−0.22	0.09	−0.22	0.07	−0.20	0.30
	(0.13)		(0.18)		(0.12)	
Consumption	−1.37	0.66	−1.47	0.73	−1.05	0.46
	(0.19)		(0.21)		(0.43)	
Investment	−1.45	0.72	−1.60	0.76	−0.95	0.67
	(0.17)		(0.21)		(0.25)	
NX to GDP	0.91	0.29	0.87	0.27	0.84	0.34
	(0.27)		(0.34)		(0.44)	
Exchange Rate	−0.65	0.11	0.13	0.05	−2.77	0.54
	(0.36)		(0.14)		(0.97)	
GDP Growth	−0.65	0.63	−0.69	0.62	−0.52	0.73
	(0.10)		(0.13)		(0.12)	
Unemployment	0.96	0.63	1.23	0.88	0.05	0.05
	(0.14)		(0.11)		(0.09)	
Debt to GDP	3.60	0.35	3.73	0.42	2.42	0.18
	(0.93)		(1.03)		(1.92)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (6) 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 A6b: Univariate Regressions: Social Benefits (Shortfall)

	Social Benefits (Shortfall)					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	−2.60	0.13	−2.00	0.07	−5.15	0.61
	(1.29)		(1.66)		(1.56)	
Inflation	−1.11	0.30	−1.18	0.30	−0.71	0.33
	(0.32)		(0.42)		(0.38)	
Consumption	−1.85	0.16	−1.31	0.08	−4.04	0.60
	(0.83)		(1.02)		(1.23)	
Investment	−1.74	0.13	−1.34	0.08	−3.18	0.67
	(0.85)		(1.09)		(0.84)	
NX to GDP	2.34	0.25	2.10	0.23	2.80	0.34
	(0.78)		(0.91)		(1.48)	
Exchange Rate	−0.97	0.03	0.67	0.18	−8.09	0.41
	(1.06)		(0.34)		(3.67)	
GDP Growth	−0.79	0.12	−0.59	0.07	−1.58	0.59
	(0.41)		(0.53)		(0.50)	
Unemployment	1.41	0.17	1.53	0.20	0.26	0.11
	(0.59)		(0.73)		(0.28)	
Debt to GDP	2.99	0.03	2.99	0.04	0.17	0.00
	(3.18)		(3.50)		(7.11)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (6) 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 A6c: Univariate Regressions: Primary Balance

	Primary Balance					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	−0.41	0.02	0.13	0.00	−1.80	0.60
	(0.62)		(0.83)		(0.55)	
Inflation	−0.28	0.10	−0.38	0.13	−0.09	0.05
	(0.17)		(0.23)		(0.16)	
Consumption	−0.40	0.04	−0.16	0.01	−1.07	0.34
	(0.40)		(0.51)		(0.56)	
Investment	−0.10	0.00	0.21	0.01	−0.96	0.49
	(0.41)		(0.55)		(0.37)	
NX to GDP	0.66	0.10	0.54	0.06	1.14	0.45
	(0.39)		(0.49)		(0.48)	
Exchange Rate	−0.75	0.09	0.31	0.16	−3.44	0.59
	(0.46)		(0.16)		(1.07)	
GDP Growth	−0.08	0.01	0.09	0.01	−0.55	0.57
	(0.20)		(0.26)		(0.18)	
Unemployment	0.16	0.01	0.25	0.02	0.09	0.10
	(0.29)		(0.39)		(0.10)	
Debt to GDP	1.69	0.05	0.54	0.01	5.20	0.61
	(1.42)		(1.73)		(1.56)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (6) 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 A6d: Univariate Regressions: Total Revenue

	Total Revenue					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	−1.55	0.09	−1.90	0.13	−0.34	0.01
	(0.93)		(1.17)		(1.52)	
Inflation	0.47	0.11	0.56	0.13	0.20	0.07
	(0.26)		(0.34)		(0.28)	
Consumption	−0.70	0.04	−0.98	0.09	0.25	0.01
	(0.62)		(0.74)		(1.20)	
Investment	−0.83	0.06	−1.04	0.09	−0.08	0.00
	(0.63)		(0.79)		(0.90)	
NX to GDP	−0.93	0.08	−1.31	0.17	0.21	0.01
	(0.61)		(0.69)		(1.11)	
Exchange Rate	−0.71	0.03	−0.33	0.08	−1.87	0.06
	(0.75)		(0.26)		(2.84)	
GDP Growth	−0.41	0.07	−0.50	0.09	−0.11	0.01
	(0.30)		(0.38)		(0.47)	
Unemployment	0.32	0.02	0.37	0.02	0.08	0.02
	(0.45)		(0.59)		(0.18)	
Debt to GDP	4.64	0.15	3.58	0.11	7.67	0.44
	(2.10)		(2.46)		(3.26)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (6) 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 A6e: Univariate Regressions: Standard VAT Rate

	Standard VAT Rate					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	−2.42	0.29	−3.66	0.32	−1.87	0.64
	(0.74)		(1.25)		(0.57)	
Inflation	−0.13	0.01	−0.35	0.03	−0.05	0.01
	(0.25)		(0.44)		(0.17)	
Consumption	−1.51	0.28	−2.13	0.29	−1.32	0.62
	(0.47)		(0.79)		(0.42)	
Investment	−1.39	0.22	−2.36	0.31	−1.04	0.57
	(0.51)		(0.84)		(0.37)	
NX to GDP	0.97	0.11	1.54	0.16	1.05	0.36
	(0.54)		(0.84)		(0.57)	
Exchange Rate	−1.55	0.19	0.29	0.04	−3.50	0.57
	(0.62)		(0.32)		(1.25)	
GDP Growth	−0.68	0.23	−1.06	0.27	−0.53	0.56
	(0.24)		(0.41)		(0.19)	
Unemployment	0.81	0.15	2.35	0.60	0.05	0.03
	(0.38)		(0.45)		(0.11)	
Debt to GDP	4.25	0.16	7.78	0.34	4.07	0.46
	(1.88)		(2.56)		(1.81)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (6) 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 A6f: Univariate Regressions: Top Personal Income Tax Rate

	Top Personal Income Tax Rate					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	−0.36	0.08	−1.23	0.41	0.25	0.14
	(0.24)		(0.35)		(0.24)	
Inflation	0.05	0.02	0.09	0.03	0.04	0.12
	(0.07)		(0.13)		(0.04)	
Consumption	−0.18	0.05	−0.78	0.43	0.27	0.26
	(0.16)		(0.21)		(0.17)	
Investment	−0.24	0.08	−0.82	0.42	0.20	0.26
	(0.16)		(0.23)		(0.13)	
NX to GDP	0.03	0.00	0.21	0.03	−0.22	0.20
	(0.16)		(0.27)		(0.17)	
Exchange Rate	0.19	0.04	0.03	0.01	0.40	0.10
	(0.19)		(0.10)		(0.46)	
GDP Growth	−0.10	0.06	−0.34	0.32	0.08	0.14
	(0.08)		(0.12)		(0.07)	
Unemployment	0.22	0.13	0.47	0.27	−0.03	0.12
	(0.11)		(0.18)		(0.03)	
Debt to GDP	1.61	0.29	2.59	0.42	0.65	0.11
	(0.49)		(0.71)		(0.68)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (6) 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 A6g: Univariate Regressions: Top Corporate Tax Rate

	Top Corporate Tax Rate					
	All Countries		Fixed XRT		Floating XRT	
	α	R^2	α^{fix}	R^2	α^{fl}	R^2
GDP	0.97	0.16	1.17	0.25	−0.51	0.03
	(0.43)		(0.48)		(1.09)	
Inflation	0.10	0.02	0.16	0.06	−0.33	0.35
	(0.13)		(0.16)		(0.17)	
Consumption	0.66	0.17	0.76	0.27	0.05	0.00
	(0.28)		(0.29)		(0.87)	
Investment	0.55	0.12	0.69	0.20	−0.33	0.04
	(0.29)		(0.33)		(0.64)	
NX to GDP	−0.08	0.00	−0.21	0.02	0.57	0.07
	(0.30)		(0.33)		(0.78)	
Exchange Rate	−0.12	0.00	−0.12	0.05	0.07	0.00
	(0.36)		(0.12)		(2.12)	
GDP Growth	0.25	0.11	0.31	0.17	−0.13	0.02
	(0.14)		(0.16)		(0.34)	
Unemployment	−0.51	0.20	−0.62	0.31	0.01	0.00
	(0.20)		(0.22)		(0.13)	
Debt to GDP	−1.17	0.04	−1.15	0.06	−3.11	0.14
	(1.07)		(1.12)		(2.93)	

Notes: Table displays the estimated coefficient on the government finance variable from regression (6) 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 A7: Estimated Intercepts

USA	ECB	CZE	HUN	POL	ROM	SWE	GBR	NOR	CHE
2.45	0.59	0.40	1.10	5.30	−1.71	4.20	3.35	3.38	1.02
(0.21)	(0.25)	(0.47)	(1.12)	(0.40)	(1.98)	(0.28)	(0.31)	(0.37)	(0.24)

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

Table A8: INTEREST RATES

	CB rate			Taylor deviation		
	04-07	08-09	10-14	04-07	08-09	10-14
Belgium	2.7	2.6	0.8	0.0	0.0	0.4
Bulgaria	2.7	2.6	0.8	0.0	0.0	0.4
Czech Republic	3.3	3.5	1.1	−0.3	−2.8	0.9
Denmark	2.9	3.1	0.6	0.0	0.0	0.4
Germany	2.7	2.6	0.8	0.0	0.0	0.4
Estonia	2.7	2.6	0.8	0.0	0.0	0.4
Ireland	2.7	2.6	0.8	0.0	0.0	0.4
Greece	2.7	2.6	0.8	0.0	0.0	0.4
Spain	2.7	2.6	0.8	0.0	0.0	0.4
France	2.7	2.6	0.8	0.0	0.0	0.4
Italy	2.7	2.6	0.8	0.0	0.0	0.4
Cyprus	4.7	2.6	0.8	0.0	0.0	0.4
Latvia	4.4	5.3	2.5	0.0	0.0	0.4
Lithuania	2.7	2.6	0.8	0.0	0.0	0.4
Luxembourg	2.7	2.6	0.8	0.0	0.0	0.4
Hungary	8.3	8.7	5.0	0.1	2.1	2.0
Netherlands	2.7	2.6	0.8	0.0	0.0	0.4
Austria	2.7	2.6	0.8	0.0	0.0	0.4
Poland	4.9	4.7	3.5	−0.6	−3.8	−3.7
Portugal	2.7	2.6	0.8	0.0	0.0	0.4
Romania	11.8	9.4	5.2	−0.5	1.4	3.8
Slovenia	3.8	2.6	0.8	0.0	0.0	0.4
Slovak Republic	4.1	2.6	0.8	0.0	0.0	0.4
Finland	2.7	2.6	0.8	0.0	0.0	0.4
Sweden	2.4	2.4	1.0	−1.7	−2.8	−2.4
United Kingdom	4.8	2.7	0.5	−0.2	−2.1	−4.0
Norway	2.7	3.5	1.7	−1.1	−2.8	−3.2
Switzerland	1.5	1.2	−0.1	0.5	−1.4	−0.0
United States	3.6	1.0	0.1	−0.4	−1.8	−1.4
Average	3.5	3.2	1.2	−0.1	−0.5	−0.0

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

Table A9: STEADY-STATE GOVERNMENT PURCHASES AND TAX RATES

	Gov't Purchases		Taxes			Spread
	Share GDP	Share Interm	Cons	Labor	Capital	
Austria	22.1	81.3	22.6	42.0	23.4	0.4
Belgium	24.6	87.4	21.4	41.8	30.7	0.4
Bulgaria	22.5	90.1	25.0	27.4	12.2	1.7
Cyprus	20.9	93.5	20.9	22.9	28.5	0.6
Czech Republic	24.7	78.7	21.8	40.5	19.0	0.4
Denmark	28.2	91.6	34.4	35.8	38.8	0.5
Estonia	22.5	90.4	24.7	33.2	10.4	0.5
Finland	25.9	78.1	25.6	40.7	26.8	0.3
France	27.2	82.3	19.7	38.9	44.0	0.4
Germany	20.5	79.8	19.1	37.5	21.4	0.6
Greece	25.5	96.1	16.0	37.0	16.8	0.8
Hungary	25.3	71.1	28.3	40.3	19.8	0.7
Ireland	20.4	92.9	21.6	26.6	22.4	0.6
Italy	22.6	86.8	17.2	41.8	32.4	0.5
Latvia	22.5	71.2	18.1	30.0	14.9	0.6
Lithuania	23.3	85.8	17.6	32.7	13.7	0.8
Luxembourg	20.0	84.9	36.1	29.2	39.2	0.5
Netherlands	26.9	86.3	22.8	33.4	17.9	0.3
Norway	23.5	92.7	29.6	36.7	41.9	0.5
Poland	21.9	86.0	22.0	31.2	21.4	0.6
Portugal	24.9	87.7	19.6	24.4	26.6	0.9
RoW	18.0	100.0	5.7	23.1	32.7	0.5
Romania	21.0	97.6	18.4	29.3	14.4	2.1
Slovak Republic	22.3	71.9	20.1	30.7	12.2	0.4
Slovenia	22.7	82.5	27.1	36.2	26.1	0.6
Spain	22.4	78.1	13.4	31.6	35.8	0.4
Sweden	29.2	85.0	27.7	41.4	28.0	0.4
Switzerland	14.7	99.6	9.9	22.2	27.6	0.5
United Kingdom	22.0	97.5	15.5	25.8	40.7	0.4
United States	19.4	100.0	5.7	23.1	32.7	0.5
Average	22.9	86.9	20.9	32.9	25.7	0.6

Notes: Table displays the steady-state values for the share of government purchases in GDP, the share of government purchases falling on the intermediate good, the consumption tax rate, the labor tax rate, the capital tax rate and the credit spread. See main body of the text for data sources and time periods.

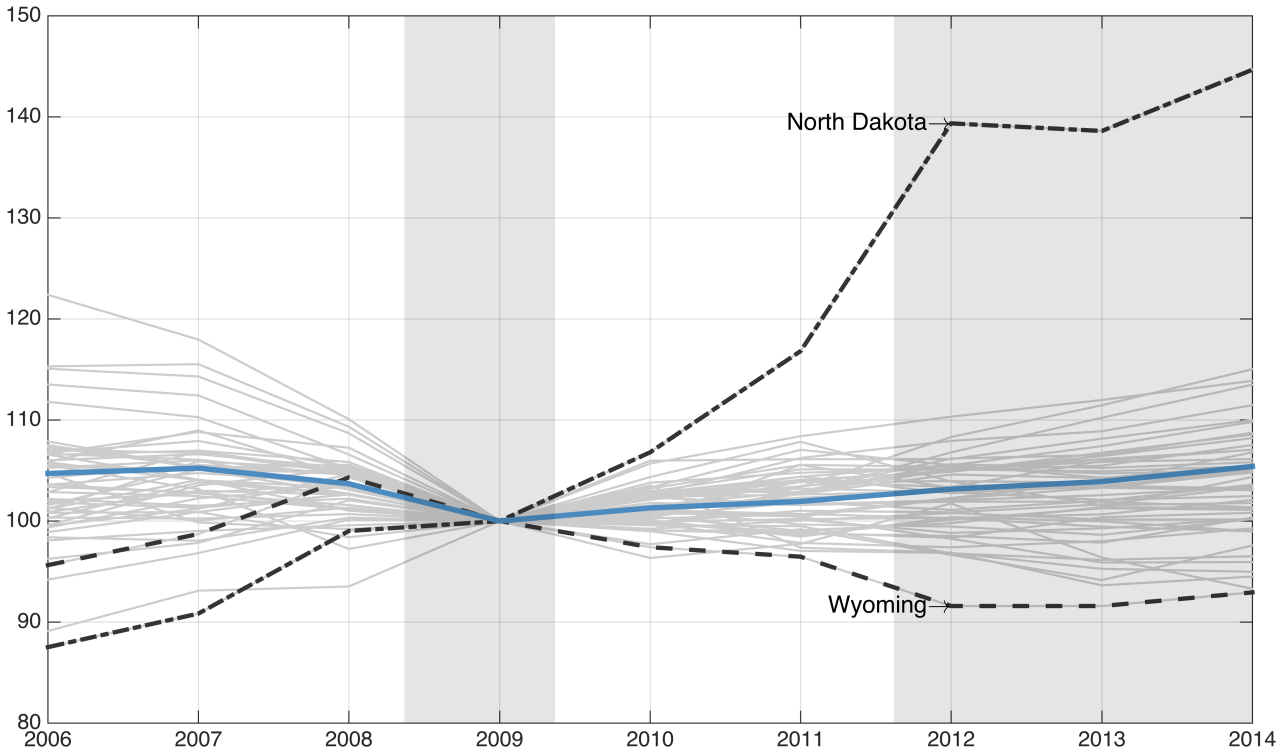


Figure A1: Real per Capita GDP Before, During and After the Crisis: US States

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.

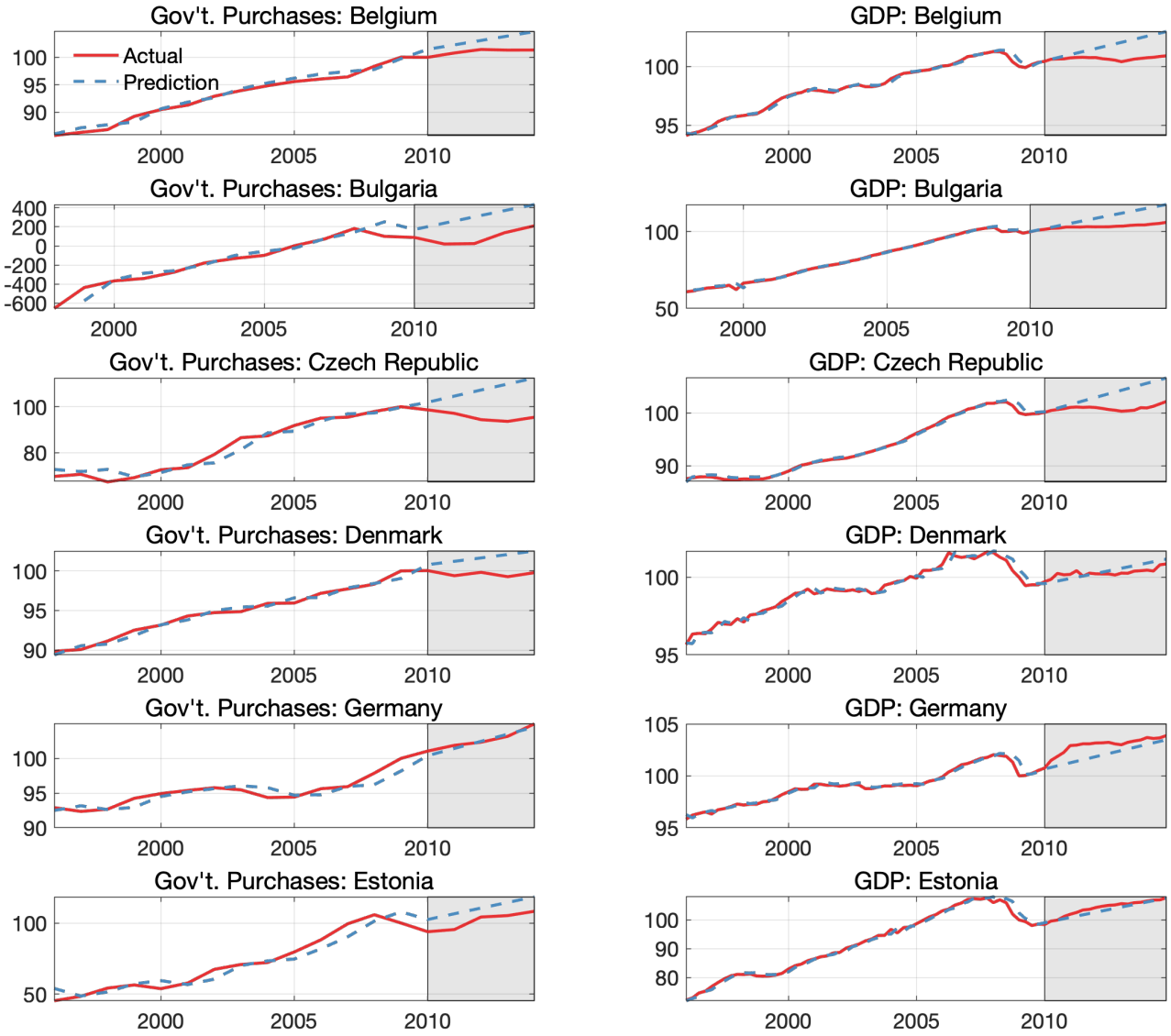


Figure A2a: Government Purchases and GDP (1)

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.

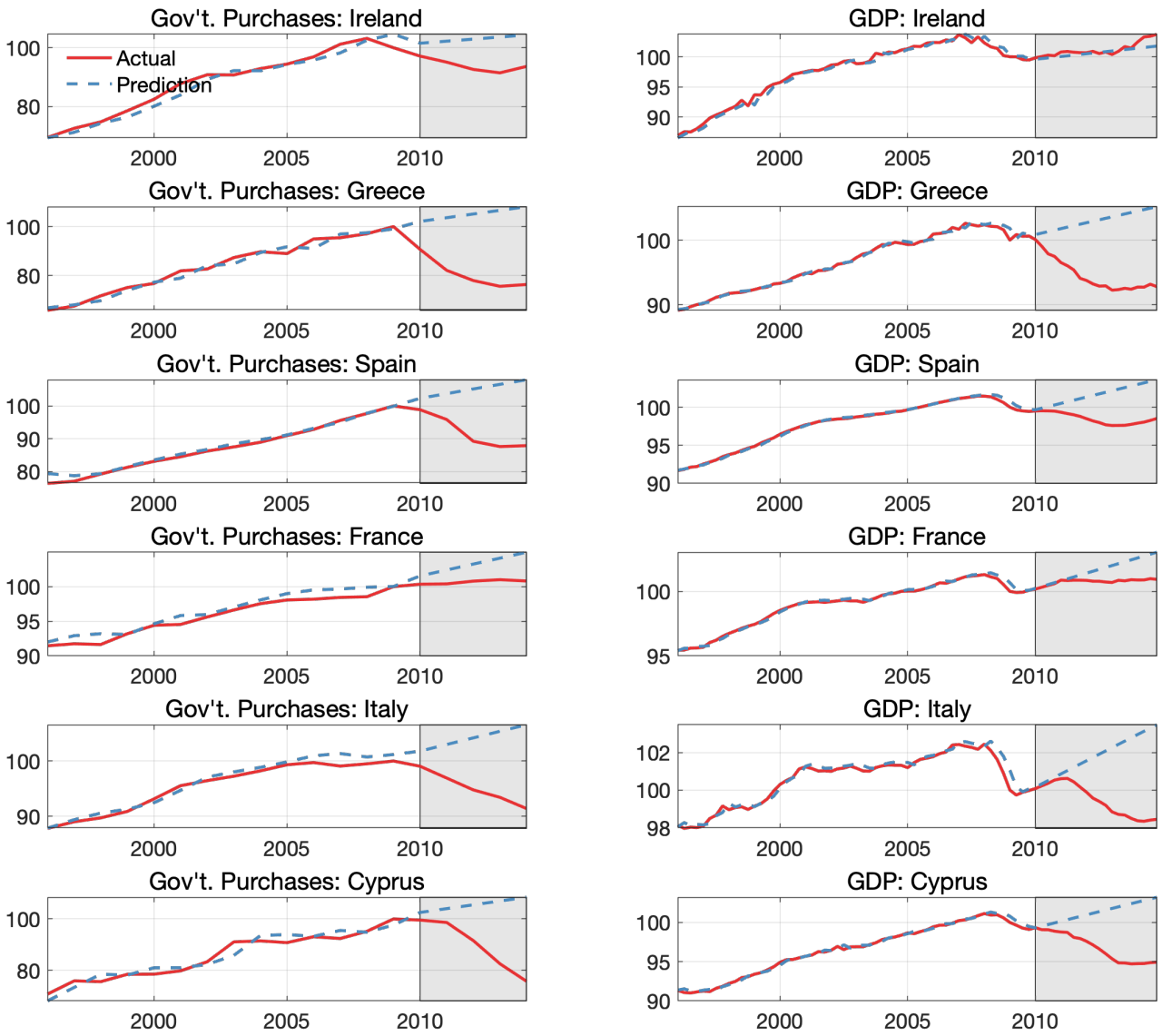


Figure A2b: Government Purchases and GDP (2)

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.

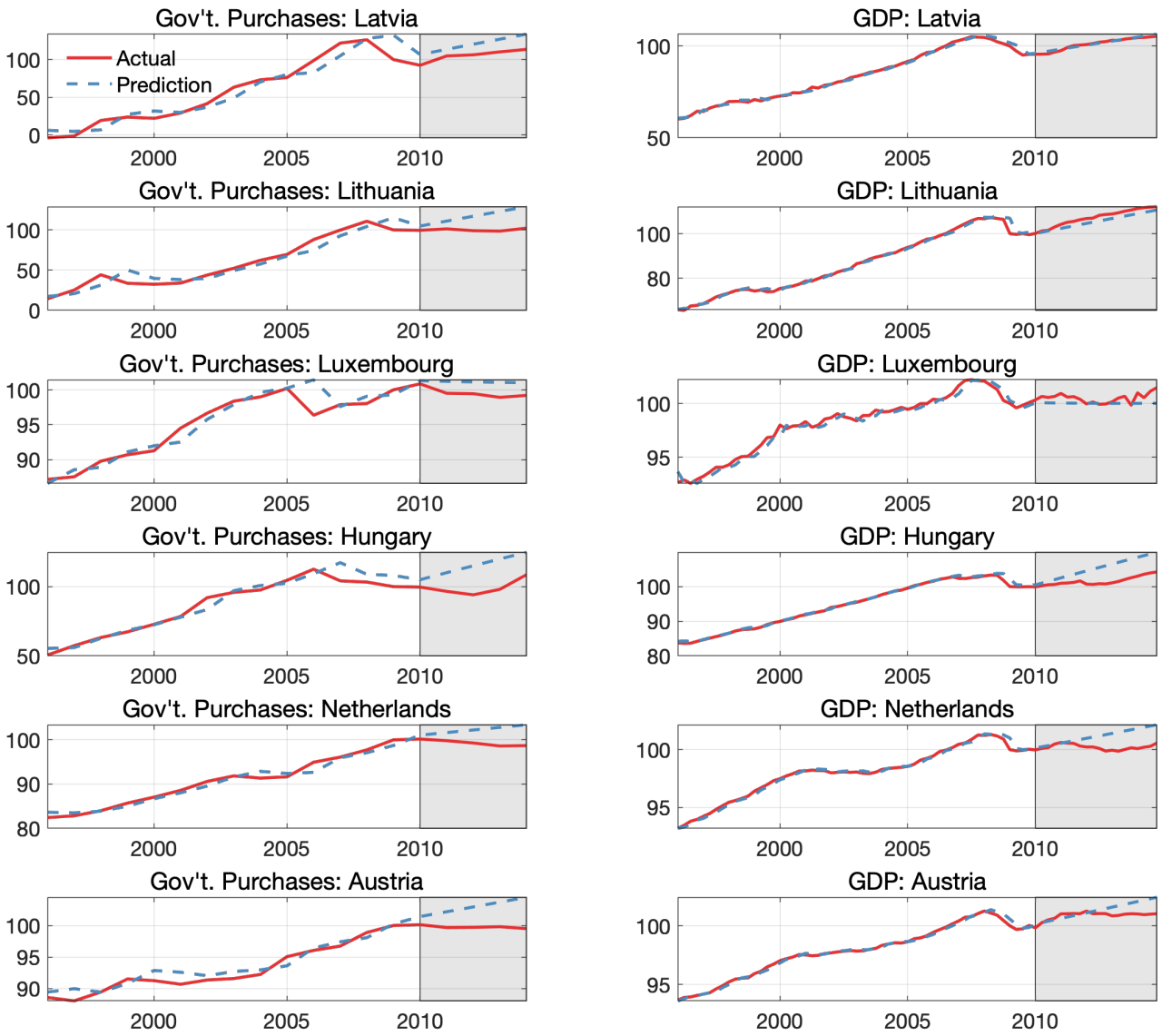


Figure A2c: Government Purchases and GDP (3)

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.

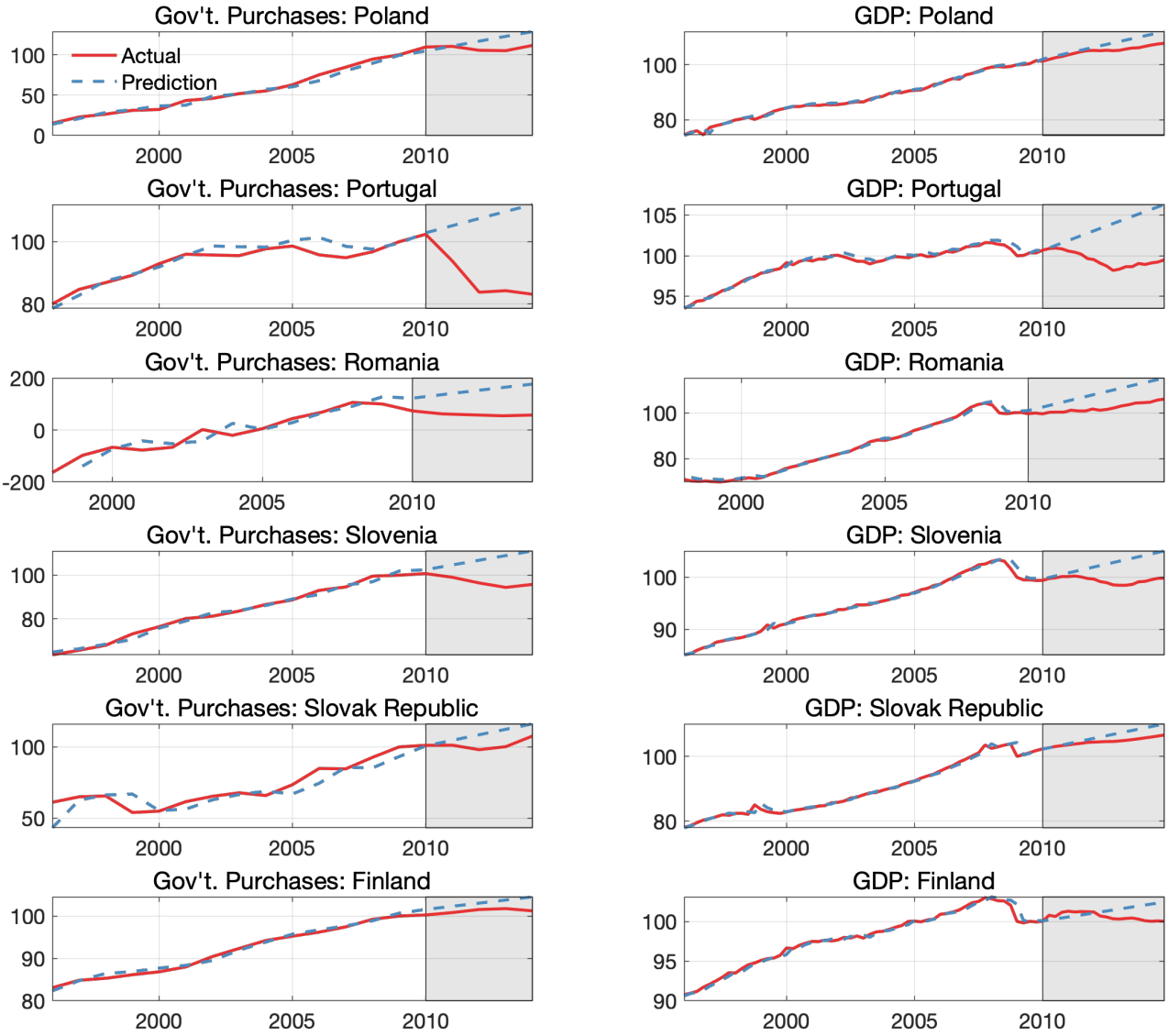


Figure A2d: Government Purchases and GDP (4)

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.

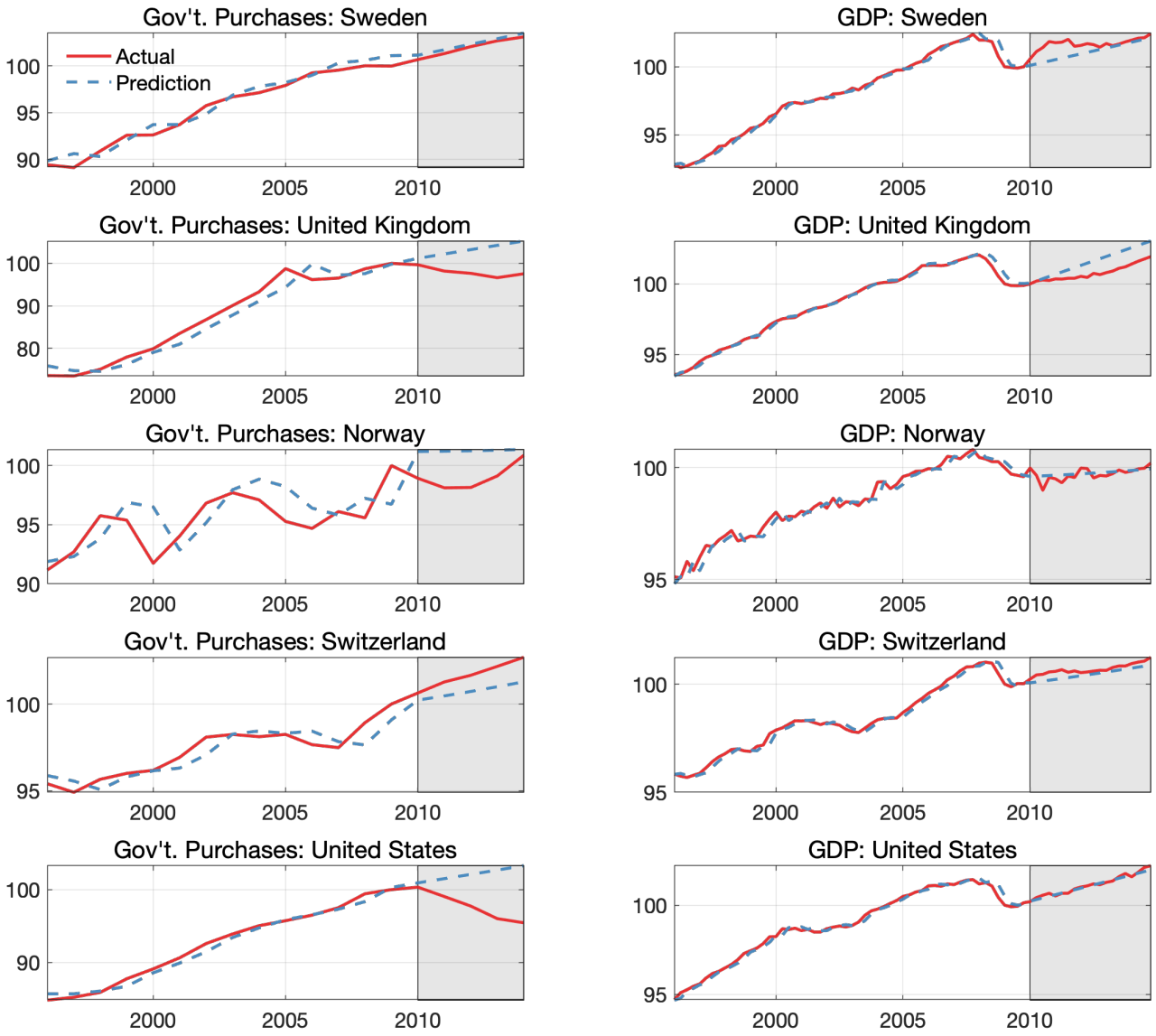


Figure A2e: Government Purchases and GDP (5)

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.

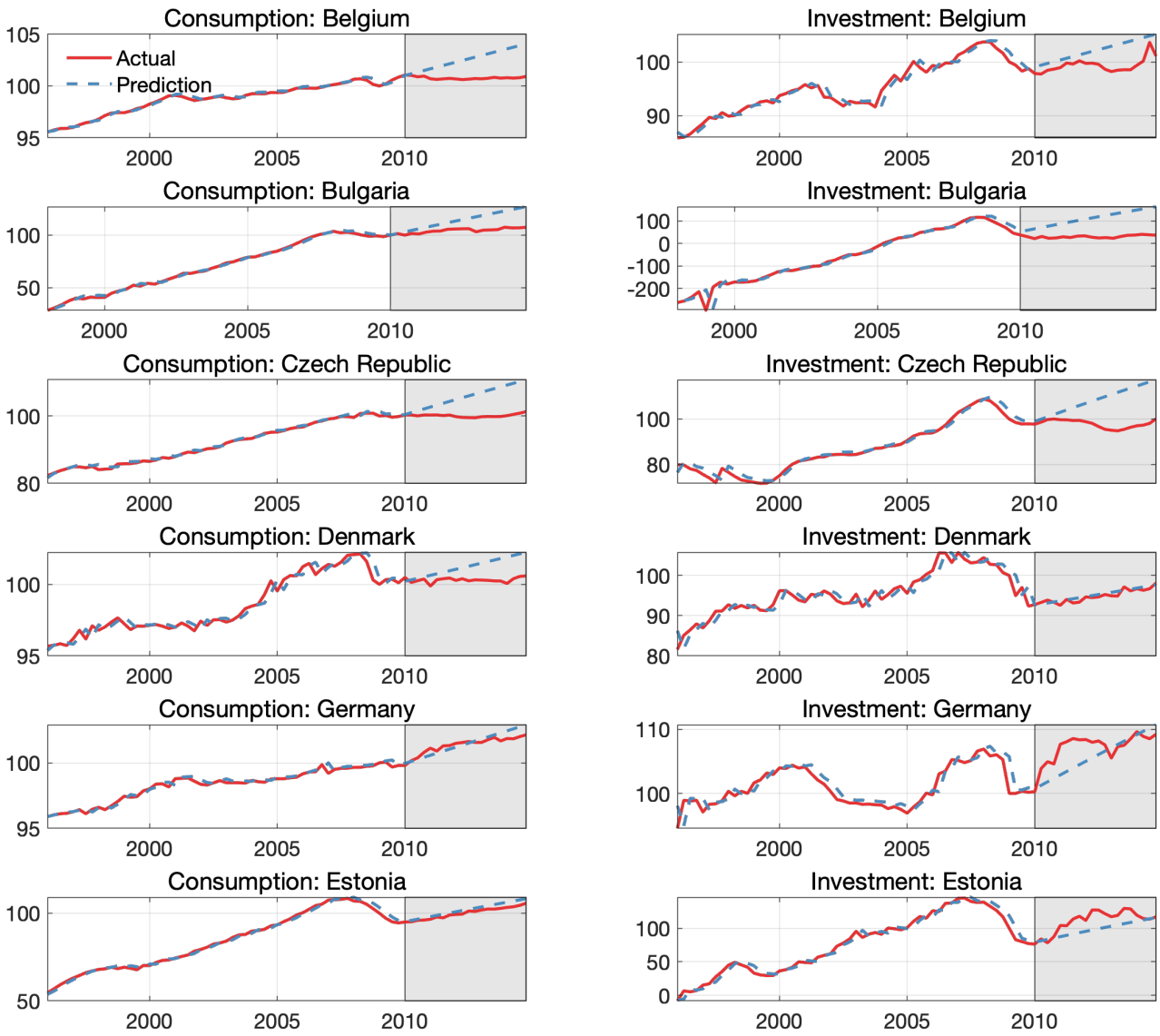


Figure A3a: Consumption and Investment (1)

Note: Left column panels display real private consumption per capita 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 investment per capita.

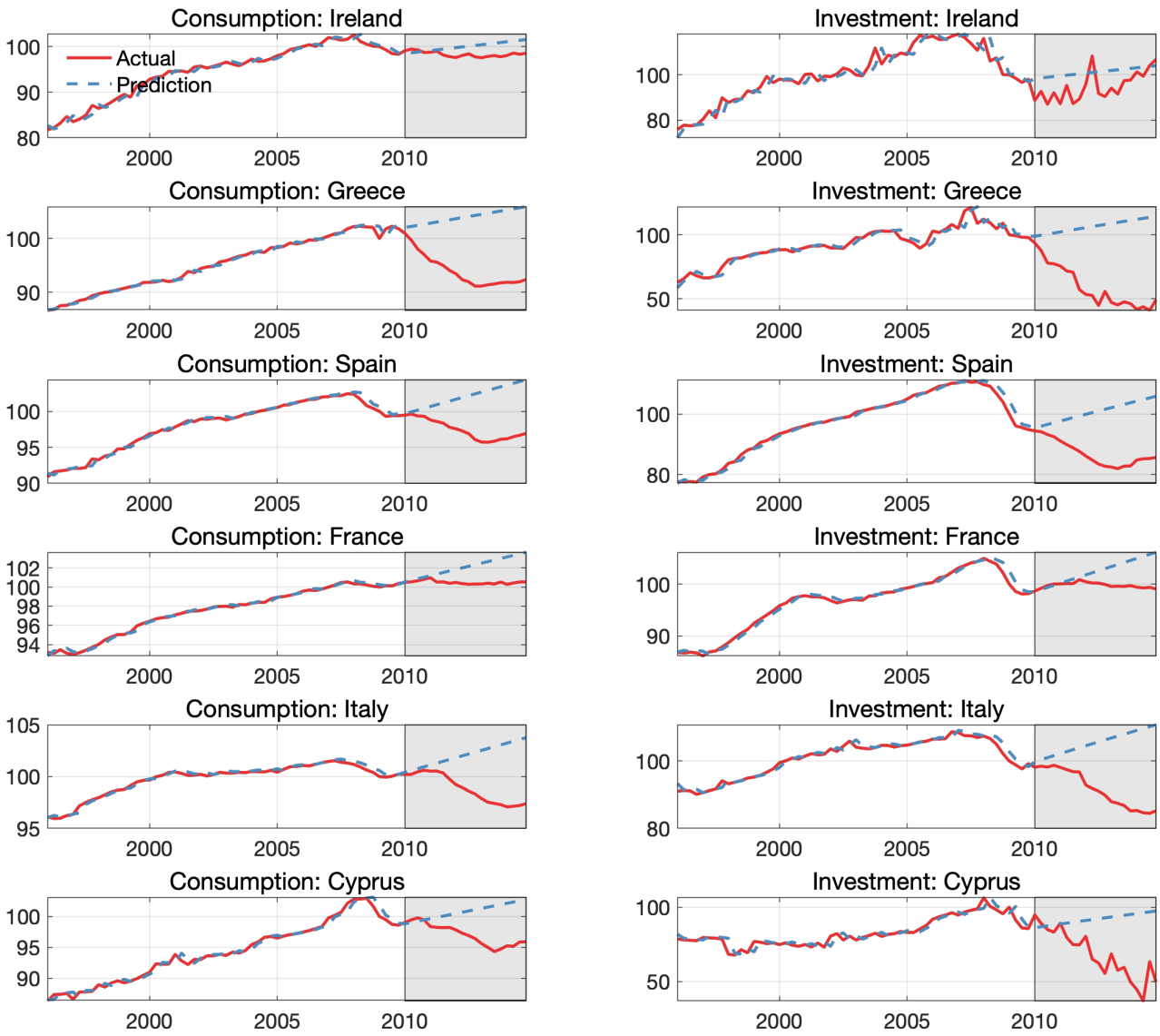


Figure A3b: Consumption and Investment (2)

Note: Left column panels display real private consumption per capita 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 investment per capita.

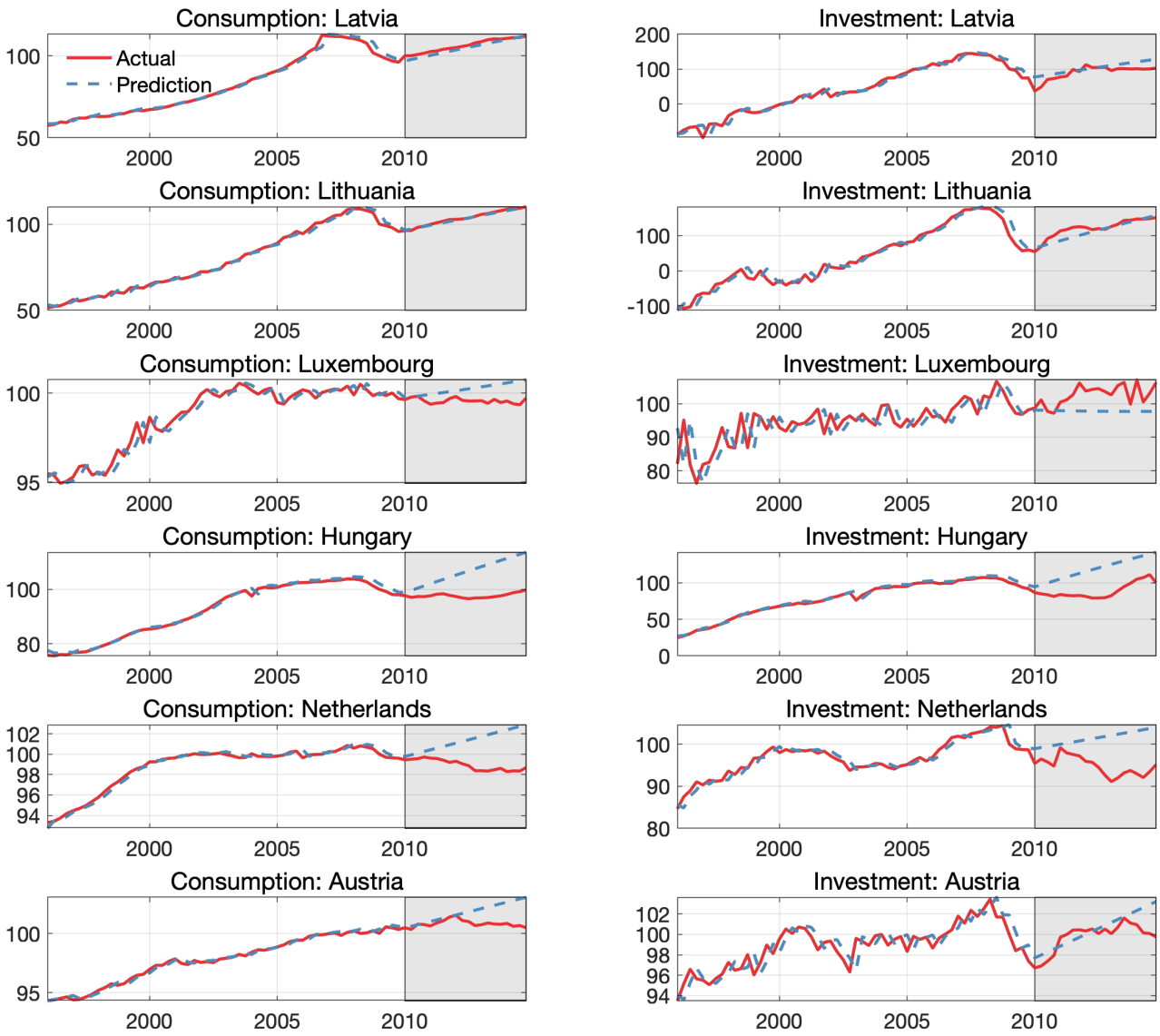


Figure A3c: Consumption and Investment (3)

Note: Left column panels display real private consumption per capita 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 investment per capita.

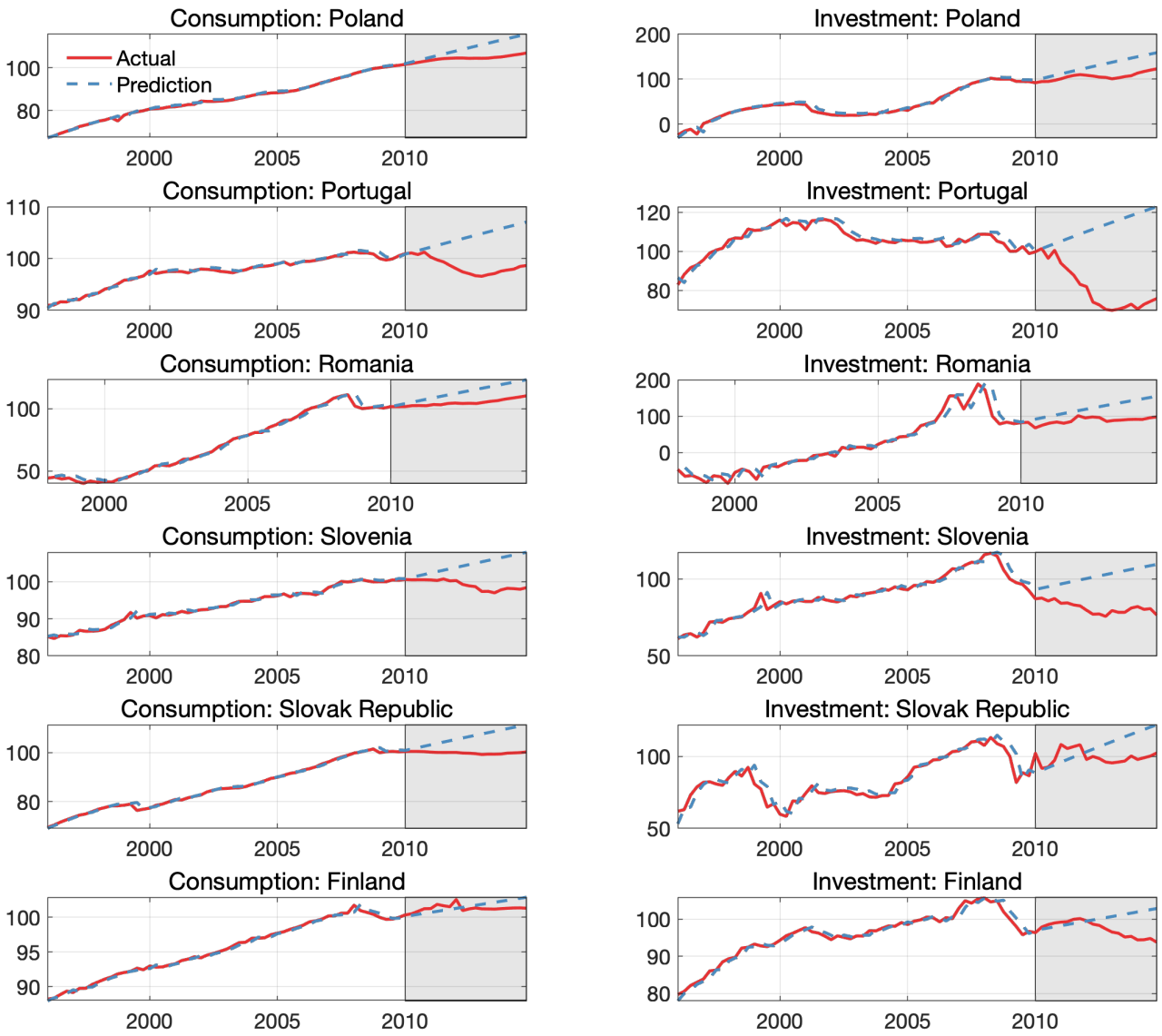


Figure A3d: Consumption and Investment (4)

Note: Left column panels display real private consumption per capita 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 investment per capita.

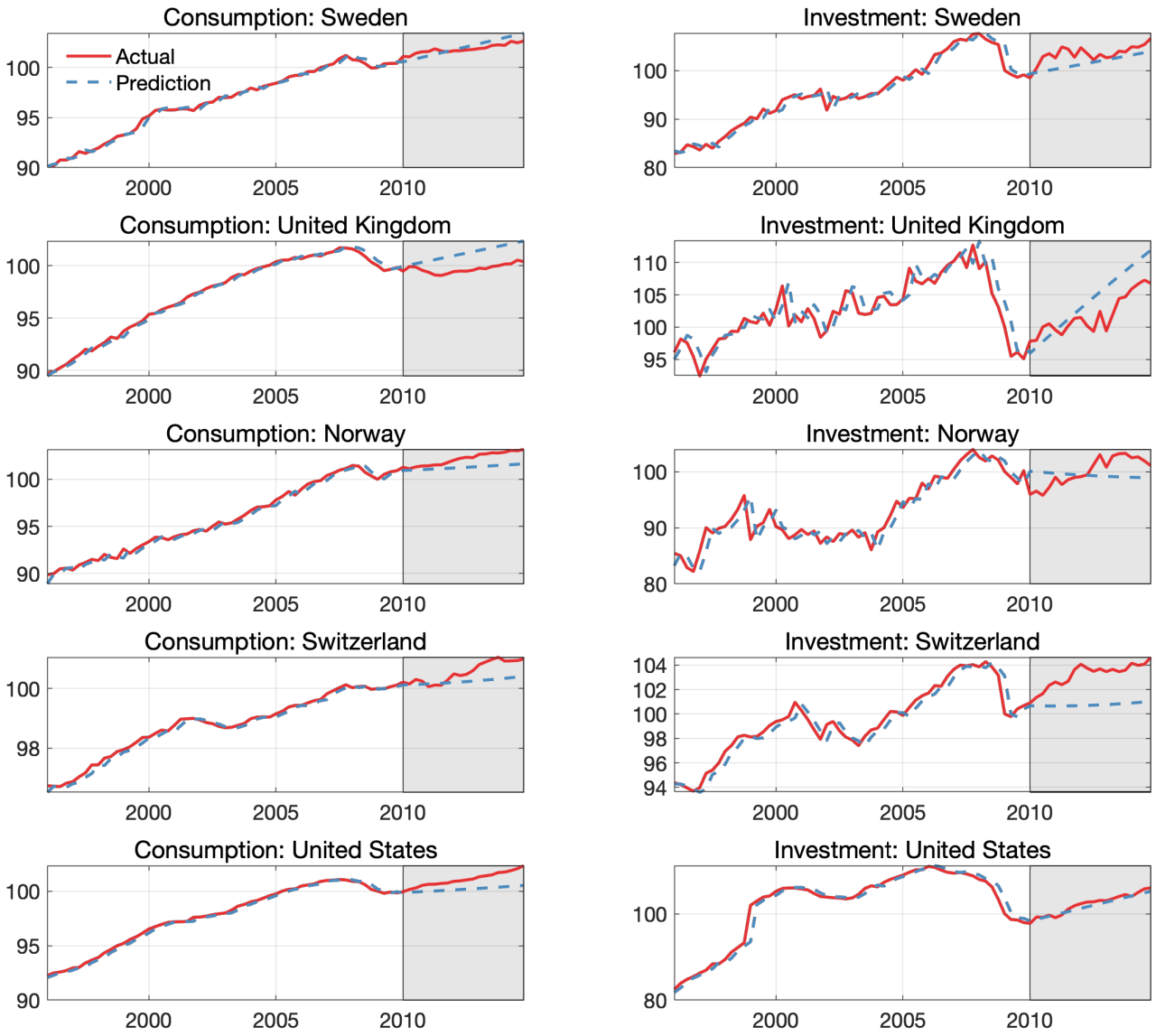


Figure A3e: Consumption and Investment (5)

Note: Left column panels display real private consumption per capita 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 investment per capita.

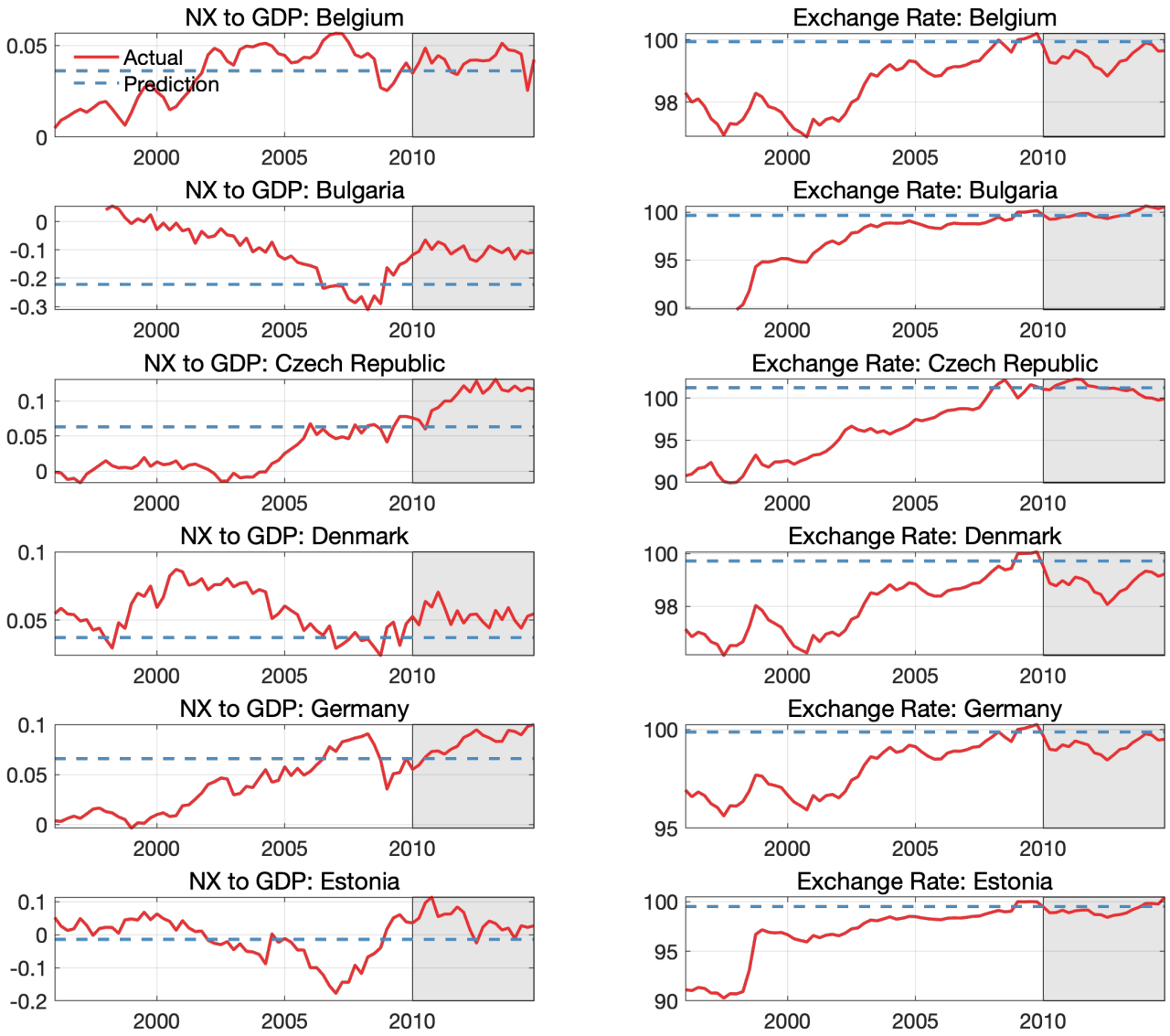


Figure A4a: Net Exports and Exchange Rates (1)

Note: Left column panels display net exports to GDP for various countries, together with their predicted values. Right column panels display the corresponding series for the nominal effective exchange rates.

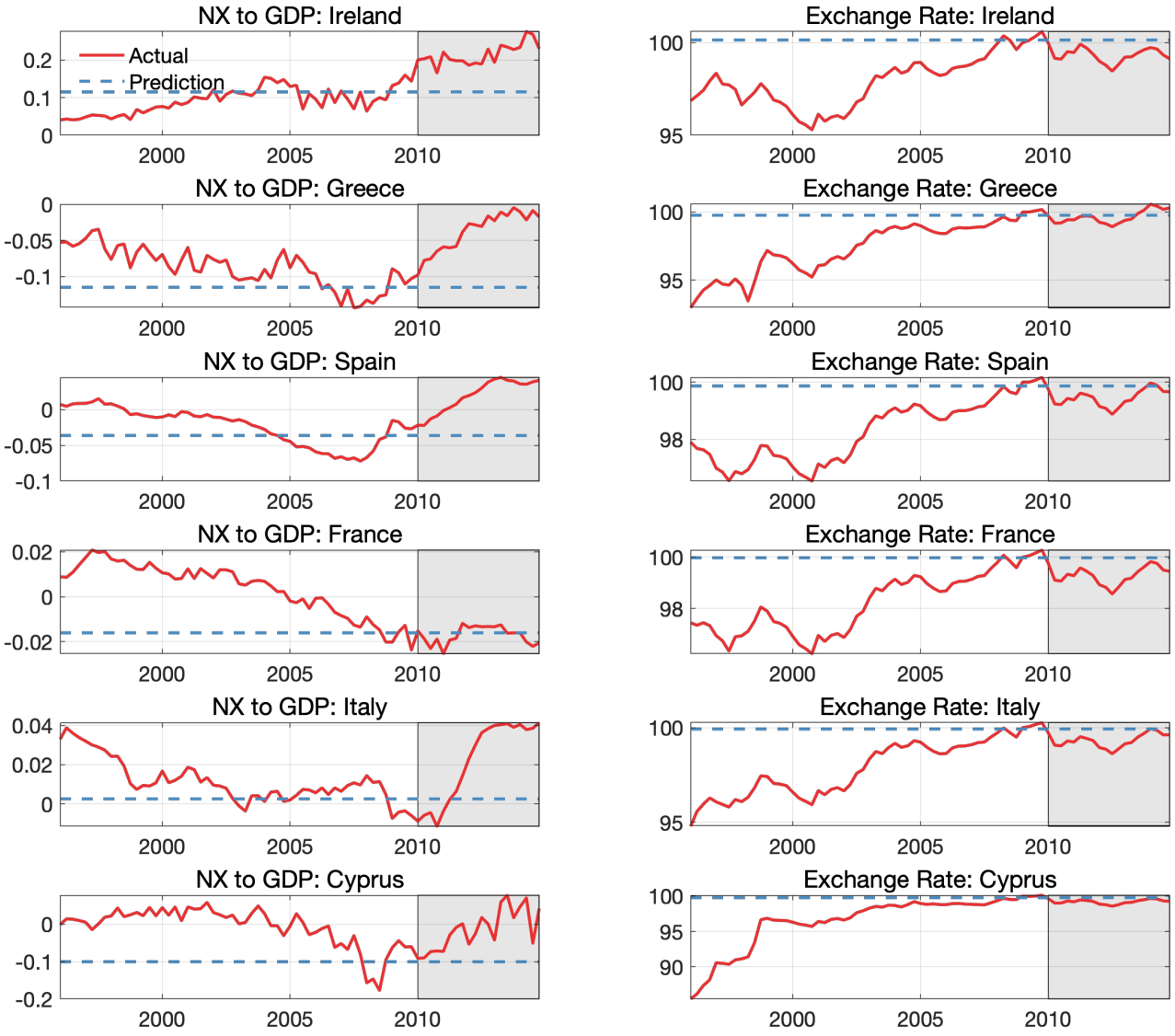


Figure A4b: Net Exports and Exchange Rates (2)

Note: Left column panels display net exports to GDP for various countries, together with their predicted values. Right column panels display the corresponding series for the nominal effective exchange rates.

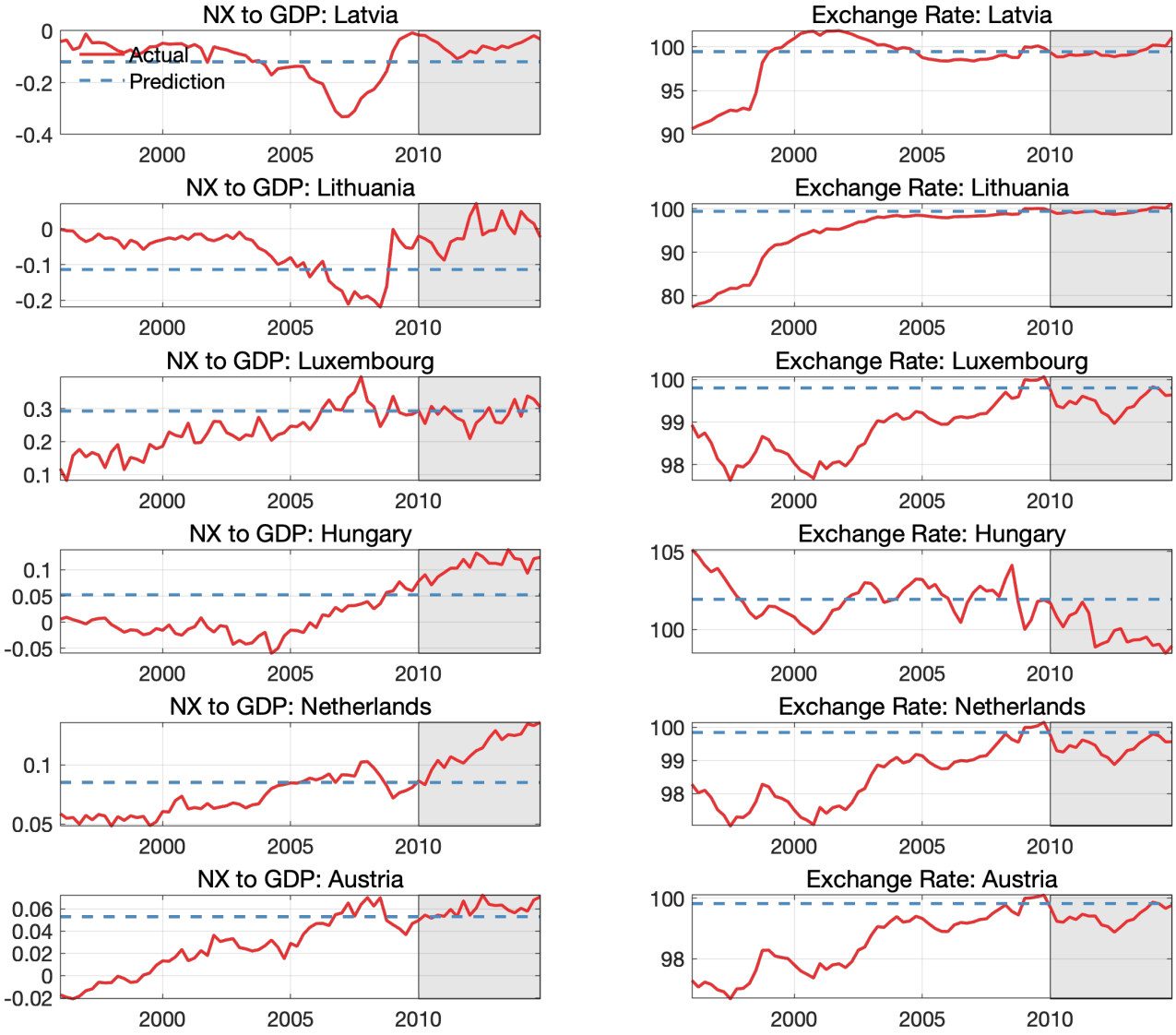


Figure A4c: Net Exports and Exchange Rates (3)

Note: Left column panels display net exports to GDP for various countries, together with their predicted values. Right column panels display the corresponding series for the nominal effective exchange rates.

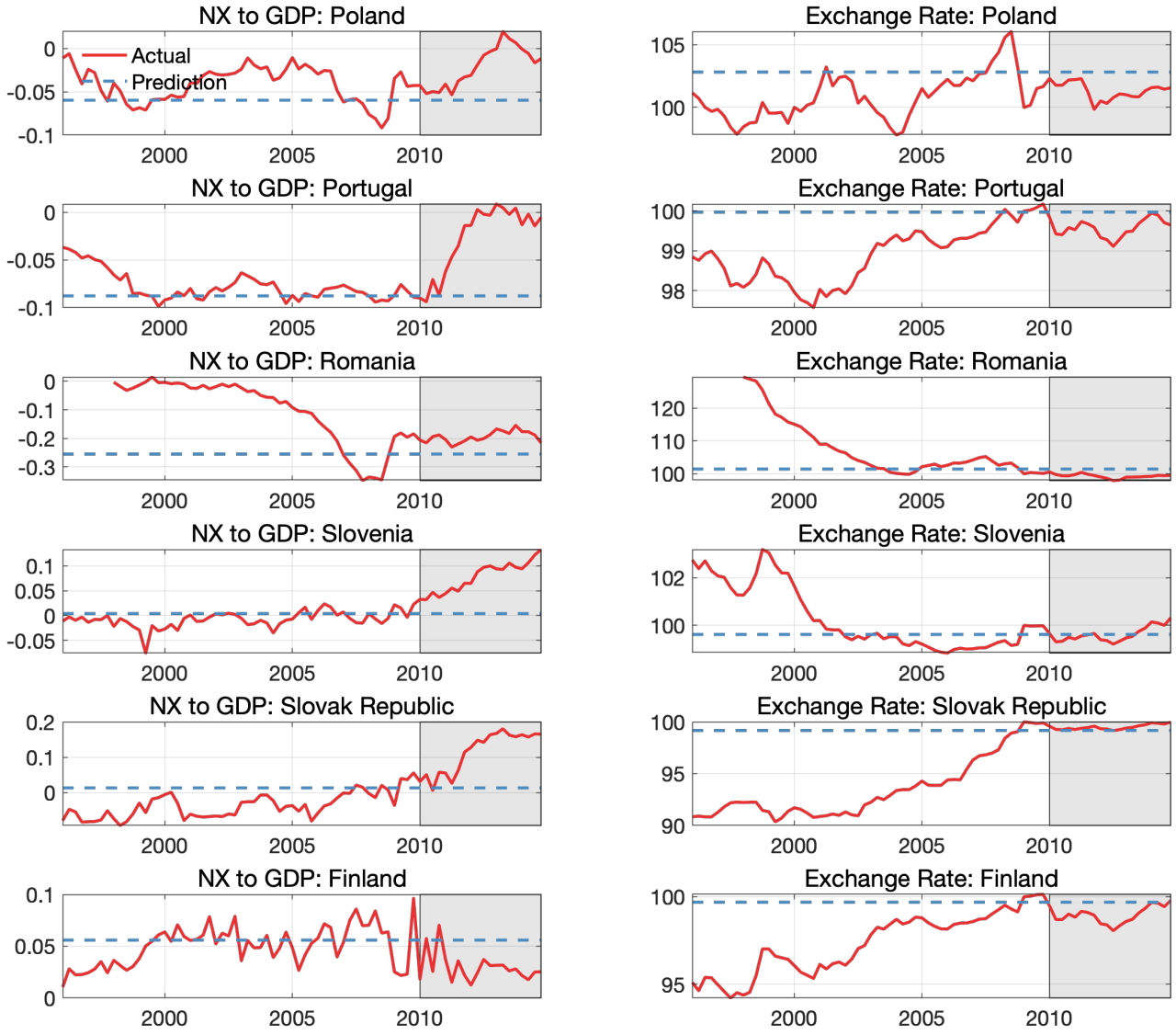


Figure A4d: Net Exports and Exchange Rates (4)

Note: Left column panels display net exports to GDP for various countries, together with their predicted values. Right column panels display the corresponding series for the nominal effective exchange rates.

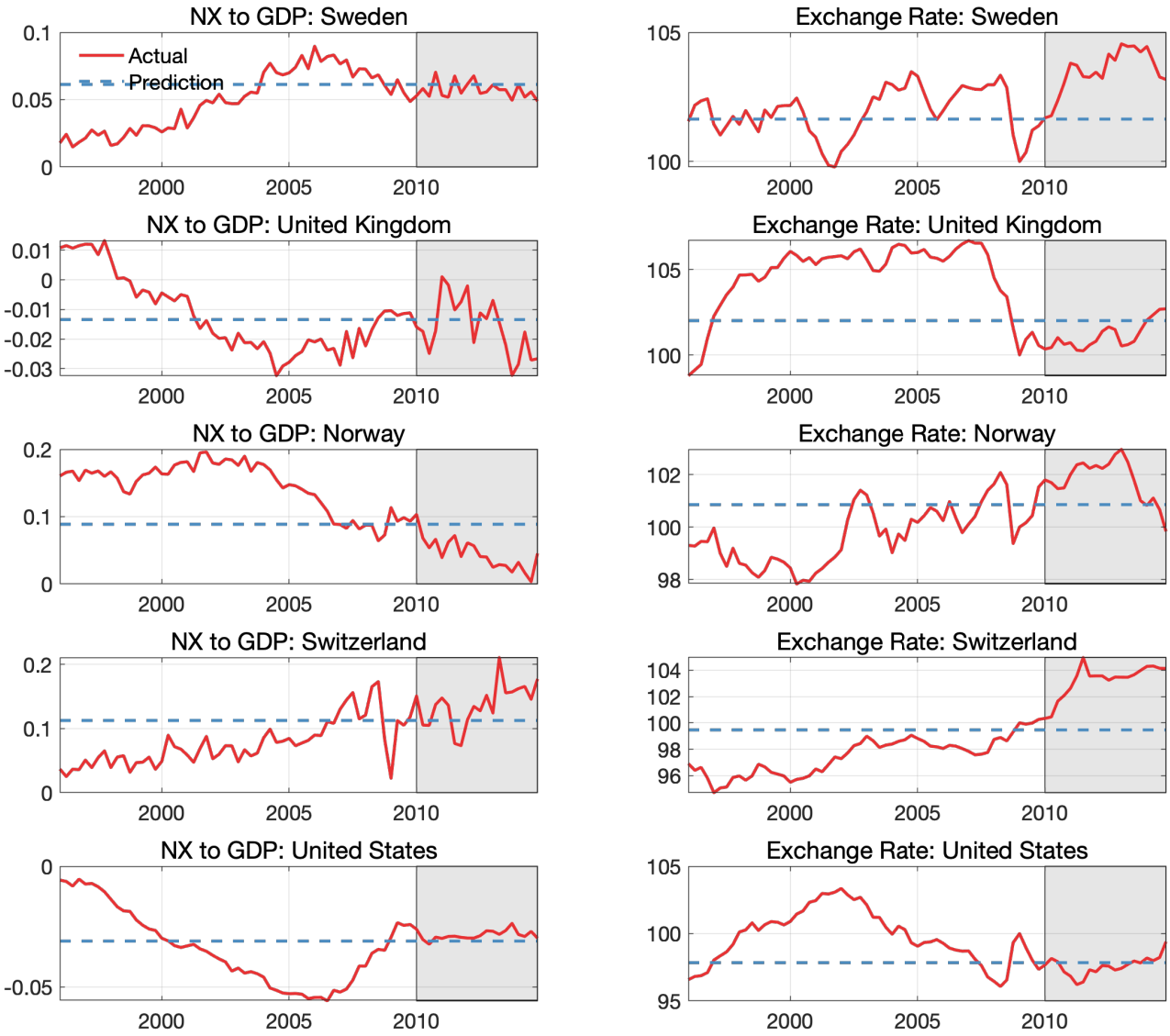


Figure A4e: Net Exports and Exchange Rates (5)

Note: Left column panels display net exports to GDP for various countries, together with their predicted values. Right column panels display the corresponding series for the nominal effective exchange rates.

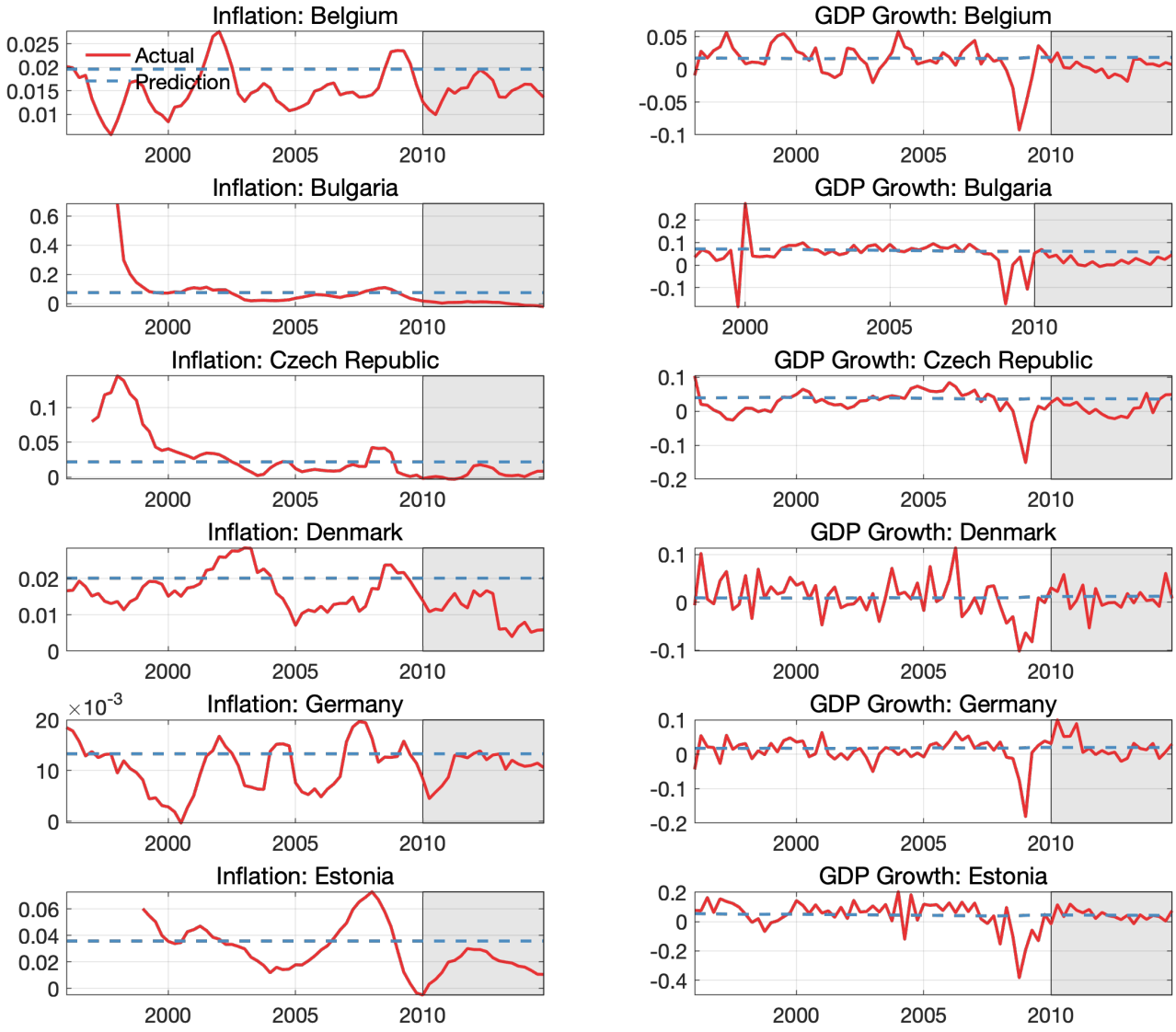


Figure A5a: Inflation and GDP Growth (1)

Note: Left column panels display year-to-year inflation rates for various countries, together with their predicted values. Right column panels display the corresponding series for growth rates of real GDP.

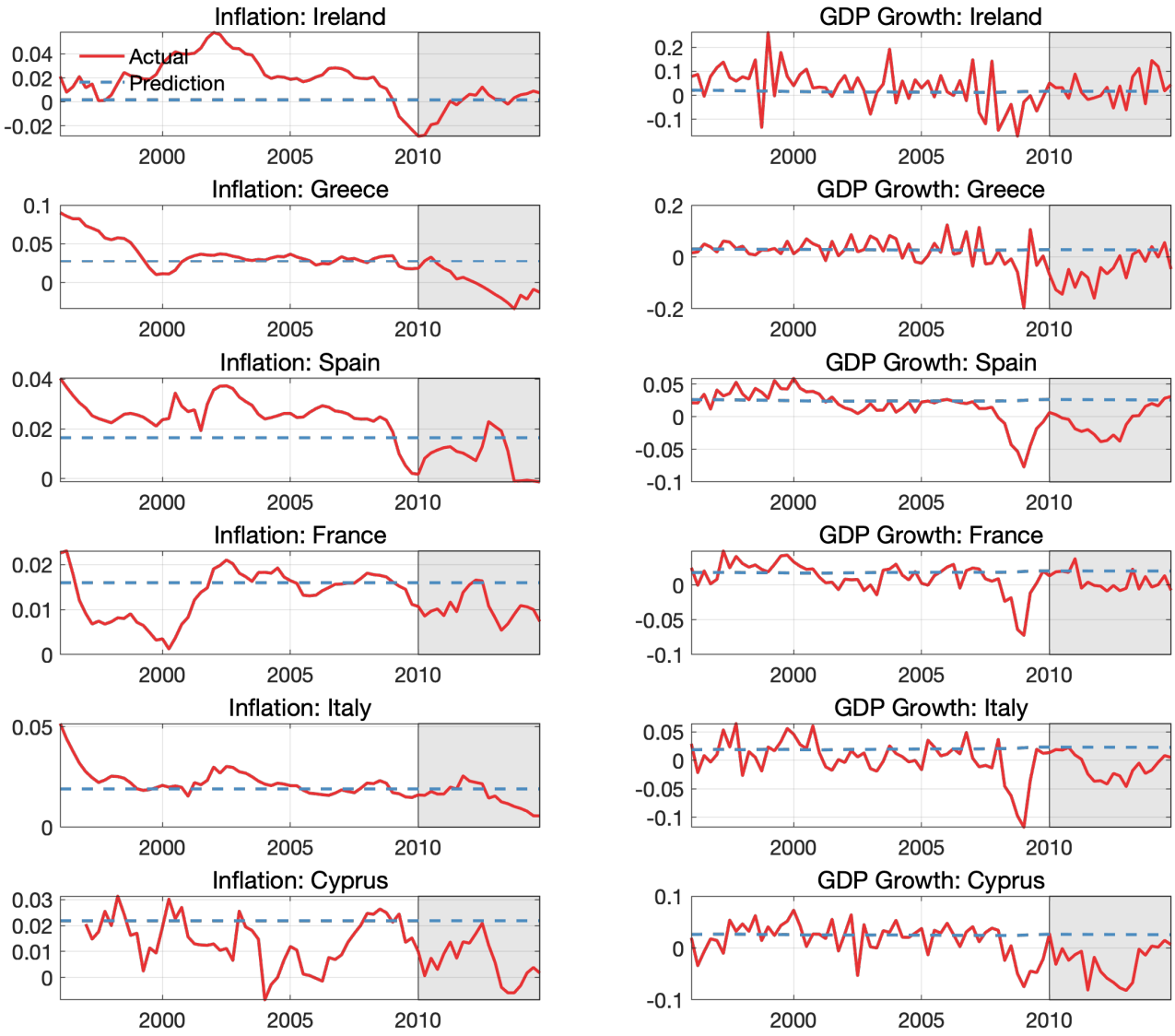


Figure A5b: Inflation and GDP Growth (2)

Note: Left column panels display year-to-year inflation rates for various countries, together with their predicted values. Right column panels display the corresponding series for growth rates of real GDP.

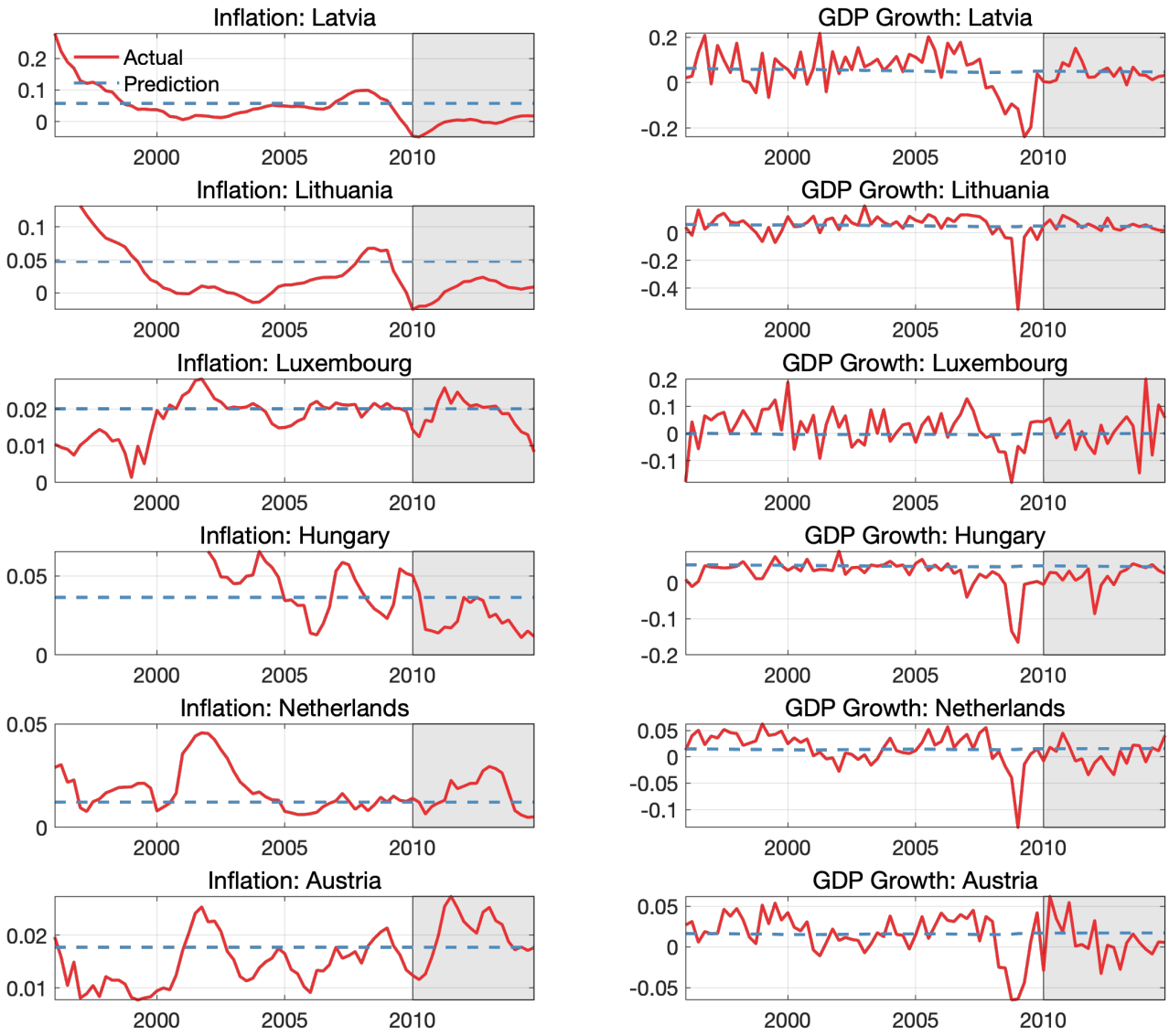


Figure A5c: Inflation and GDP Growth (3)

Note: Left column panels display year-to-year inflation rates for various countries, together with their predicted values. Right column panels display the corresponding series for growth rates of real GDP.

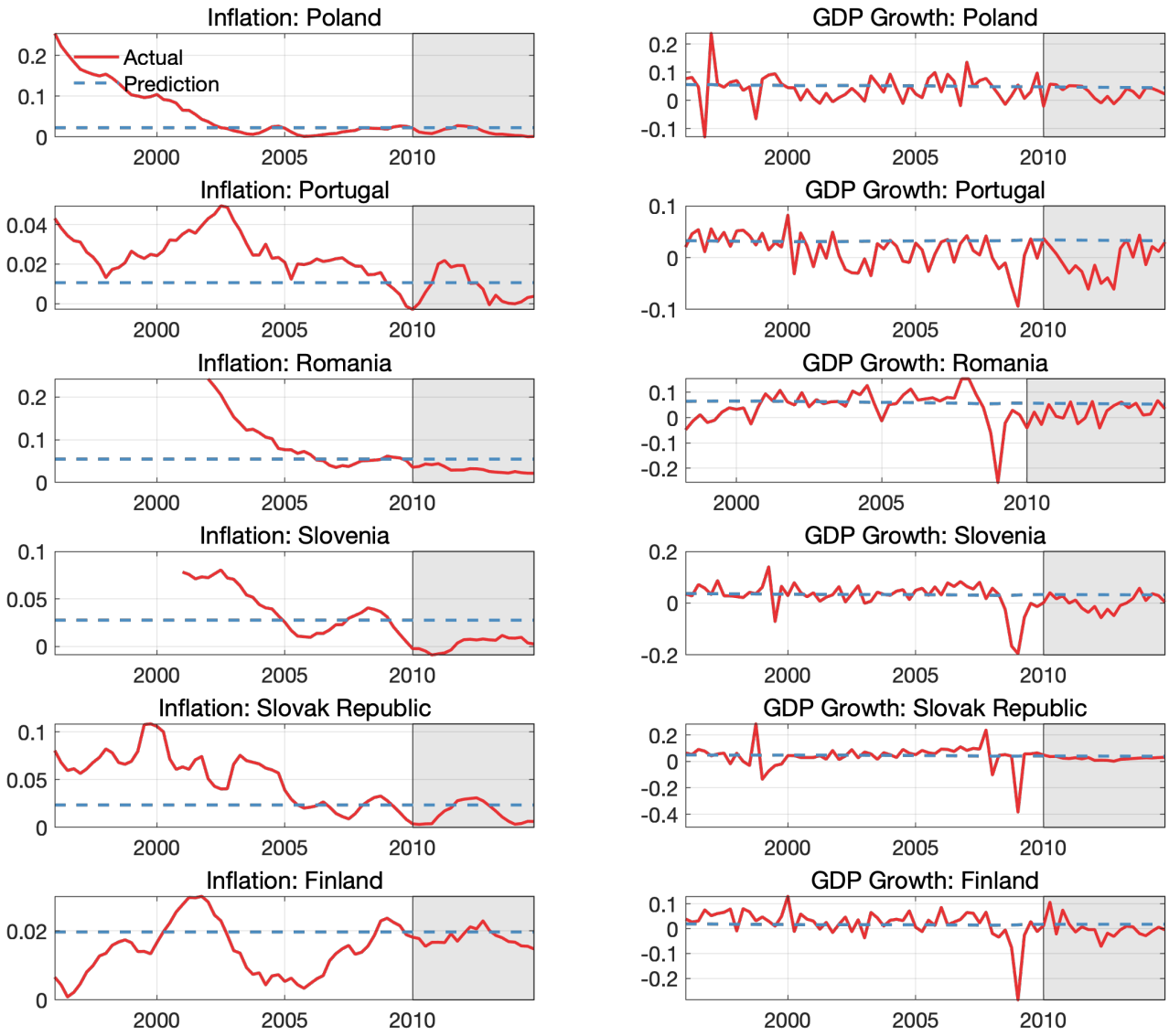


Figure A5d: Inflation and GDP Growth (4)

Note: Left column panels display year-to-year inflation rates for various countries, together with their predicted values. Right column panels display the corresponding series for growth rates of real GDP.

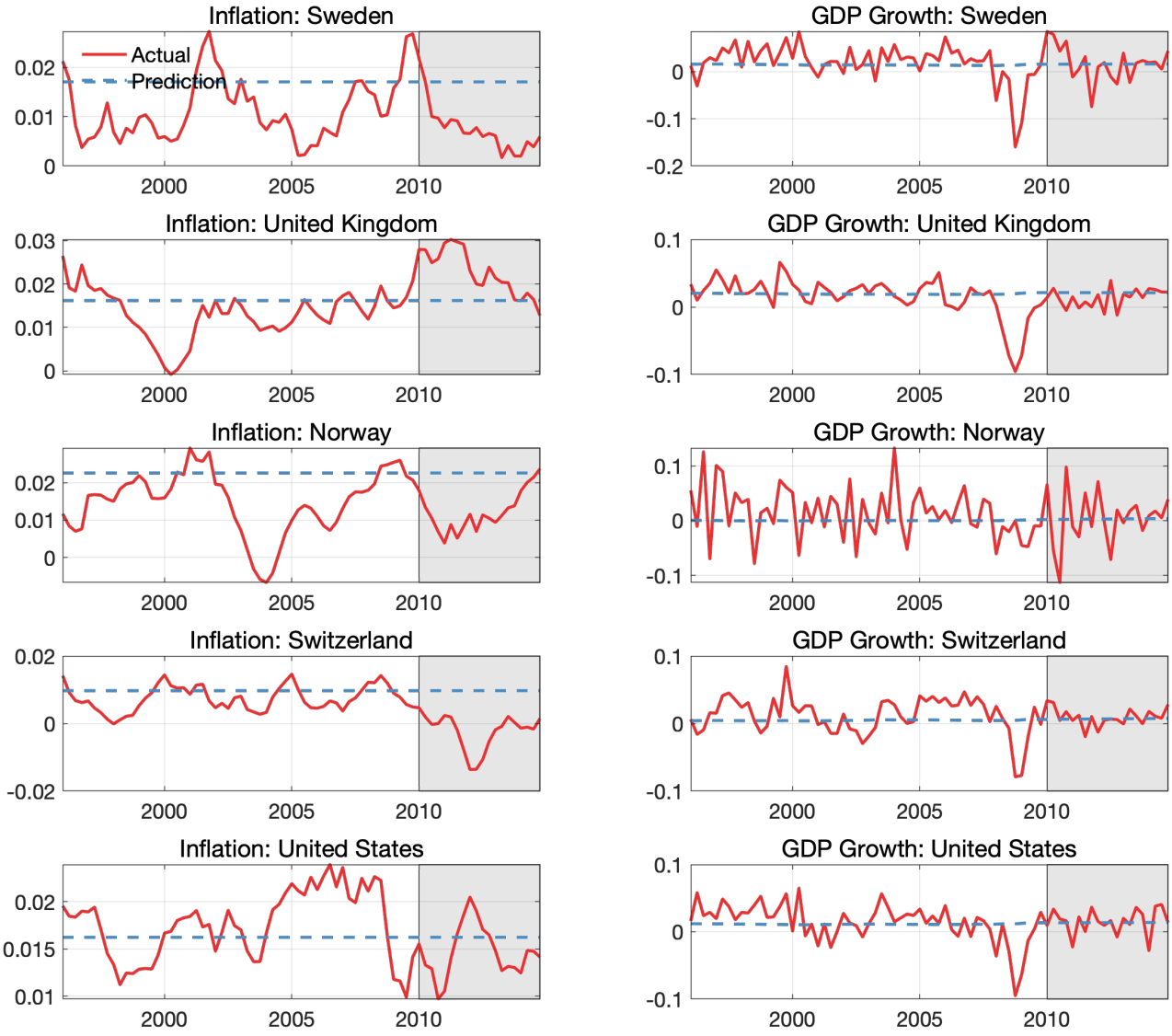


Figure A5e: Inflation and GDP Growth (5)

Note: Left column panels display year-to-year inflation rates for various countries, together with their predicted values. Right column panels display the corresponding series for growth rates of real GDP.

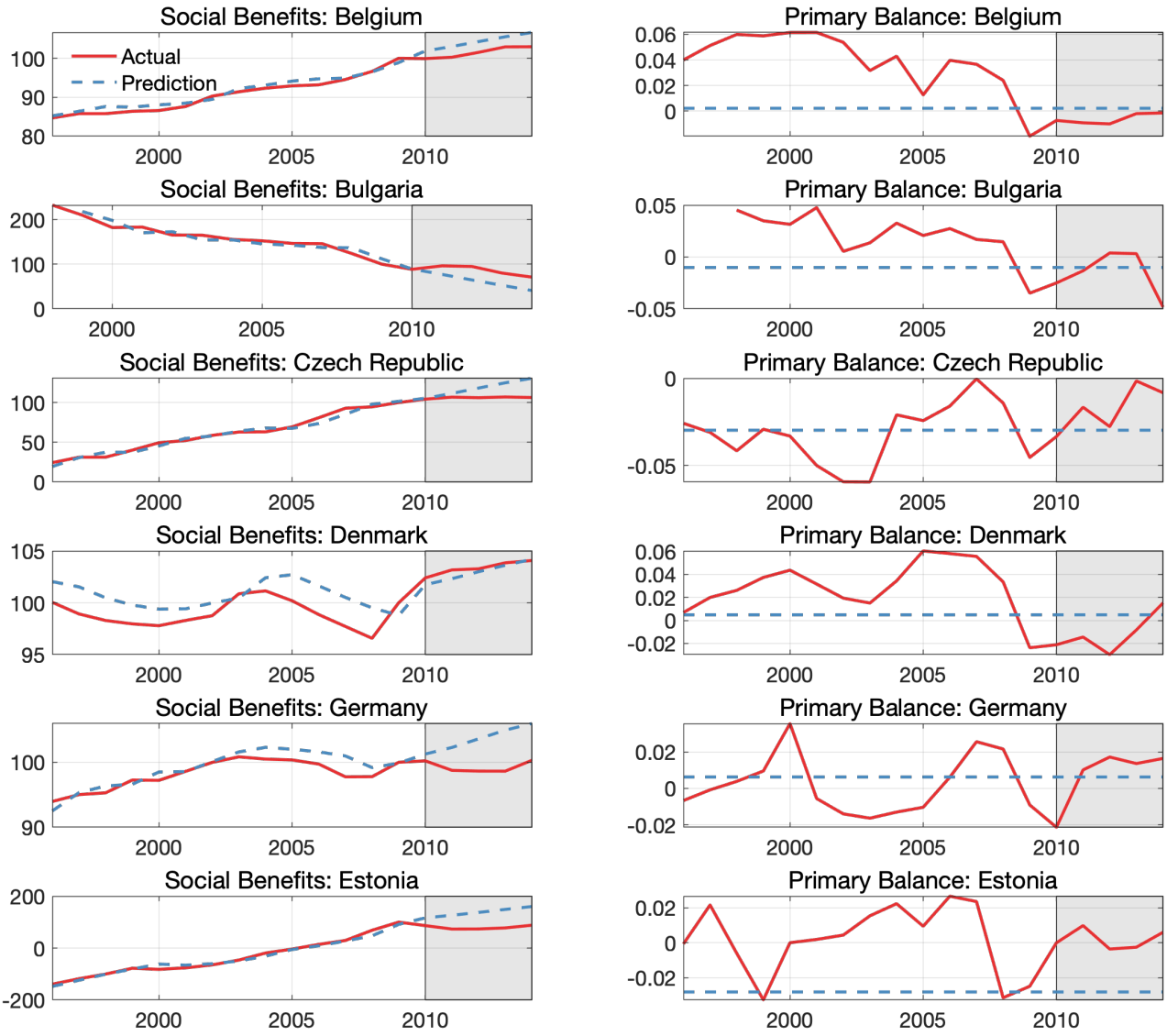


Figure A6a: Social Benefits and Total Outlays (1)

Note: Left column panels display real social benefits per capita 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 total outlays per capita.

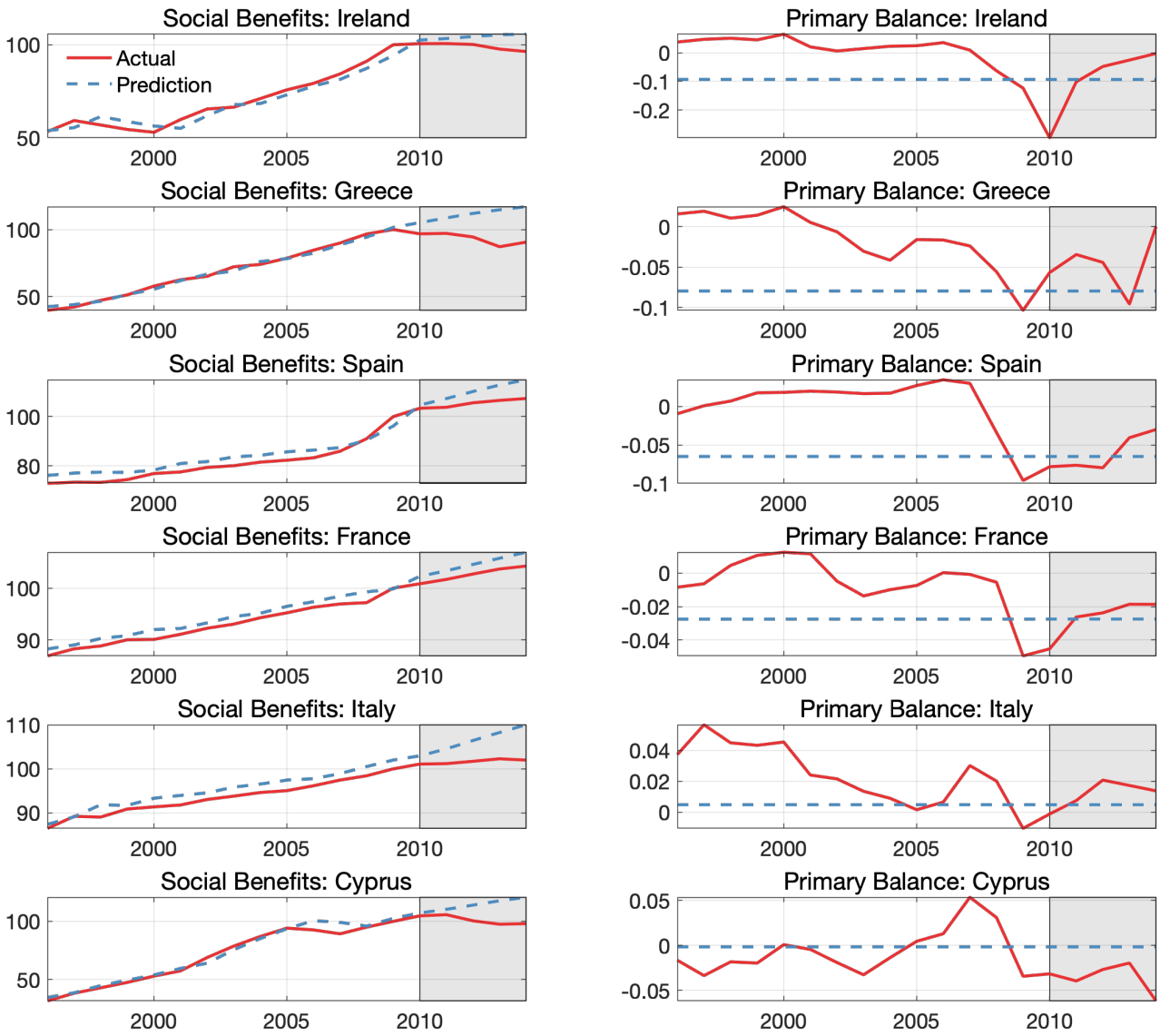


Figure A6b: Social Benefits and Total Outlays (2)

Note: Left column panels display real social benefits per capita 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 total outlays per capita.

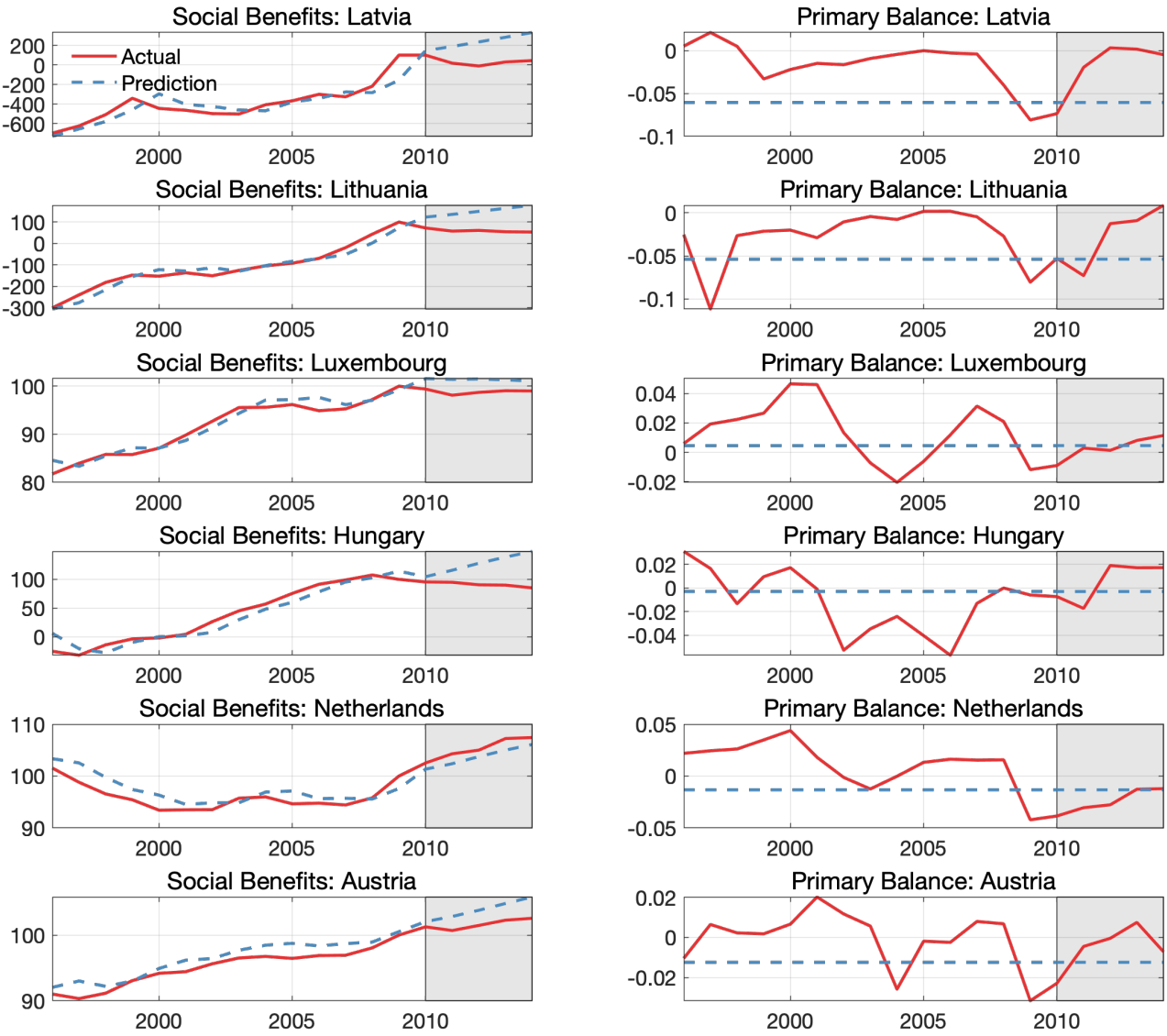


Figure A6c: Social Benefits and Total Outlays (3)

Note: Left column panels display real social benefits per capita 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 total outlays per capita.

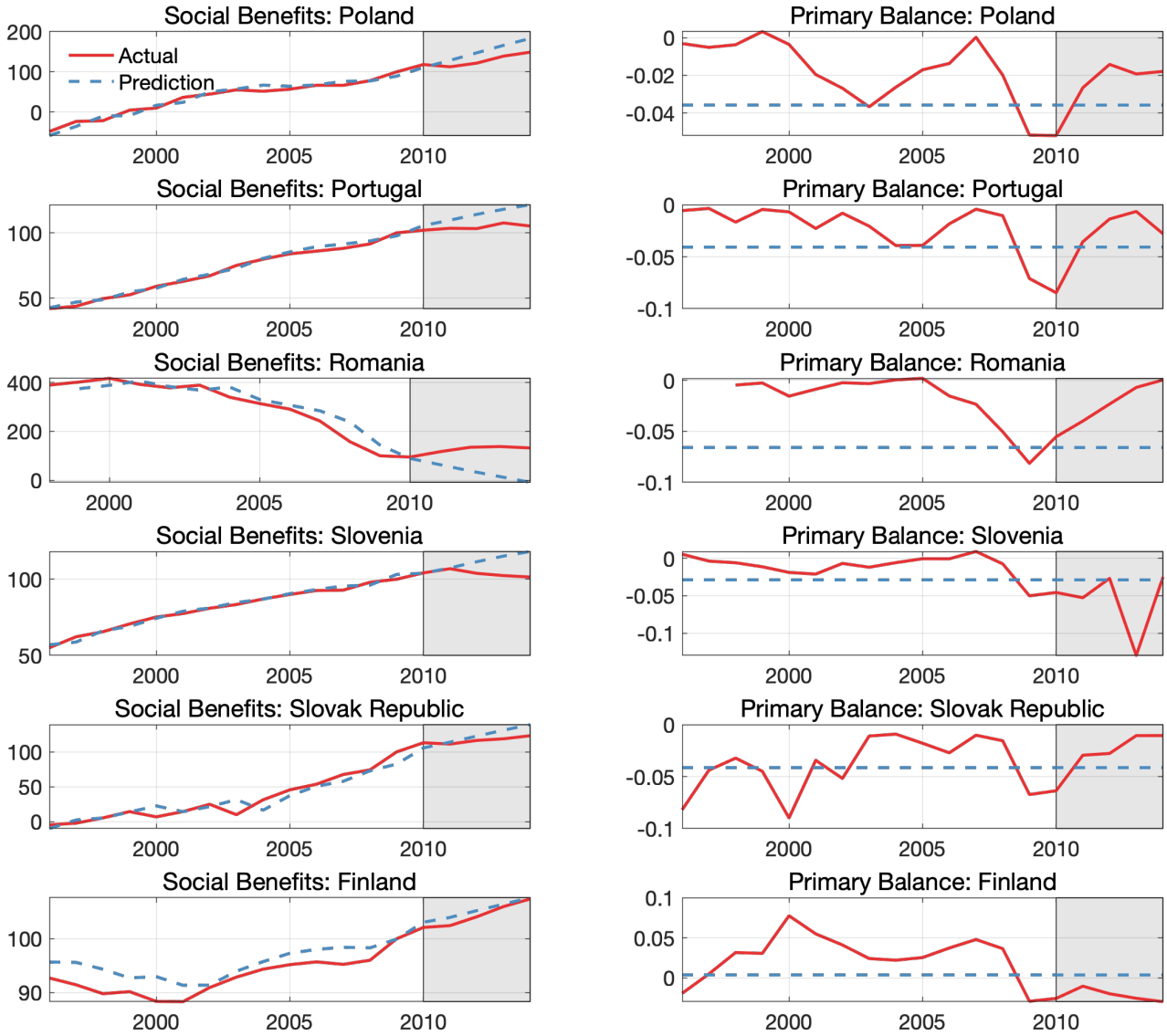


Figure A6d: Social Benefits and Total Outlays (4)

Note: Left column panels display real social benefits per capita 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 total outlays per capita.

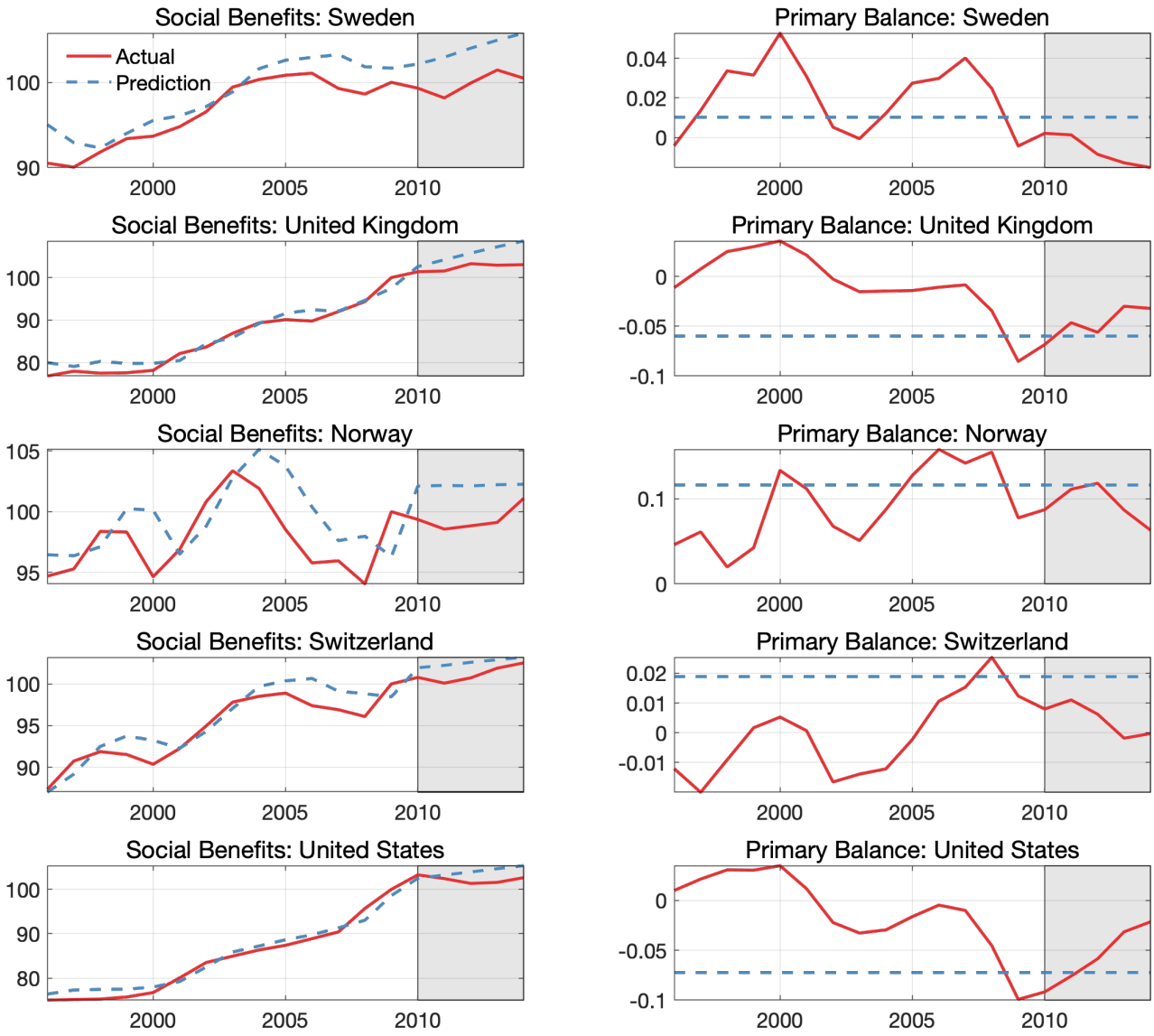


Figure A6e: Social Benefits and Total Outlays (5)

Note: Left column panels display real social benefits per capita 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 total outlays per capita.

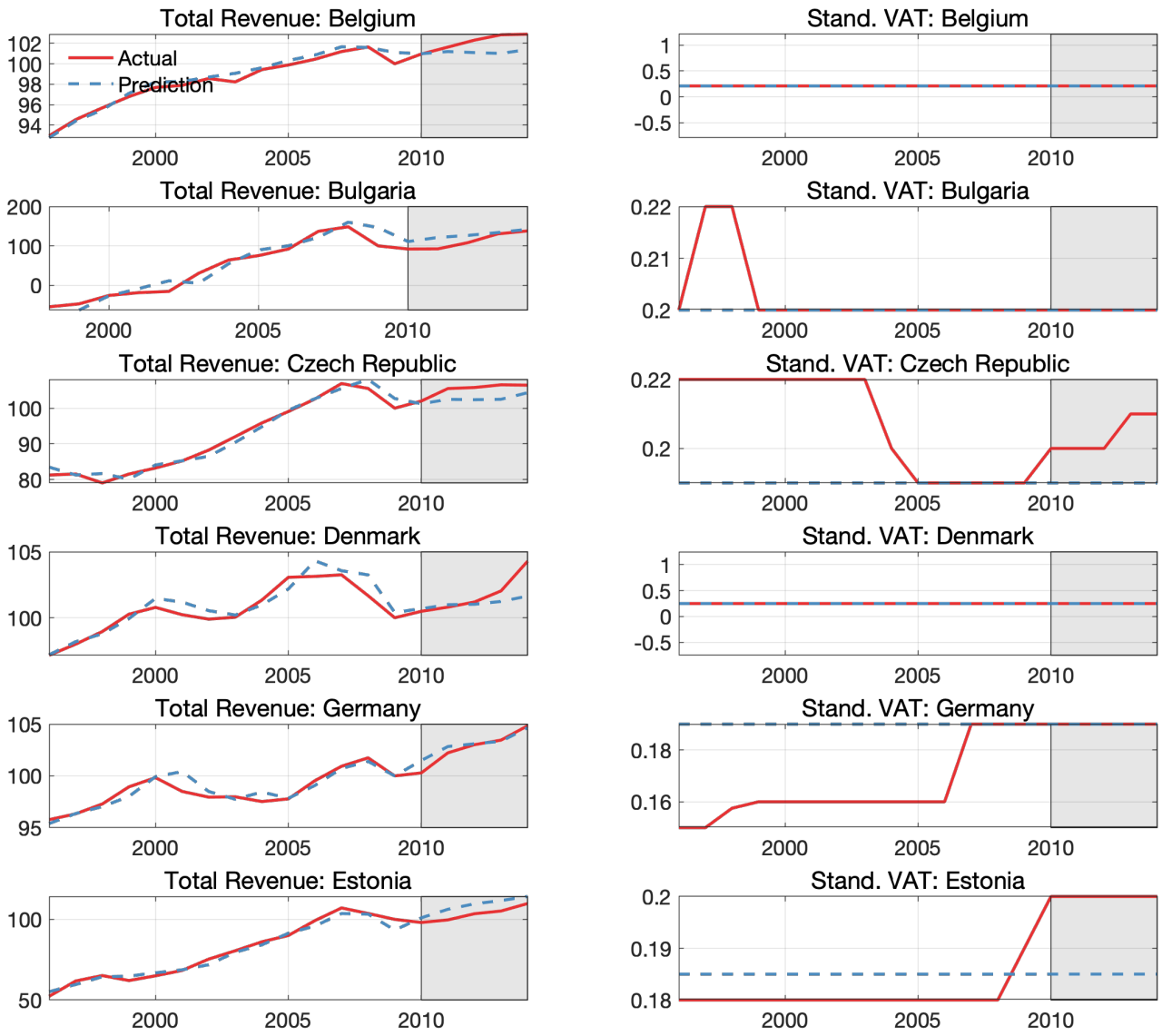


Figure A7a: Primary Balance and Total Revenue (1)

Note: Left column panels display the primary balance in percent of GDP for various countries, together with its predicted value. Right column panels display the corresponding series for real total revenue per capita, on a log scale (normalized to 2009=100)

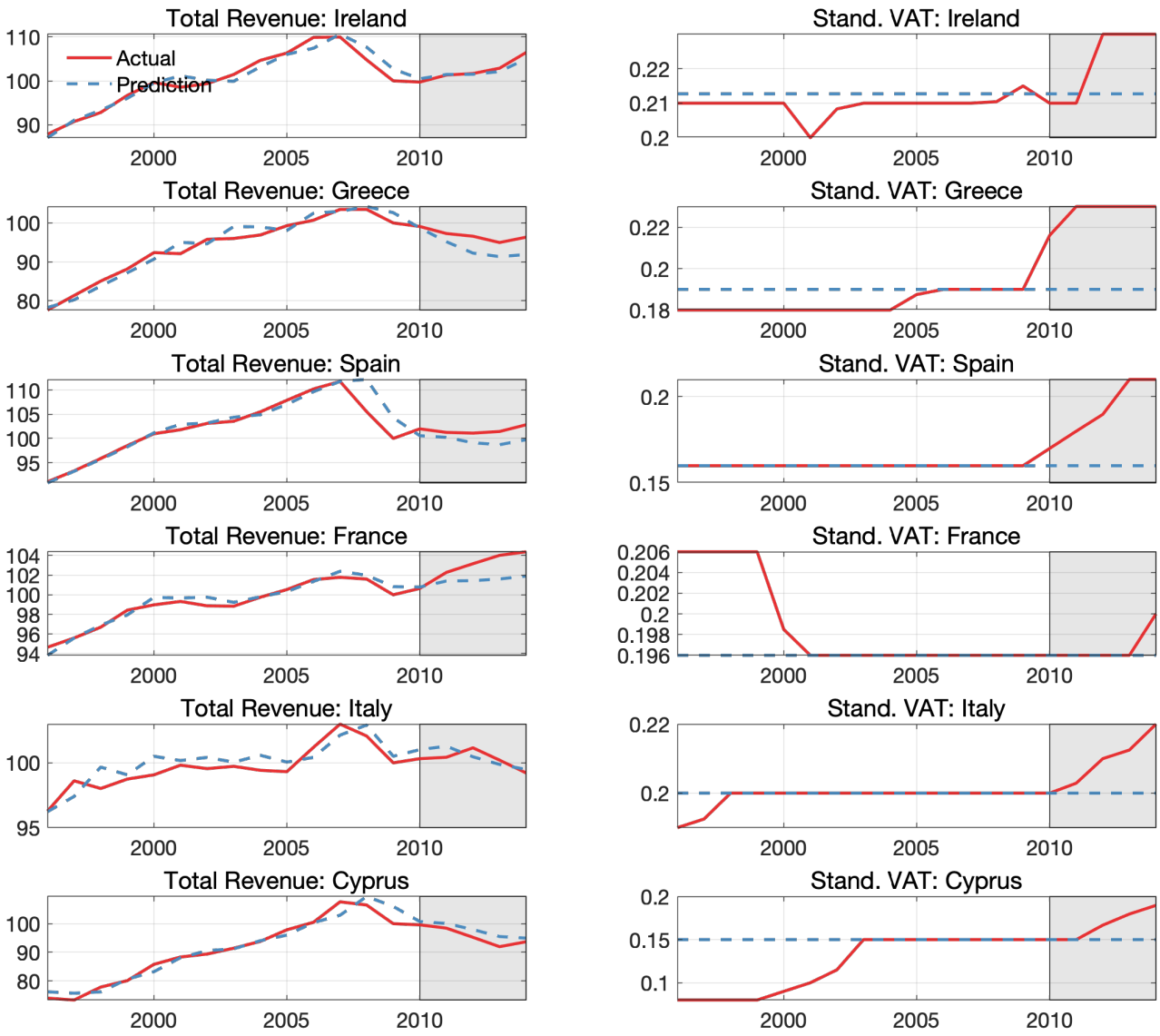


Figure A7b: Primary Balance and Total Revenue (2)

Note: Left column panels display the primary balance in percent of GDP for various countries, together with its predicted value. Right column panels display the corresponding series for real total revenue per capita, on a log scale (normalized to 2009=100)

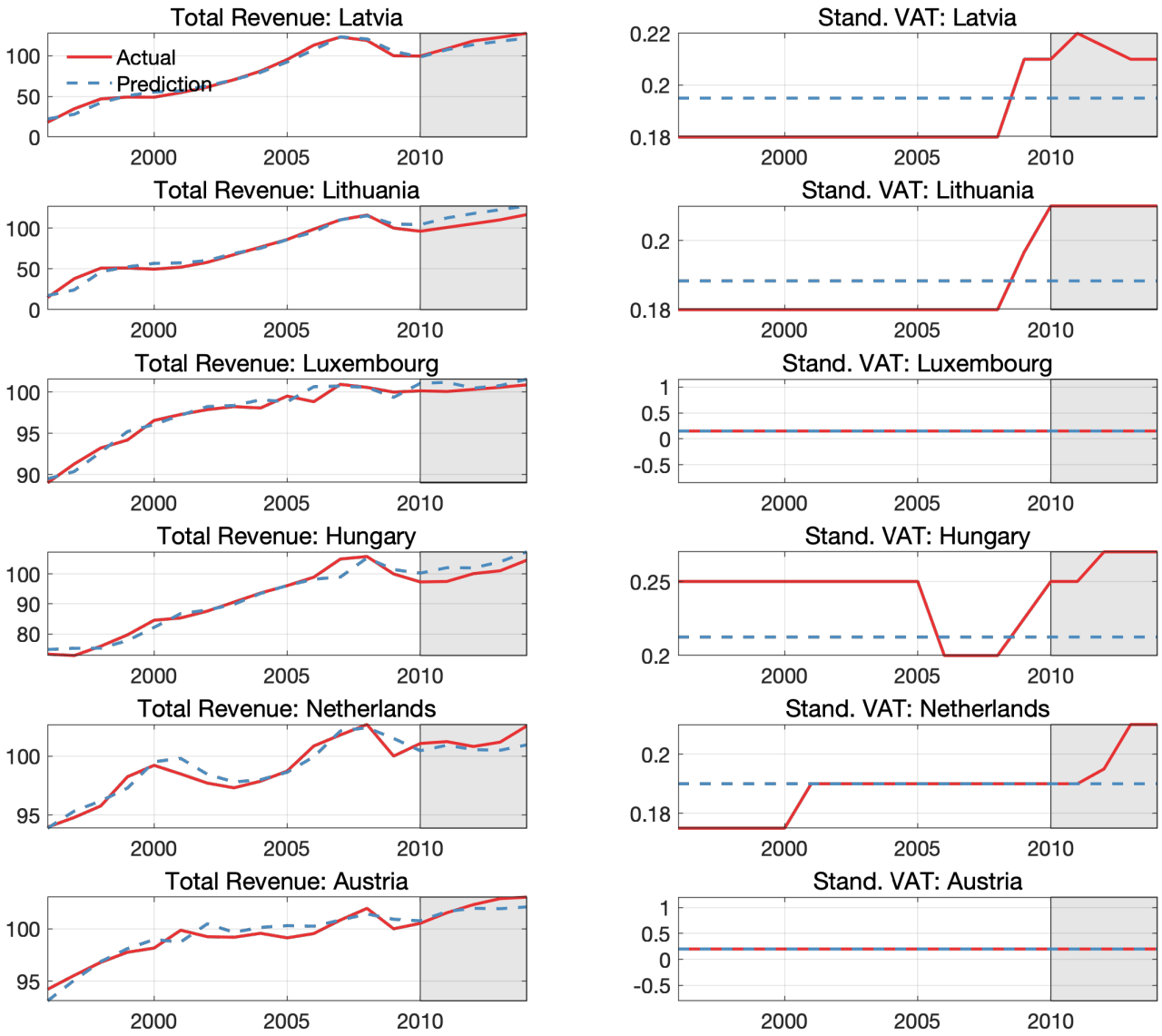


Figure A7c: Primary Balance and Total Revenue (3)

Note: Left column panels display the primary balance in percent of GDP for various countries, together with its predicted value. Right column panels display the corresponding series for real total revenue per capita, on a log scale (normalized to 2009=100)

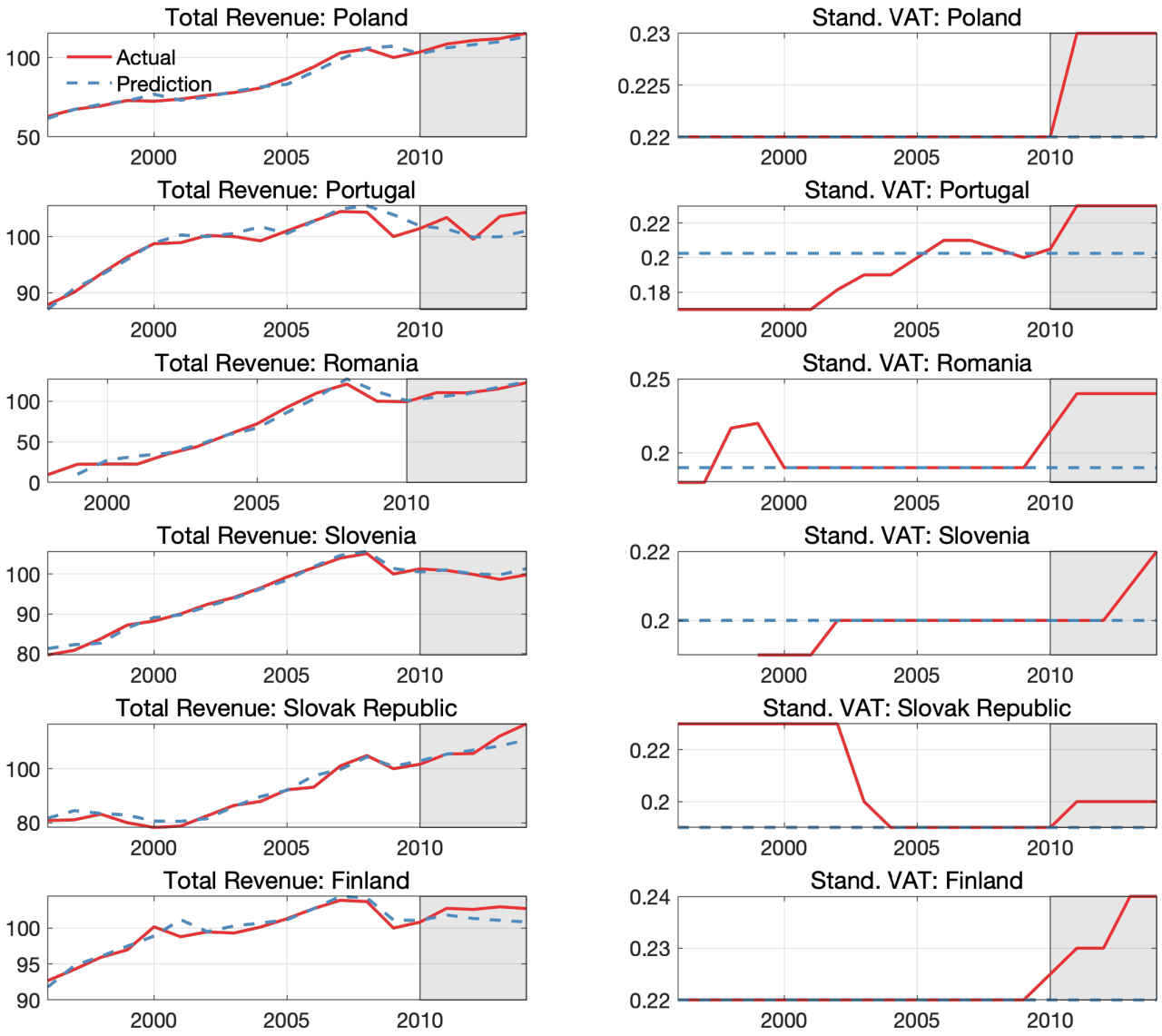


Figure A7d: Primary Balance and Total Revenue (4)

Note: Left column panels display the primary balance in percent of GDP for various countries, together with its predicted value. Right column panels display the corresponding series for real total revenue per capita, on a log scale (normalized to 2009=100)

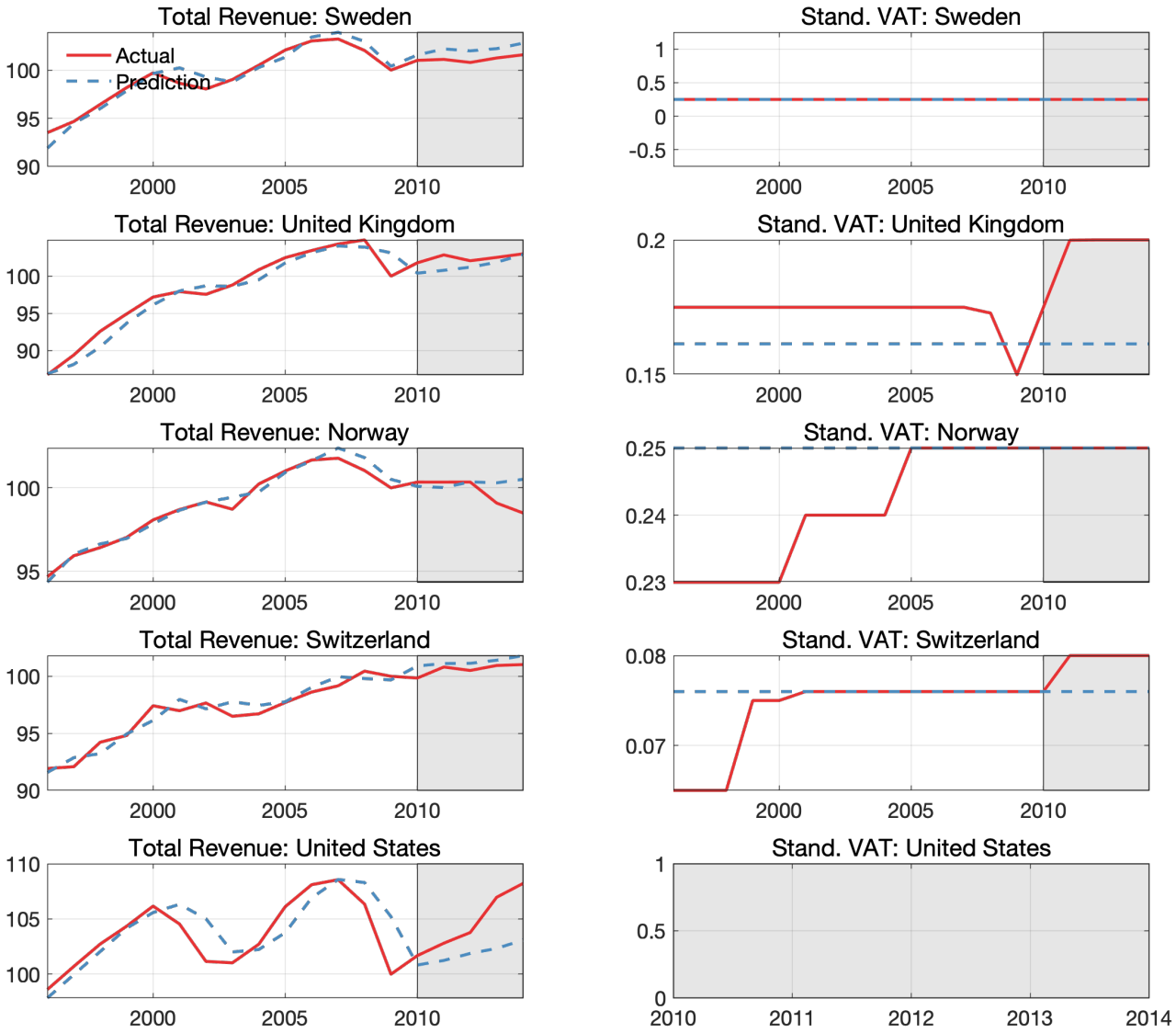


Figure A7e: Primary Balance and Total Revenue (5)

Note: Left column panels display the primary balance in percent of GDP for various countries, together with its predicted value. Right column panels display the corresponding series for real total revenue per capita, on a log scale (normalized to 2009=100)

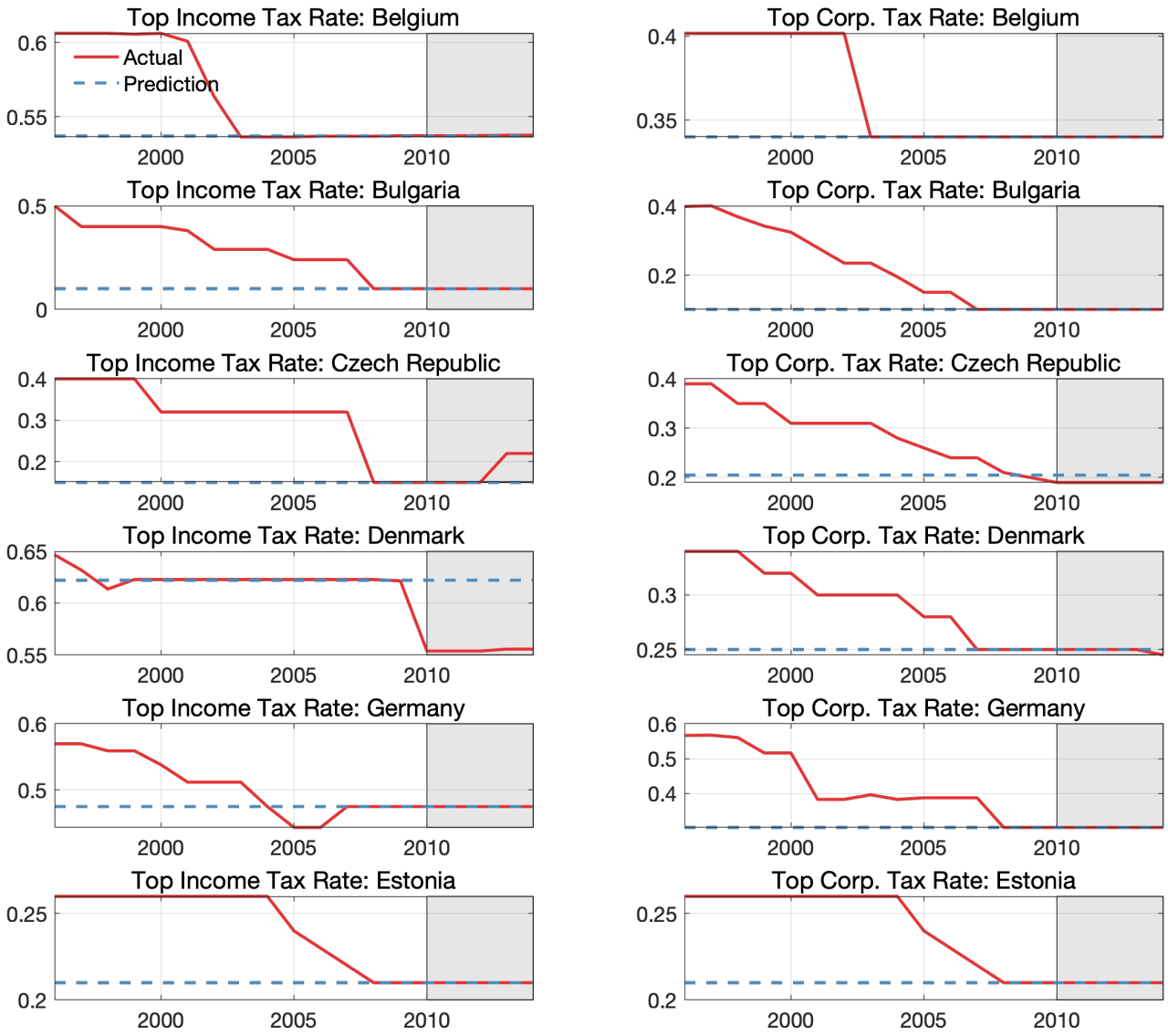


Figure A8a: Tax Rates (1)

Note: Left column panels display the standard VAT for various countries, together with its predicted value. Center column panels display the corresponding series for the top income tax rate. Right column panels display the corresponding series for the top corporate tax rate.

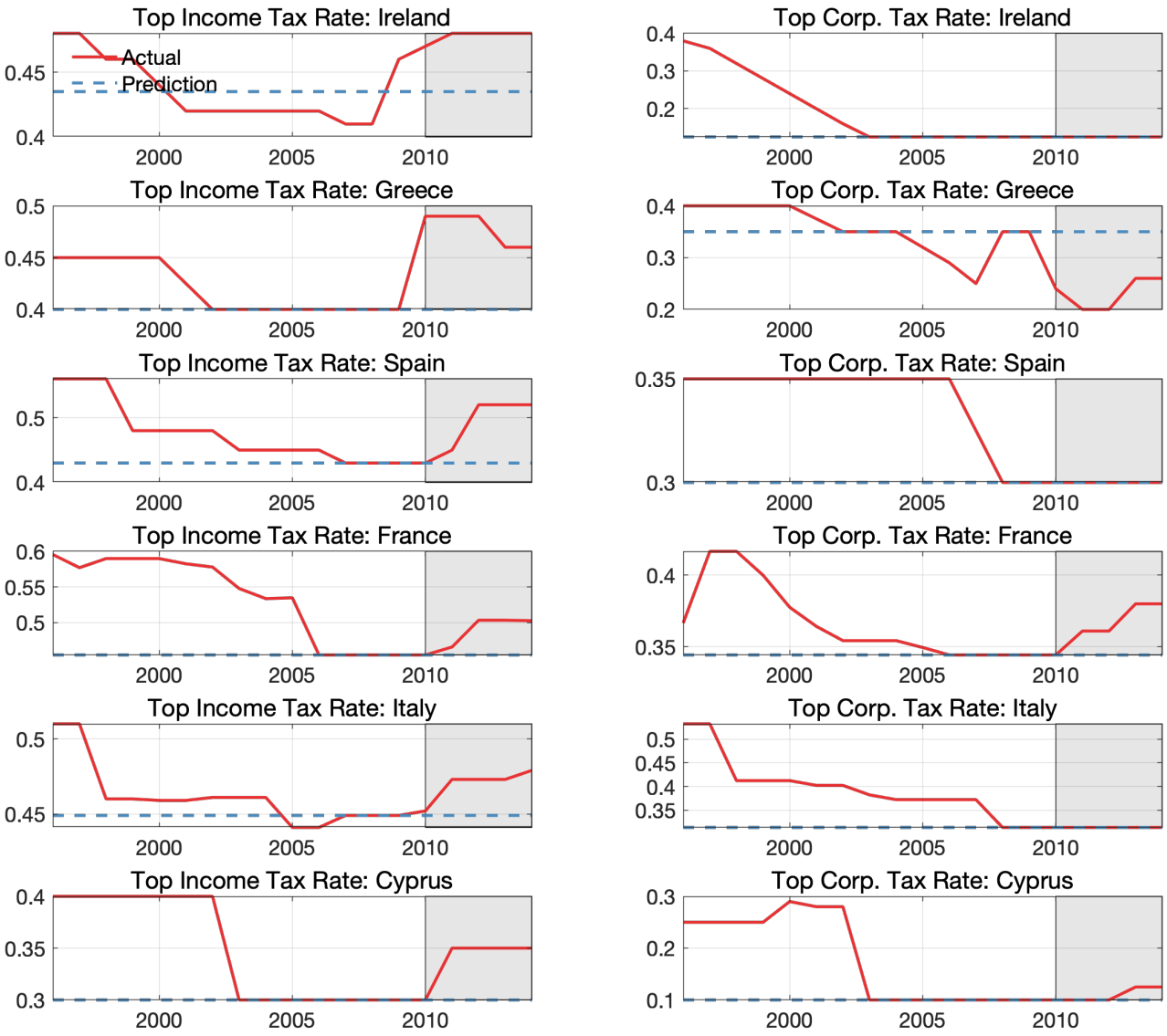


Figure A8b: Tax Rates (2)

Note: Left column panels display the standard VAT for various countries, together with its predicted value. Center column panels display the corresponding series for the top income tax rate. Right column panels display the corresponding series for the top corporate tax rate.

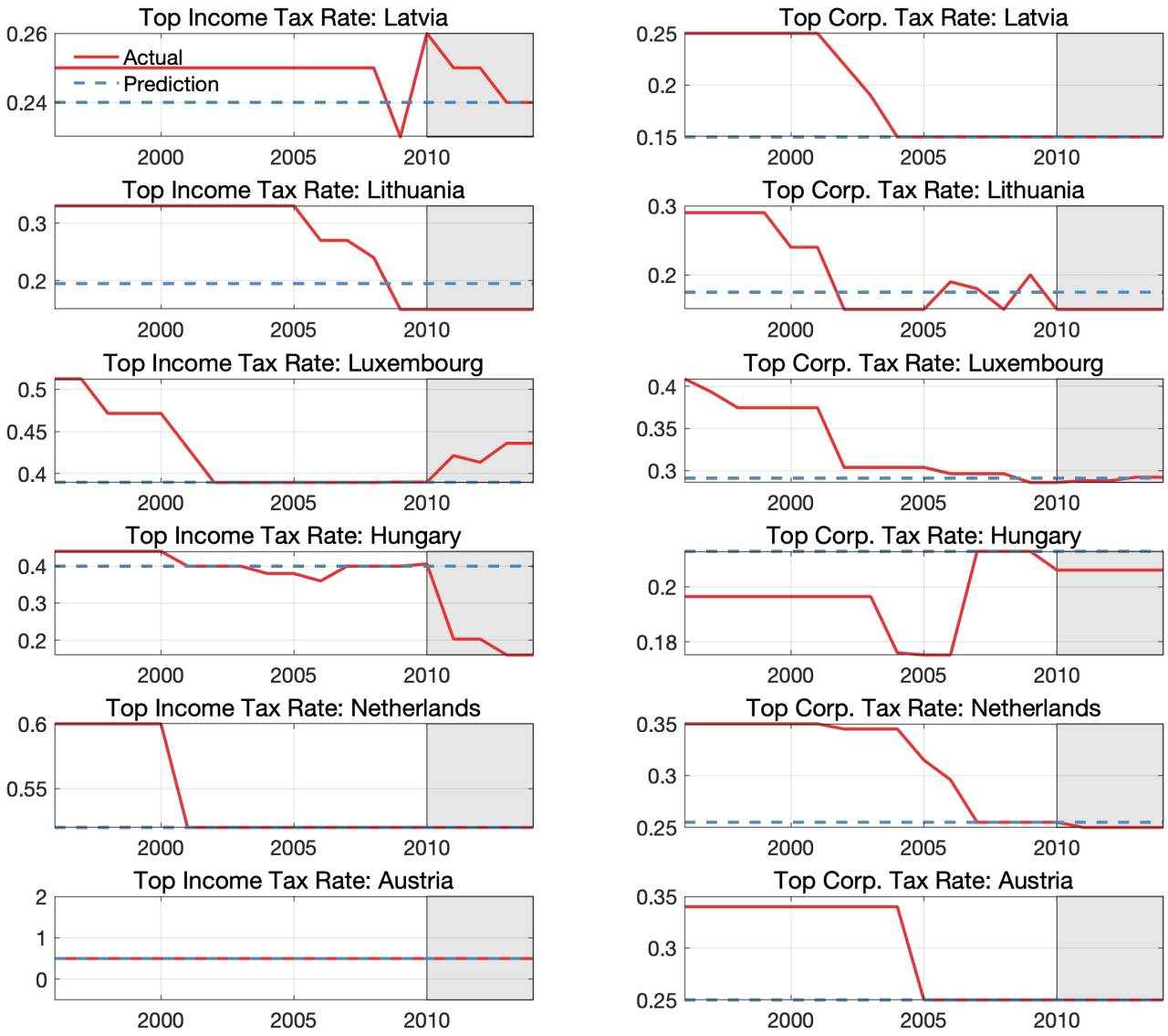


Figure A8c: Tax Rates (3)

Note: Left column panels display the standard VAT for various countries, together with its predicted value. Center column panels display the corresponding series for the top income tax rate. Right column panels display the corresponding series for the top corporate tax rate.

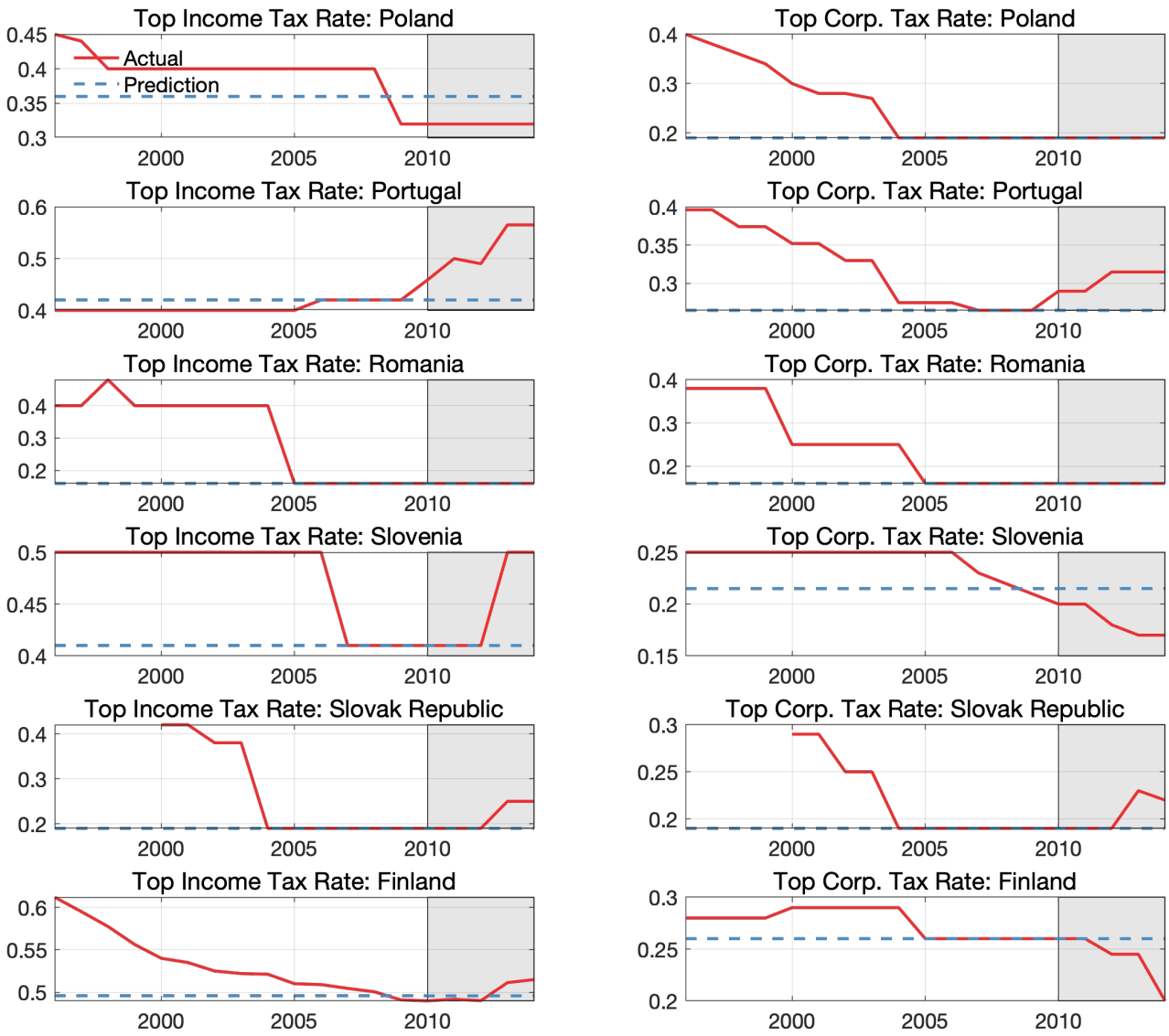


Figure A8d: Tax Rates (4)

Note: Left column panels display the standard VAT for various countries, together with its predicted value. Center column panels display the corresponding series for the top income tax rate. Right column panels display the corresponding series for the top corporate tax rate.

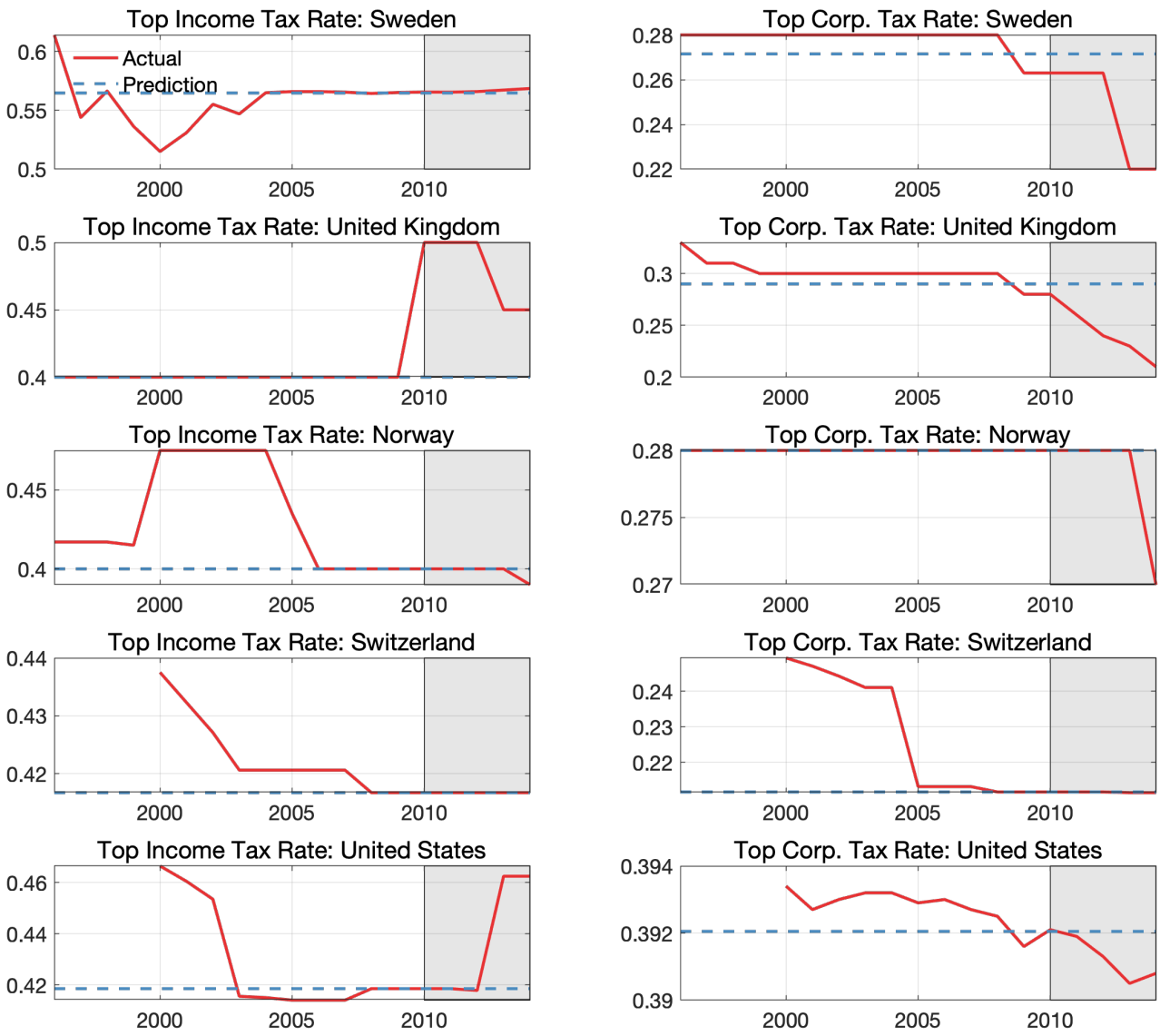


Figure A8e: Tax Rates (5)

Note: Left column panels display the standard VAT for various countries, together with its predicted value. Center column panels display the corresponding series for the top income tax rate. Right column panels display the corresponding series for the top corporate tax rate.

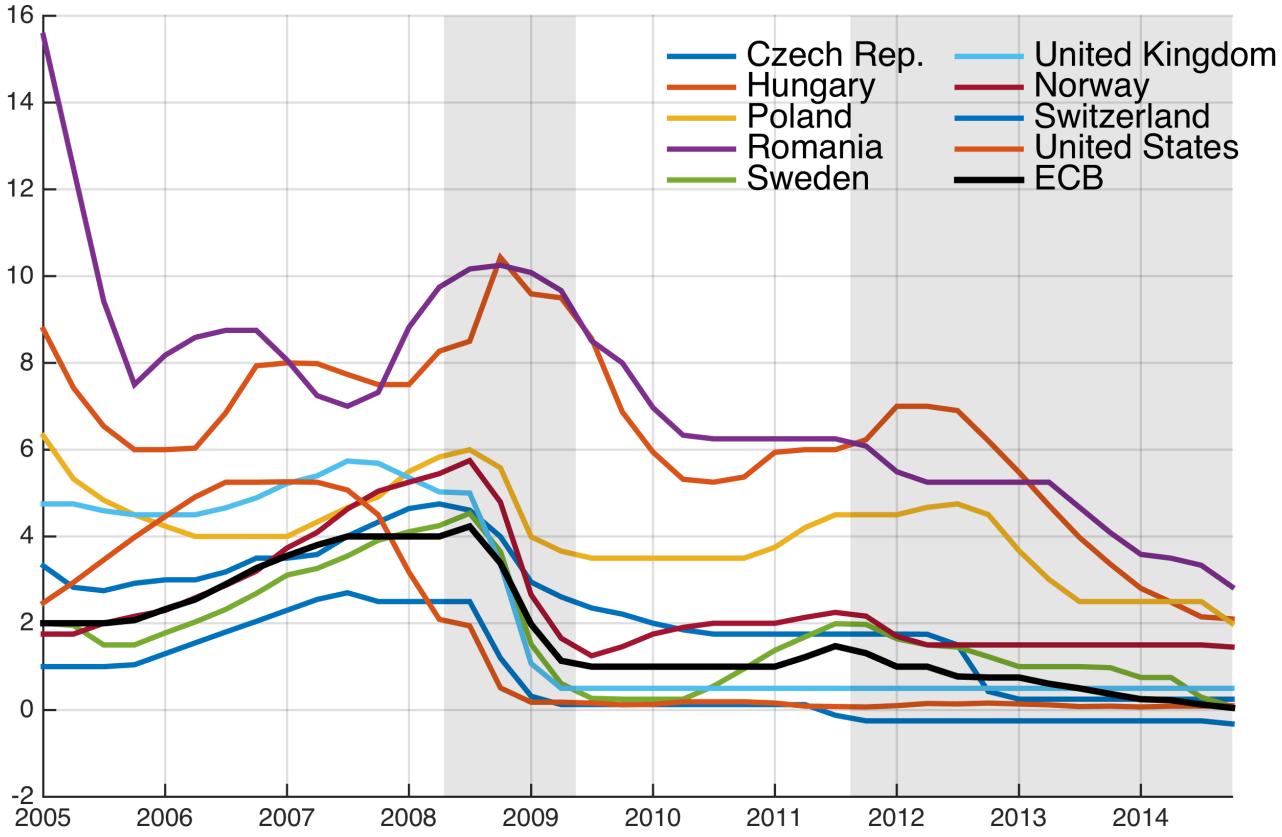


Figure A9: Central Bank Policy Interest Rates

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

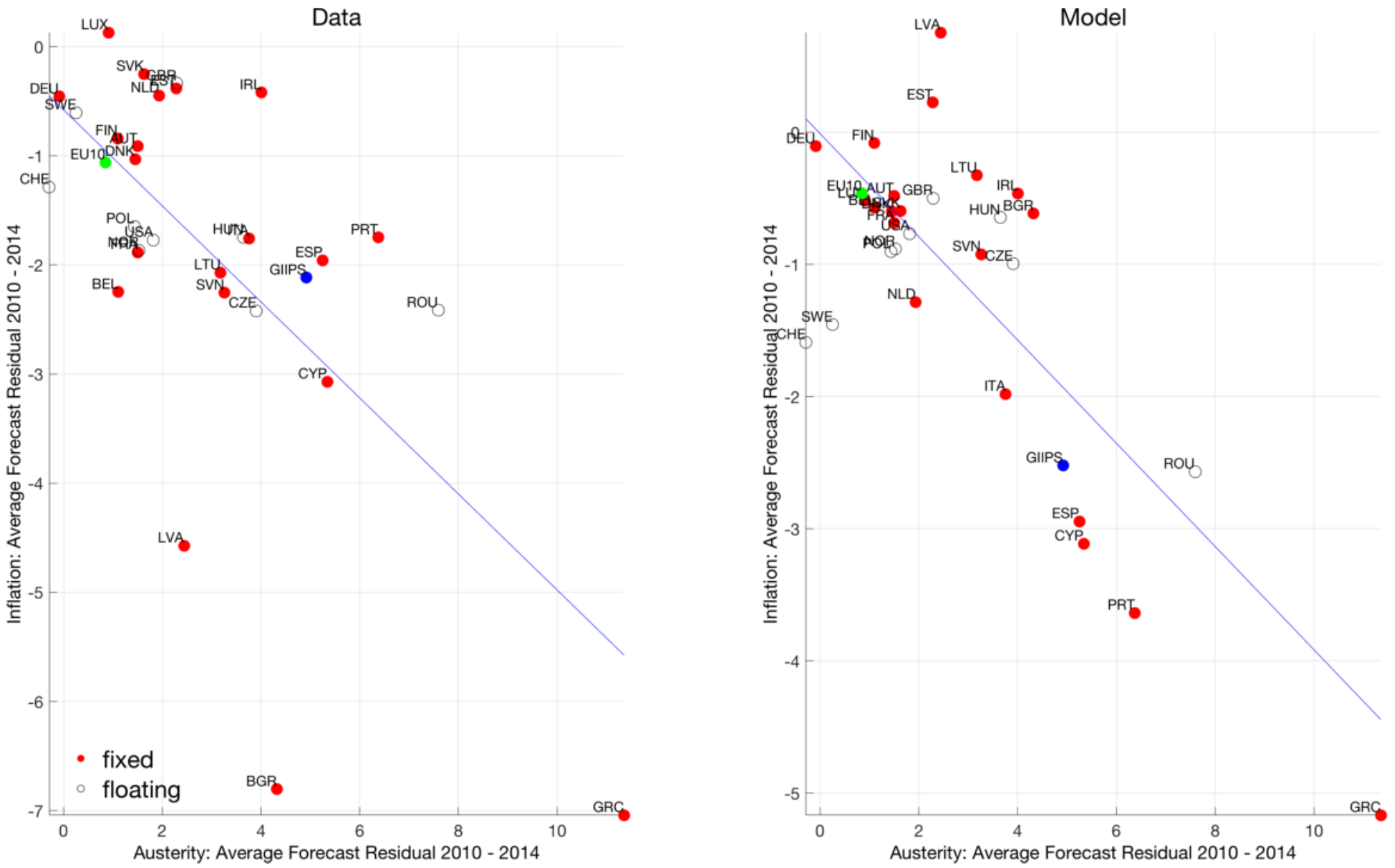


Figure A10a: Inflation and Austerity: Data vs. Model

Note: See Figure 4.

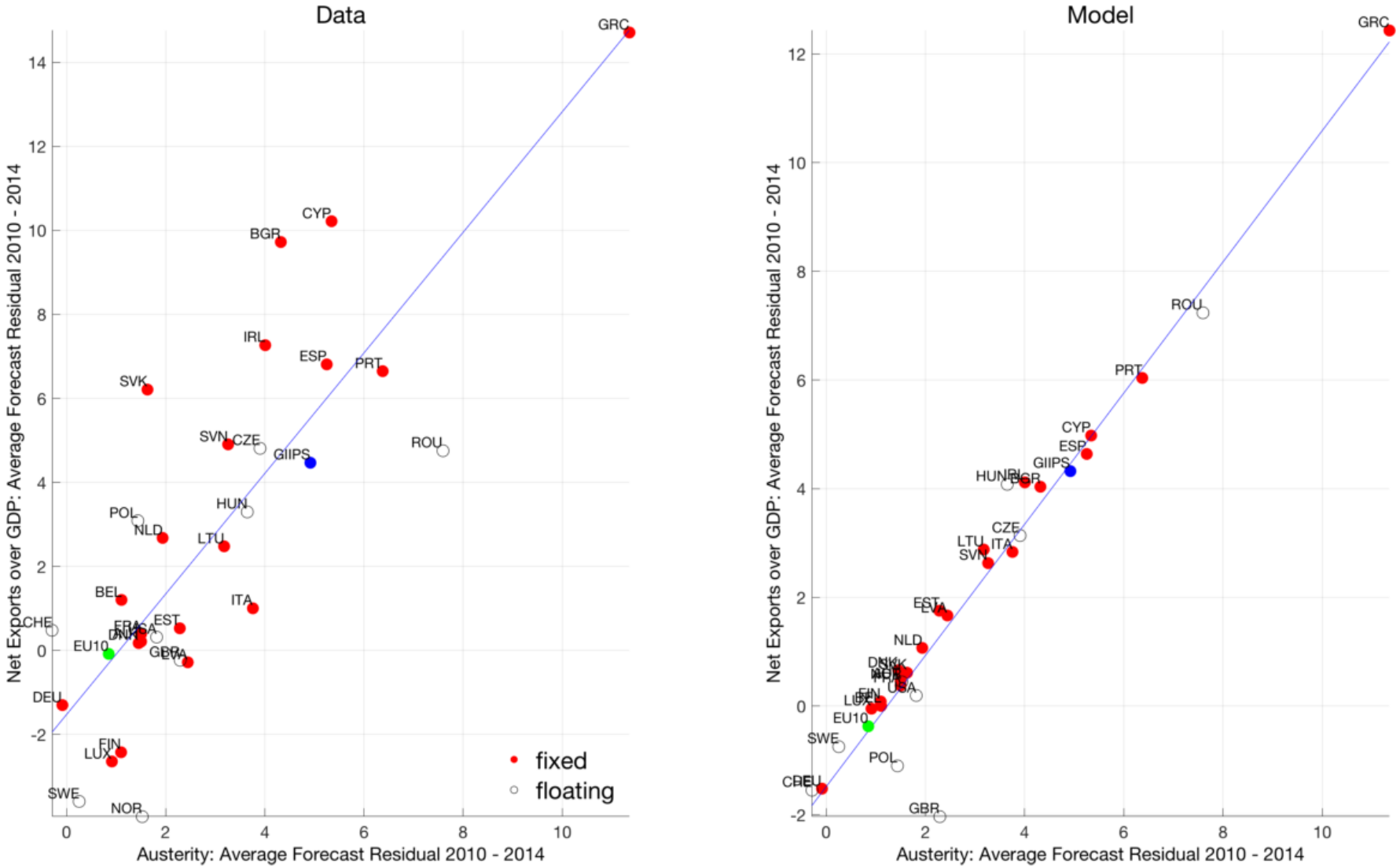


Figure A10b: Net Exports and Austerity: Data vs. Model

Note: See Figure 4.

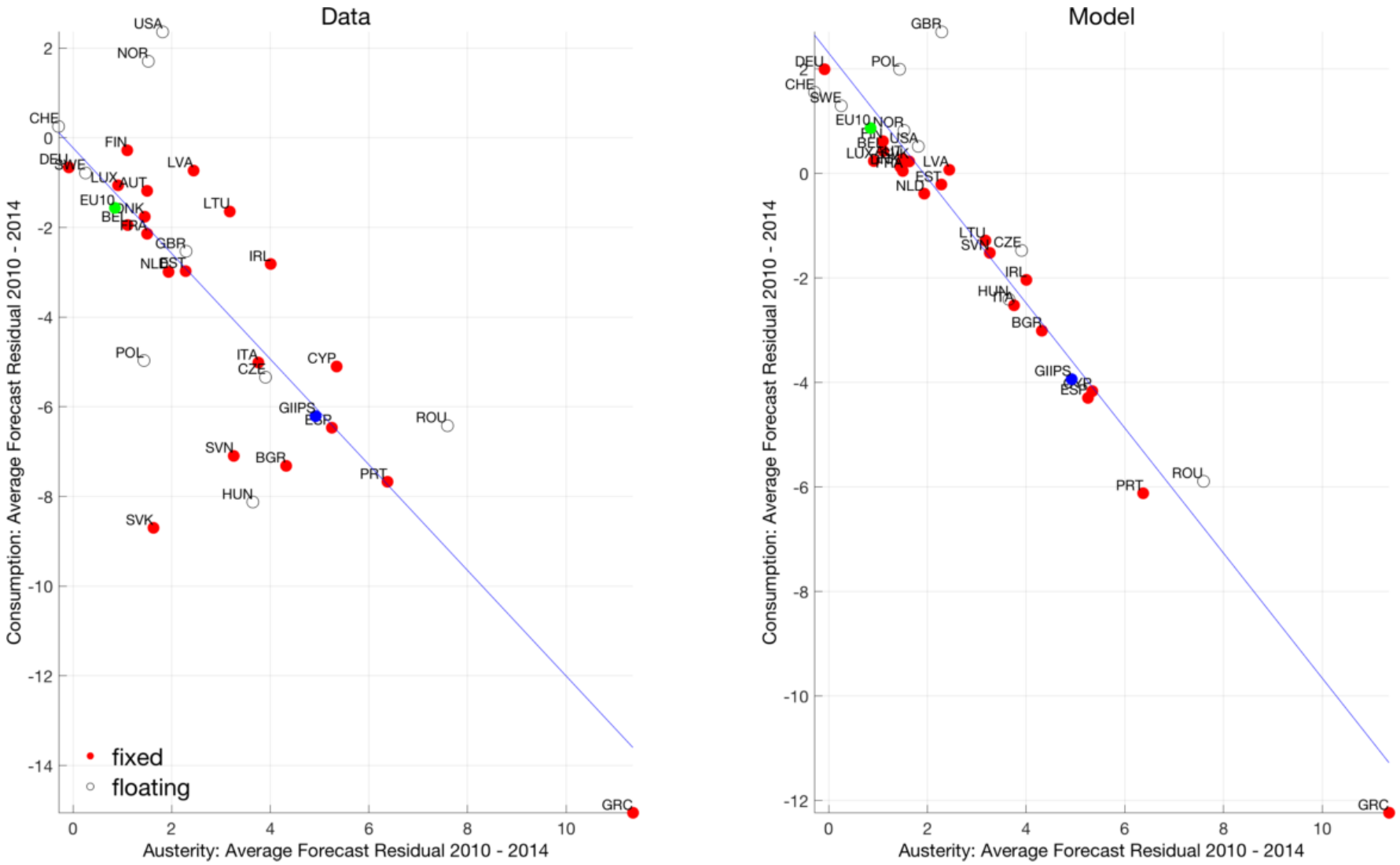


Figure A10c: Consumption and Austerity: Data vs. Model

Note: See Figure 4.

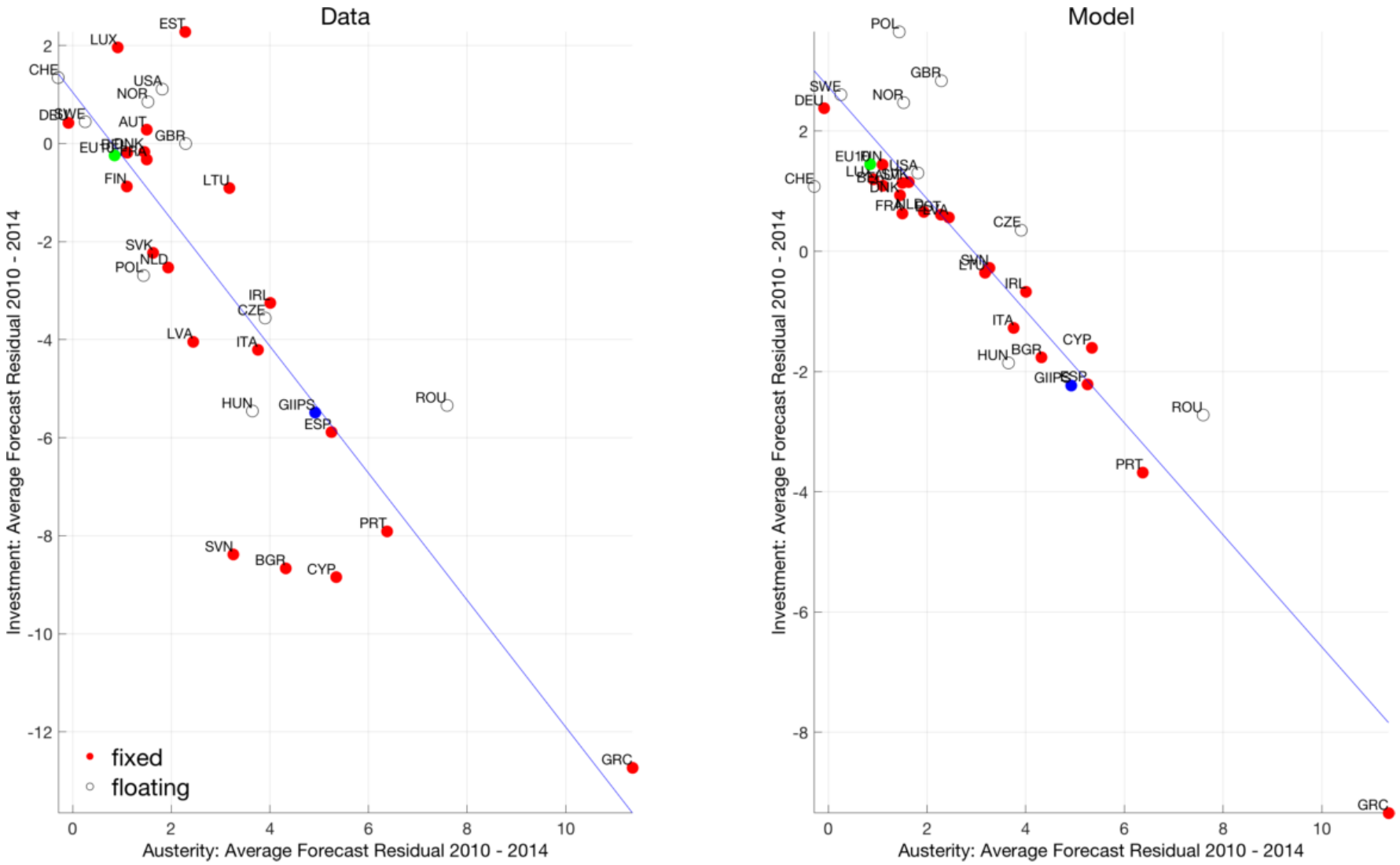


Figure A10d: Investment and Austerity: Data vs. Model

Note: See Figure 4.

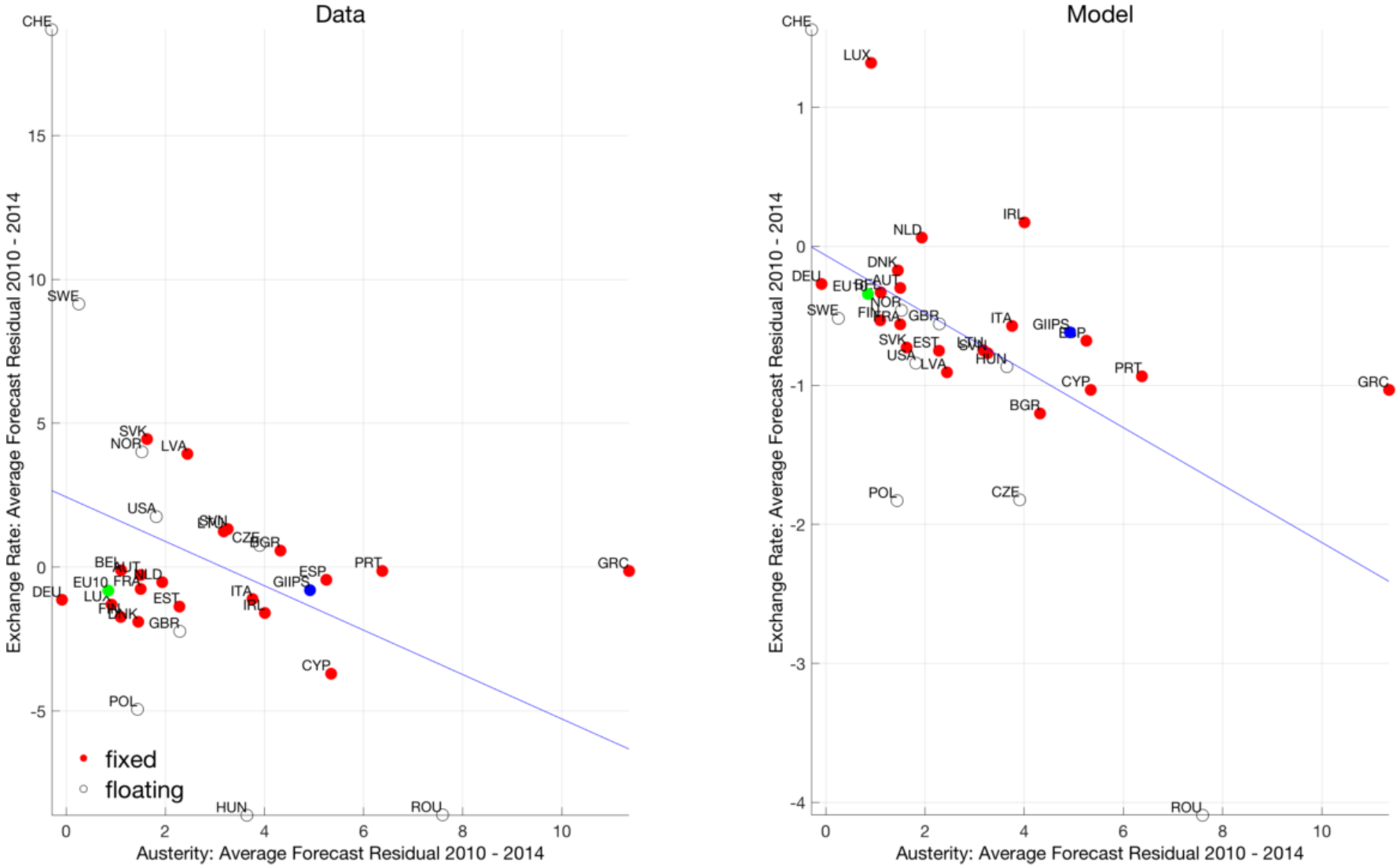


Figure A10e: Nominal Effective Exchange Rate and Austerity: Data vs. Model

Note: See Figure 4.

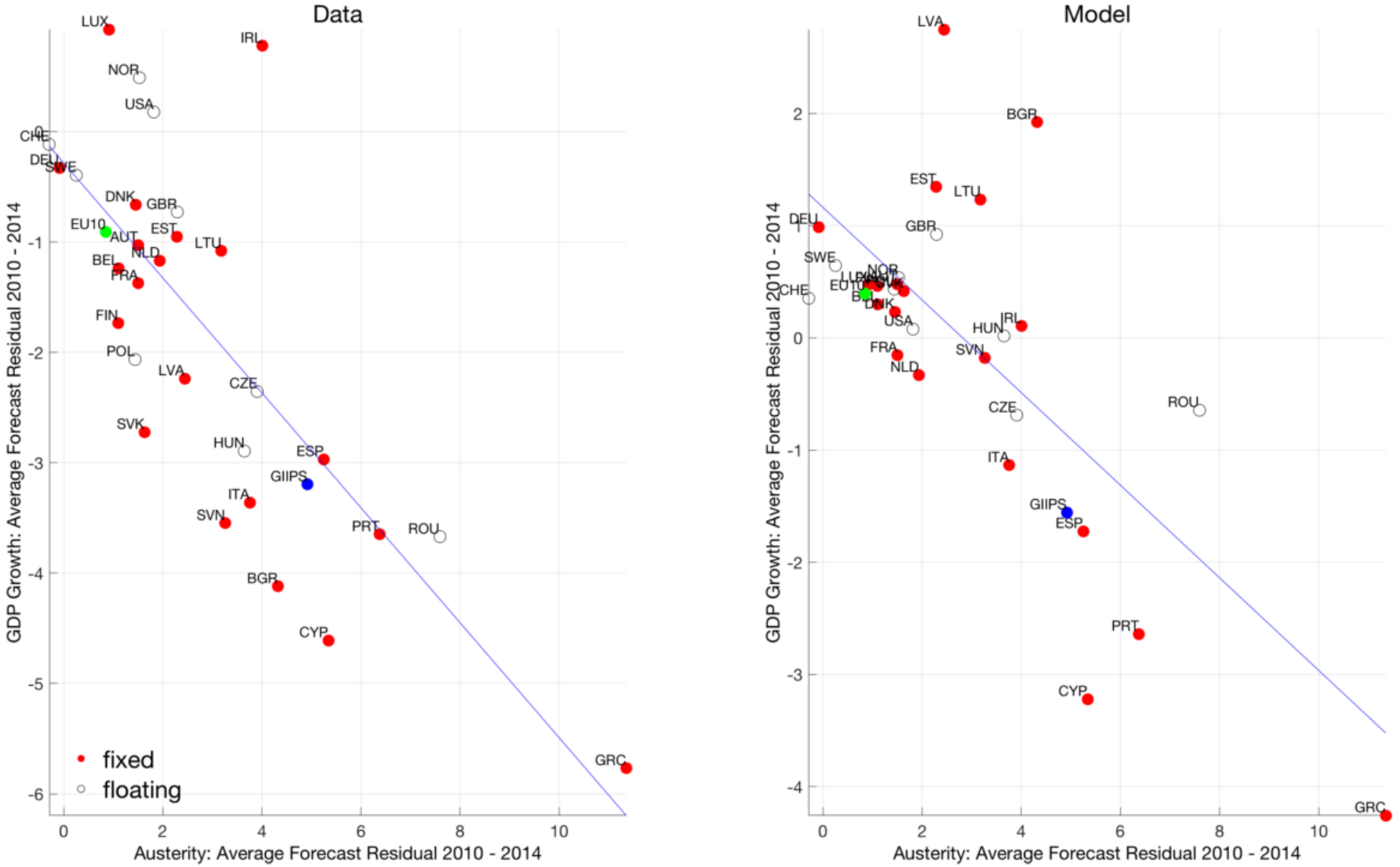


Figure A10f: GDP Growth and Austerity: Data vs. Model

Note: See Figure 4.

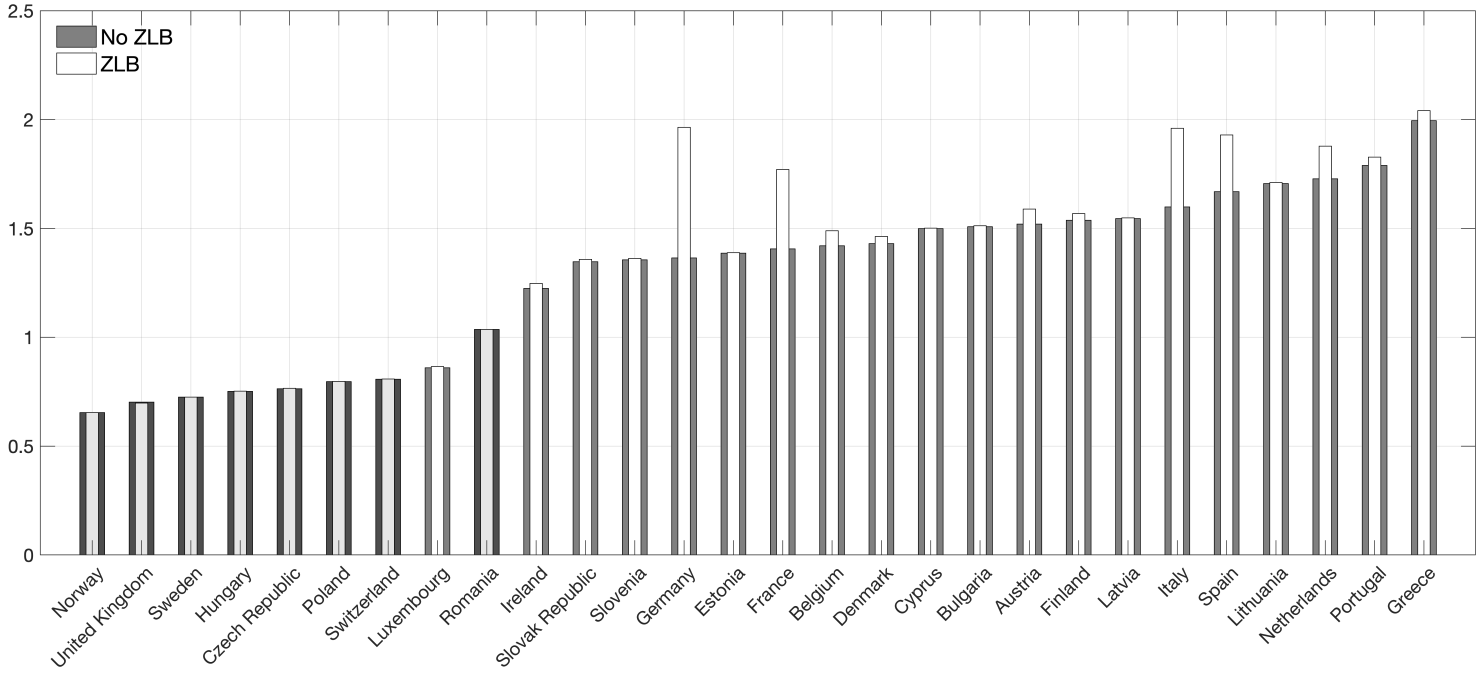
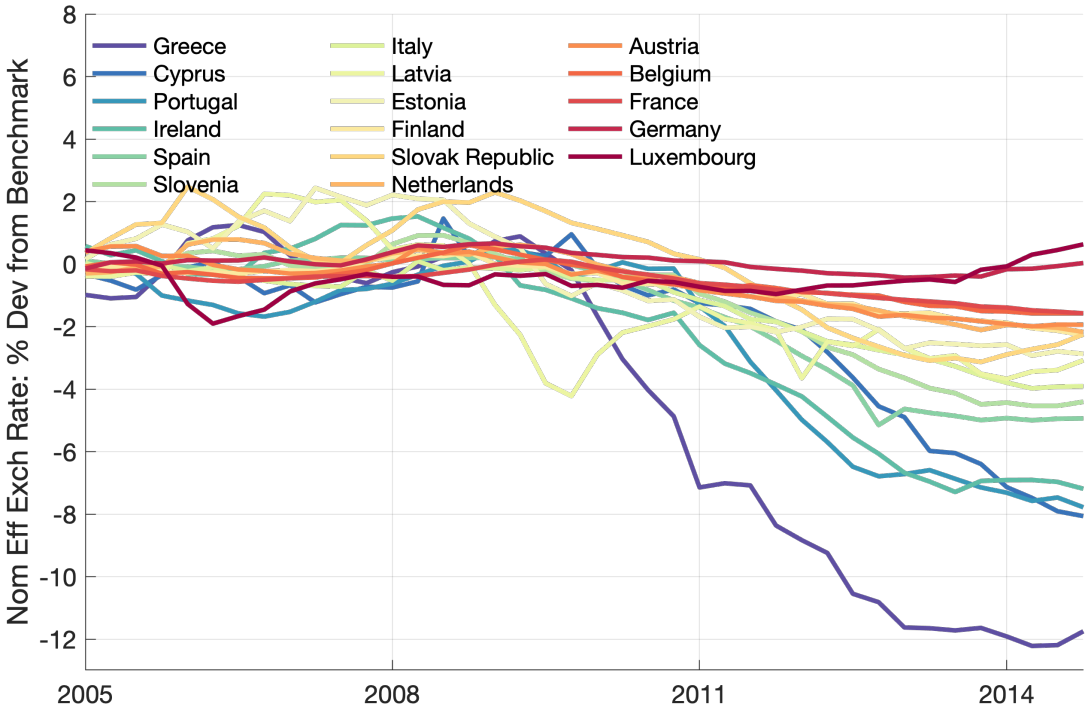
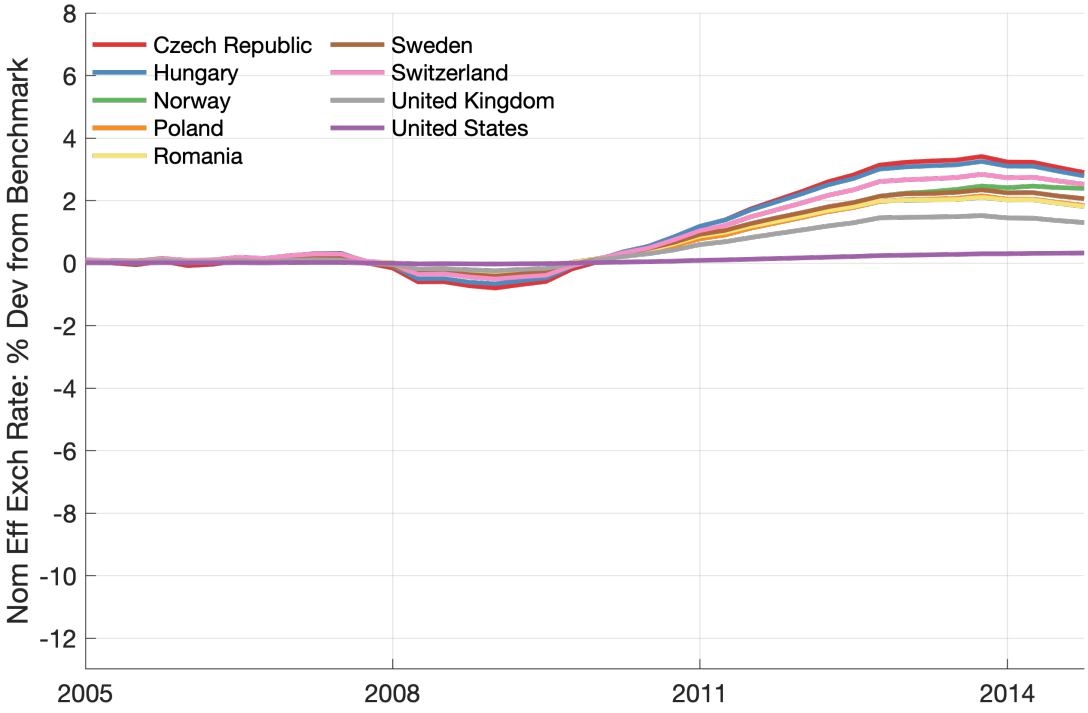


Figure A11: Domestic Multiplier

Note: Figure displays the average 2010 - 2014 GDP deviation predicted by the model in a counterfactual experiment less the GDP deviations in the benchmark model. In the counterfactual experiment, the country whose GDP is plotted raises its government purchases by 1 percent of GDP. Hence, every bar corresponds to a different simulation. The thin light bars correspond to the scenario where a ZLB is imposed for the euro area in both the benchmark and the counterfactual. Countries with floating exchange rates have darker bars.



(a) Eurozone Countries



(a) Floating Countries

Figure A12: 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.

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

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A Remarks

A.1 Linking of Time Series

In an attempt to create long time-series of data, we link data from several sources. This was necessary because European countries recently updated their national accounting system from the European System of Accounts (ESA) 95 to ESA 2010.[1] Time-series based on ESA 95 were no longer updated after 2013, while time-series based on ESA 2010 typically do not extend back before 1995. Eurostat, our main data source, does not report a harmonized, linked time series. For some variables, the OECD and – for annual data – AMECO (the Annual Macro-ECOnomic database of the European Commission) report longer, linked time series. Whenever needed, we link time series ourselves using one of three methods, called 'growth', 'linear','none'. For instance, to extrapolate the time series x_t backwards for $t < T$ using the time series y_t, we use

$$x_t = y_t \frac{1}{4} \sum_{s=0}^{3} \frac{x_{T+s}}{y_{T+s}} \qquad \text{('growth')}$$

$$x_t = y_t + \frac{1}{4} \sum_{s=0}^{3} (x_{T+s} - y_{T+s}) \qquad \text{('linear')}$$

$$x_t = y_t \qquad \text{('none')}$$

The adjustment factor, based on (up to) four observations, serves to correct for level differences between the two time series.

A.2 Government Purchases

We define government purchases as the sum of government consumption expenditure and government gross investment that are included in GDP. This follows the definition used by the BEA. European statistics offices, in general, do only report government consumption expenditure in their national account tables, but not government gross investment. Instead, they report gross fixed capital formation (GFCF) in the government accounts. According to the European System of Accounts 2010, GFCF consists of "acquisitions, less disposals, of fixed assets."[2] In contrast to gross investment, GFCF includes purchase and sales of *existing* fixed assets. It was not possible to obtain

[1] The two accounting systems correspond to the UN Systems of National Accounts (SNA) 93 and SNA 2008. For our purpose, the changes have been very minor.

[2] See http://ec.europa.eu/eurostat/web/esa-2010, Paragraph 3.124.

data series from national statistical offices that had all these purchases and sales of existing assets removed. But several statistical offices reported the most discernible transactions that we removed from government GFCF. These include a £15.6 billion transfer of British Nuclear Fuels (a public corporation) to Nuclear Decommissioning Authority (which is part of the central government) in the second quarter of 2005, a CZK 81 billion transfer of financial assets from Czech Railways (a non-financial corporation) to the Railway Infrastructure Administration (part of the government) in the first quarter of 2003, €150 million net sales of real estate property holdings from the statutory employment pension scheme in Finland in the third quarter of 2010, a €9.587 billion disposal of real estate by the Italian Social Security Funds in the fourth quarter of 2002 and several sales of buildings and infrastructure in Belgium (€319.4 million in 2001Q4, €177.7 million in 2002Q4, €167.4 million in 2003Q4, €154.4 in 2004Q2, €275.7 in 2004Q4, €91.2 million in 2005Q4, €674.5 million in 2006Q4 and €100 in 2012Q4).

B Data Sources

B.1 Interest Rate Data

Table 1: INTEREST RATES ON LOANS TO NON-FINANCIAL COOPERATIONS

Country	Series Name	Currency	Time Period	Source	Download
Belgium:	Loans (other than bank overdraft), up to EUR 1 million, floating rate and up to 1 year initial rate fixation[1]	Euro	2003:2014.75	National Bank of Belgium, Online Statistics > Other financial statistics > Corporate credit observatory> MIR: Interest rates on new business	03/02/16
Bulgaria:	Bulgaria Long-term Corporate Lending Rate, ILBGRCW	Bulgaria new lev	1994.75:1998.75	GFD: Fixed income database	01/02/15
	Short-term loans in BGN to non-financial corporations (up to Dec 2006); Loans up to 1 year in BGN to non-financial corporations (since Jan 2007)[2]	Bulgarian lev	1999:2006.75	Bulgarian National Bank: Statistics > Monetary and Interest Rate Statistics > Interest Rate Statistics > Interest rates and volumes of new business on loans to non-financial corporations and households by original maturity (since Jan 2007) and Interest rates and volumes of new business on loans other than overdraft to non-financial corporations and households by original maturity (up to Dec 2006); http://www.bnb.bg/Statistics/StMonetaryInterestRate/StInterestRate/StIRInterestRate/index.htm?toLang=_EN	03/12/16

	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, other currencies, MIR.M.BG.B.A2A.F.R.0.2240.BGN.N[1]	Bulgarian lev	2007:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Czech Republic:	Czech Business Loans to 1 Year, IL-CZESTM	Czech koruna	1993:2003.75	GFD: Fixed income database	01/02/15
	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.CZ.B.A2A.F.R.0.2240.CZK.N[1]	Czech koruna	2004:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Denmark:	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.DK.B.A2A.F.R.0.2240.DKK.N[1]	Danish krone	2003:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Germany:	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.DE.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2003:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Estonia:	3.7.1 Interest rate on loans to non-financial corporations (total)[1]	Euro	1999:2014.75	Eesti Pank > Statistical indicators > Financial sector statistics > Credit institutions statistics > 3.7 Interest rates	03/02/16
Ireland:	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.IE.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2003:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16

Greece:	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.GR.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2003:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Spain:	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.ES.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2003:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
France:	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.FR.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2003:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Italy:	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.IT.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2003:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Cyprus:	Retail Bank interest rates > Lending rates > Enterprises - secured loans[1]	Cypriot pound	2003:2005.75	Money, Banking and other Financial Statistics, Mar 2008 (pdf file)	03/02/16
	Commercial bank interest rates > lending rates > Enterprises - secured loans[1]	Cypriot pound / Euro	2006:2007.75	Central Bank of Cyprus: Monetary and Financial Statistics, edition Jan 2008, Table 8 (excel file);	03/02/16
	Loans to non-financial corporation (othern loans up to EUR 1 million), floating rate and up to 1 year initial rate fixation, new business[1]	Euro	2008:2014.75	Central Bank of Cyprus: Monetary and Financial Statistics, editions Jan 2010 and Feb 2016, Table 8 (excel files);	03/02/16

Latvia:	Weighted average interest rates charged by banks in transactions with domestic enterprises, new loans, short-term[1]	Latvian lat	1999:2003.75	Bank of Latvia: Table 17b, bank.lv > statisika > Procentu likmju statistika > Procentu likmju statistika arhivs (only accessible on Latvian website, not English website)	03/08/16
	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.LV.B.A2A.F.R.0.2240.LVL.N[1]	Latvian lat	2004:2013.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.LV.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2014:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Lithuania:	Interest rates on bank loans (non-financial corporations), 6-12 months[1]	Lithuanian lita	1999:2004.5	Central Bank of the Republic of Lithuania: Monetary Financial Institutions Interest Rates on Loans and Deposits Statistics > Data archive > Interest rates on bank loans	03/02/16
	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.LT.B.A2A.F.R.0.2240.LTL.N[1]	Lithuanian lita	2004.75:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Luxembourg:	Loans up to 1 year, AAR / NDER, Total, Non-Financial corporations, outstanding amount, MIR.M.LU.B.A20.F.R.A.2240.EUR.O[1]	Euro	2003:2005.75	ECB: MIR: MFI Interest Rate Statistics	03/01/16

	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.LU.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2006:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Hungary:	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.HU.B.A2A.F.R.0.2240.HUF.N[1]	Hungarian forint	2003:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Malta:	Weighted average lending rate for non-financial companies	Maltese lira	2000:2006.75	Central Bank of Malta: Monetary, banking and financial markets > Financial market developments and interest rates > Key CBM, ECB and money market interest rates (including historic data 1997 - 2007)	03/02/16
	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.MT.B.A2A.F.R.0.2240.MTL.N[1]	Maltese lira	2007:2007.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.MT.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2008:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Netherlands:	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.NL.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2000:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16

Austria:	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.AT.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2000:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Poland:	Poland Corporate Lending Rate, ILPOLCM	Poland new zloty	1990:2004.75	GFD: Fixed income database	01/02/15
	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.PL.B.A2A.F.R.0.2240.PLN.N[1]	Polish zloty	2005:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Portugal:	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.PT.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2003:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Romania:	Romania Average Lending Rate, IL-ROUM	Romania new leu	1990.75:2006.75	GFD: Fixed income database	01/02/15
	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.RO.B.A2A.F.R.0.2240.RON.N[1]	Romanian leu	2007:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Slovenia:	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.SI.B.A2A.F.R.0.2240.SIT.N[1]	Slovenian tolar	2003:2006.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16

	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.SI.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2007:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Slovak Republic:	Interest rates on loans (outstanding amounts) - SKK, Loans to non-financial corporations with maturity up to 1 year[1]	Slovak koruna	2003:2003.75	National Bank of the Slovak Republic > Monetary and Financial Statistics > Interest rate statistics > Banking interest rates statistics - loans; Data for 2003 provided by email	03/22/16
	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.SK.B.A2A.F.R.0.2240.SKK.N[1]	Slovak koruna	2004:2008.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.SK.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2009:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Finland:	Loans [A20-A2Z] up to 1 year, AAR / NDER, Total, Non-Financial corporations, new business, MIR.M.FI.B.A2A.F.R.0.2240.EUR.N[1]	Euro	2003:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/02/16
Sweden:	MFI:s' lending rates, outstanding agreements (percent), Non-financial corporations, All accounts; 8.3.4 Monetary financial institutions (MFI), outstanding agreements[3]	Swedish krona	1996:2014.75	Email by Jens Viklund, Sweden Central Bank	03/22/16

United Kingdom:	Monthly average of UK resident monetary financial institutions' (excl. Central Bank) sterling weighted average interest rate - other loans to private non-financial corporations (in percent) not seasanolly adjusted, CFMHSDC (outstanding amount)[1]	UK pound sterling	1999:2003.75	Bank of England: Interest and exchange rate data > Effective interest rates	03/03/16
	Loans up to 1 year, AAR / NDER, Total, Non-Financial corporations, outstanding amount, MIR.M.GB.B.A20.F.R.A.2240.GBP.O[1]	UK pound sterling	2004:2014.75	ECB: MIR: MFI Interest Rate Statistics	03/01/16
Norway:	Table 07200, Interest rates on outstanding loans (per cent), by financial corporation, type of loans, sector, time and contents (total, excluding The Norwegian Public Service Pension Fund; to non-financial corporations; outstanding amount)	Norwegian krona	2002:2014.75	Statistics Norway: Banking and financial markets > Interest rates in banks and mortgage companies	03/02/16
Switzerland:	Switzerland Mortgage Lending Rate, ILCHEM	Switzerland franc	1990:2014.75	GFD: Fixed income database	01/02/15

United States:	Weighted-Average Effective Loan Rate for All Commercial and Industry Loans, All Commercial Banks[EEANQ], E.2 Survey of Terms of Business Lending	US dollar	1997.25:2014.75	Board of Governors of the Federal Reserve System (US),Weighted-Average Effective Loan Rate for All Commercial and Industry Loans, All Commercial Banks[EEANQ], retrieved from FRED, Federal Reserve Bank of St. Louis https://research.stlouisfed.org/fred2/series/EEANQ, March 2, 2016.	03/03/16

Notes: Linking method: linear.

ECB refers to the Statistical DataWarehouse http://sdw.ecb.europa.eu/. GFD is the Global Financial Data Database https://www.globalfinancialdata.com/Databases/databases.html

[1] Monthly data converted to quarterly data using simple averages.

[2] Difference between ECB and BNB data: ECB reports data by initial rate fixation (not original maturity). BNB only has data by initial rate fixation from 2007 onwards, so we use data by original maturity for years before 2007.

[3] Data starting from Oct 2005 is monthly data; transformed to quarterly data using averages of monthly data.

Table 2: CENTRAL BANK INTEREST RATES 1999 - 2014

Country	Series Name	Start Date	Source
Bulgaria	*see ECB*		
Czech Republic	Lombard rate	1/1/93	http://www.cnb.cz/en/monetary_policy/instruments/
Denmark	The Nationalbanks official rates - Lending	1/1/95	http://nationalbanken.statbank.dk/nbf/99541
Estonia	*see ECB*		
Greece	Lombard facility (till Dec 2000), *see ECB* (since Jan 2001)	1/1/95	http://www.bankofgreece.gr/Pages/en/Statistics/rates_markets/monetary/default.aspx
Hungary	Prime rate	10/15/90	http://english.mnb.hu/Root/ENMNB/Jegybanki_alapkamat_alakulasa
Cyprus	interest rate ceiling at 7% (till Dec 2000), marginal lending facility rate (Jan 2001 - Aug 2006), minimum bid rate on repo operations (Sep 2006 - Dec 2007), *see ECB* (since Jan 2008)	1/1/99	http://www.centralbank.gov.cy/media/pdf/Official_Interest_Rates_until_end_2007EN.pdf
Latvia	Refinancing rate (till Dec 2013), *see ECB* (since Jan 2014)	1/1/93	Email by Egils Kauzens, Bank of Latvia
Lithuania	*see United States* (from Jan 1995 till Feb 2002), *see ECB* (since Mar 2002)		
Poland	Reference rate	1/1/98	http://www.nbp.pl/homen.aspx?f=/en/statystyka/instrumenty/instrumenty.html
Romania	Reference interest rate (till Oct 2011), Policy Rate (since Nov 2011)	2/1/02	http://www.bnr.ro/NBR's-Reference-Interest-Rate-3317.aspx
Slovenia	60-day tollar bill rate (till Oct 2001), main refinancing rate (Oct 2001 - Dec 2007), *see ECB* (since Jan 2007)	1/1/99	http://www.bsi.si/en/financial-data.asp?MapaId=975
Slovak Republic	Key interest rate (till Dec 2008), *see ECB* (since Jan 2009)	1/1/97	http://www.nbs.sk/en/monetary-policy/macroeconomic-database/macroeconomic-database-chart
Sweden	Repo Rate	1/1/94	http://www.riksbank.se/en/Interest-and-exchange-rates/Explanation-of-the-series/Riksbank-interest-rates/
United Kingdom	Quarterly average of official bank rate (IUQABEDR)	1/1/74	http://www.bankofengland.co.uk/boeapps/iadb/Repo.asp?Travel=NIxIRx
Norway	Key policy rate (FOLIO.NOM)	01/01/91	http://www.norges-bank.no/en/Statistics/Interest-rates/Key-policy-rate-monthly/
Switzerland	Discount rate (till Dec 1999), Average of target rate (since Jan 2000)	11/5/79	Email by Josef Bächtiger, SNB, http://www.snb.ch/en/iabout/monpol/monstat/id/monpol_monstat_zielband
United States	Effective Federal Funds Rate [FEDFUNDS]	7/1/54	https://research.stlouisfed.org/fred2/series/FEDFUNDS/
ECB	Fixed rate tenders (till 6/28/00 and since 10/15/08), Variable rate tenders (from 6/28/00 to 10/15/08)	1/1/99	http://sdw.ecb.europa.eu/browse.do?node=bbn131

Notes: Bulgaria's and Denmark's currency were pegged to the euro since 1999. Several countries adopted the euro over the sample period: Estonia (Jan 2011), Greece (Jan 2001), Cyprus (Jan 2008), Latvia (Jan 2014), Slovenia (Jan 2007) and the Slovak Republic (Jan 2009). All data was downloaded in June 2015. Time series for Romania only goes back to Jan 2002.

B.2 Annual Data

Table 3: REAL GDP (ANNUAL)

#	Series Name	Source	Unit	Download
(2)	Gross domestic product at market prices	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Chain linked volumes (2010), million euro	10/14/17
(3)	Gross domestic product - expenditure approach, VPVOBARSA[1]	OECD: Quarterly National Accounts	US Dollar, millions, 2010	10/17/17
(4)	Gross domestic product at market prices	AMECO: 6.1 Gross domestic product at constant prices	Million units of national currency, chain-linked volumes, reference year 2010	10/17/17

Notes: Linking method: growth.
[1] Data has been converted into 2010 million euro using the conversion factor 0.85687.

Data sets used by time and country

Belgium: 1960:1994 (3), 1995:2016 (2); *Bulgaria*: 1998:2016 (2); *Czech Republic*: 1990:1994 (4), 1995:2016 (2); *Denmark*: 1960:1974 (3), 1975:2016 (2); *Germany*: 1991:2016 (2); *Estonia*: 1993:1994 (4), 1995:2016 (2); *Ireland*: 1960:1994 (3), 1995:2016 (2); *Greece*: 1960:1994 (3), 1995:2016 (2); *Spain*: 1960:1994 (3), 1995:2016 (2); *France*: 1960:1974 (3), 1975:2016 (2); *Italy*: 1960:1994 (3), 1995:2016 (2); *Cyprus*: 1990:1994 (4), 1995:2016 (2); *Latvia*: 1995:2016 (2); *Lithuania*: 1995:2016 (2); *Luxembourg*: 1960:1994 (3), 1995:2016 (2); *Hungary*: 1991:1994 (4), 1995:2016 (2); *Malta*: 1991:1999 (4), 2000:2016 (2); *Netherlands*: 1960:1994 (3), 1995:2016 (2); *Austria*: 1960:1994 (3), 1995:2016 (2); *Poland*: 1990:1994 (4), 1995:2016 (2); *Portugal*: 1960:1994 (3), 1995:2016 (2); *Romania*: 1998:2016 (2); *Slovenia*: 1990:1994 (4), 1995:2016 (2); *Slovak Republic*: 1992:1992 (4), 1993:1994 (3), 1995:2016 (2); *Finland*: 1960:1979 (3), 1980:2016 (2); *Sweden*: 1960:1992 (3), 1993:2016 (2); *United Kingdom*: 1960:1974 (3), 1975:2016 (2); *Norway*: 1960:1974 (3), 1975:2016 (2); *Switzerland*: 1960:1979 (3), 1980:2016 (2); *Iceland*: 1960:1994 (3), 1995:2016 (2); *Croatia*: 1995:2016 (2); *United States*: 1960:2016 (3);

Table 4: NOMINAL GDP (ANNUAL)

#	Series Name	Source	Unit	Download
(2)	Gross domestic product at market prices	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Million units of national currency	10/14/17
(3)	Gross domestic product - expenditure approach, CARSA	OECD: Quarterly National Accounts	Million units of national currency	10/17/17
(4)	Gross domestic product at market prices	Eurostat: GDP and main components - volumes [nama_gdp_k], ESA 95	Million units of national currency	12/11/15

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1960:1994 (3), 1995:2016 (2); *Bulgaria*: 1998:2016 (2); *Czech Republic*: 1995:2016 (2); *Denmark*: 1960:1974 (3), 1975:2016 (2); *Germany*: 1991:2016 (2); *Estonia*: 1995:2016 (2); *Ireland*: 1960:1994 (3), 1995:2016 (2); *Greece*: 1960:1994 (3), 1995:2016 (2); *Spain*: 1960:1994 (3), 1995:2016 (2); *France*: 1960:1974 (3), 1975:2016 (2); *Italy*: 1960:1994 (3), 1995:2016 (2); *Cyprus*: 1995:2016 (2); *Latvia*: 1995:2016 (2); *Lithuania*: 1995:2016 (2); *Luxembourg*: 1960:1994 (3), 1995:2016 (2); *Hungary*: 1993:1994 (4), 1995:2016 (2); *Malta*: 1995:2016 (2); *Netherlands*: 1960:1994 (3), 1995:2016 (2); *Austria*: 1960:1994 (3), 1995:2016 (2); *Poland*: 1995:2016 (2); *Portugal*: 1960:1994 (3), 1995:2016 (2); *Romania*: 1998:2016 (2); *Slovenia*: 1992:1994 (4), 1995:2016 (2); *Slovak Republic*: 1992:1992 (4), 1993:1994 (3), 1995:2016 (2); *Finland*: 1960:1979 (3), 1980:2016 (2); *Sweden*: 1960:1992 (3), 1993:2016 (2); *United Kingdom*: 1960:1974 (3), 1975:2016 (2); *Norway*: 1960:1974 (3), 1975:2016 (2); *Switzerland*: 1960:1979 (3), 1980:2016 (2); *Iceland*: 1960:1994 (3), 1995:2016 (2); *Croatia*: 1992:1994 (4), 1995:2016 (2); *United States*: 1960:2016 (3);

Table 5: POPULATION (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Total Population: All Ages including Armed Forces Overseas[POP]	US. Bureau of the Census, https://research.stlouisfed.org/fred2/series/POP/	Thousands	10/15/17
(2)	Population	Eurostat: Population on 1 January by age and sex [demo_pjan]	-	02/22/17

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1960:2016 (2); *Bulgaria*: 1998:2016 (2); *Czech Republic*: 1960:2016 (2); *Denmark*: 1960:2016 (2); *Germany*: 1991:2016 (2); *Estonia*: 1960:2016 (2); *Ireland*: 1960:2016 (2); *Greece*: 1960:2016 (2); *Spain*: 1960:2016 (2); *France*: 1960:2016 (2); *Italy*: 1960:2016 (2); *Cyprus*: 1960:2016 (2); *Latvia*: 1995:2016 (2); *Lithuania*: 1995:2016 (2); *Luxembourg*: 1960:2016 (2); *Hungary*: 1960:2016 (2); *Malta*: 1960:2016 (2); *Netherlands*: 1960:2016 (2); *Austria*: 1960:2016 (2); *Poland*: 1960:2016 (2); *Portugal*: 1960:2016 (2); *Romania*: 1998:2016 (2); *Slovenia*: 1960:2016 (2); *Slovak Republic*: 1960:2016 (2); *Finland*: 1960:2016 (2); *Sweden*: 1960:2016 (2); *United Kingdom*: 1960:2016 (2); *Norway*: 1960:2016 (2); *Switzerland*: 1960:2016 (2); *Iceland*: 1960:2016 (2); *Croatia*: 1960:2016 (2); *United States*: 1960:2017 (1);

Table 6: TOTAL FACTOR PRODUCTIVITY (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Multifactor productivity	OECD: Productivity ¿ Productivity and ULC - Annual, Total Economy ¿ Growth in GDP per capita, productivity and ULC	Index	10/22/17
(2)	Total factor productivity (ZVGDF)	AMECO: 8.2 Capital Stock: Factor Productivity, Total Economy	Index	10/17/17

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1960:2017 (2), 1985:2015 (1); *Bulgaria*: 1998:2017 (2); *Czech Republic*: 1995:2017 (2); *Denmark*: 1960:2017 (2), 1985:2015 (1); *Germany*: 1991:2015 (1); *Estonia*: 1995:2017 (2); *Ireland*: 1960:2017 (2), 1985:2014 (1); *Greece*: 1960:2017 (2); *Spain*: 1960:2017 (2), 1985:2014 (1); *France*: 1960:2017 (2), 1985:2016 (1); *Italy*: 1960:2017 (2), 1985:2016 (1); *Cyprus*: 1995:2017 (2); *Latvia*: 1995:2017 (2); *Lithuania*: 1995:2017 (2); *Luxembourg*: 1960:2017 (2); *Hungary*: 1995:2017 (2); *Malta*: 1995:2017 (2); *Netherlands*: 1960:2017 (2), 1985:2015 (1); *Austria*: 1960:2017 (2), 1996:2015 (1); *Poland*: 1995:2017 (2); *Portugal*: 1960:2017 (2), 1985:2014 (1); *Romania*: 1998:2017 (2); *Slovenia*: 1995:2017 (2); *Slovak Republic*: 1995:2017 (2); *Finland*: 1960:2017 (2), 1985:2016 (1); *Sweden*: 1960:2017 (2), 1985:2015 (1); *United Kingdom*: 1960:2017 (2), 1985:2015 (1); *Norway*: 1978:2017 (2); *Switzerland*: 1991:2017 (2), 1992:2015 (1); *Iceland*: 1970:2017 (2); *Croatia*: 1996:2017 (2); *United States*: 1960:2017 (2), 1985:2016 (1);

Table 7: NOMINAL GOVERNMENT GROSS FIXED CAPITAL FORMATION (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Gross fixed capital formation (P51)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	10/14/17
(2)	GP51P: Gross fixed capital formation	OECD: Dataset: 12. Government deficit/surplus, revenue, expenditure and main aggregates	Million units of national currency	10/18/17
(3)	Gross fixed capital formation (P51)	Eurostat: Government revenue, expenditure and main aggregates [gov_a_main], ESA 95	Million units of national currency	12/12/15
(4)	Government fixed capital formation, value, appropriation account	OECD: Dataset: Economic Outlook No 98 - November 2015	National currency	03/07/16
(5)	Government fixed capital formation, value, appropriation account	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16
(6)	Gross government fixed capital formation, value	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1960:1969 (6), 1970:1994 (3), 1995:2016 (1); *Bulgaria*: 1998:2016 (1); *Czech Republic*: 1995:2016 (1); *Denmark*: 1971:1994 (3), 1995:2016 (1); *Germany*: 1991:1994 (3), 1995:2016 (1); *Estonia*: 1993:1994 (3), 1995:2016 (1); *Ireland*: 1960:1984 (5), 1985:1994 (3), 1995:2016 (1); *Greece*: 1960:1987 (6), 1988:1994 (3), 1995:2016 (1); *Spain*: 1964:1994 (4), 1995:2016 (1); *France*: 1960:1977 (4), 1978:2016 (1); *Italy*: 1960:1979 (4), 1980:1994 (3), 1995:2016 (1); *Cyprus*: 1995:2016 (1); *Latvia*: 1995:2016 (1); *Lithuania*: 1995:2016 (1); *Luxembourg*: 1990:1994 (3), 1995:2016 (1); *Hungary*: 1991:1994 (5), 1995:2016 (1); *Malta*: 1995:2016 (1); *Netherlands*: 1960:1968 (6), 1969:1994 (3), 1995:2016 (1); *Austria*: 1960:1975 (5), 1976:1994 (3), 1995:2016 (1); *Poland*: 1991:1994 (3), 1995:2016 (1); *Portugal*: 1977:1994 (3), 1995:2016 (1); *Romania*: 1998:2016 (1); *Slovenia*: 1995:2016 (1); *Slovak Republic*: 1993:1994 (3), 1995:2016 (1); *Finland*: 1960:1974 (4), 1975:2016 (1); *Sweden*: 1960:1992 (4), 1993:1994 (3), 1995:2016 (1); *United Kingdom*: 1960:1969 (5), 1970:1989 (3), 1990:2016 (1); *Norway*: 1960:1989 (4), 1990:1994 (3), 1995:2016 (1); *Switzerland*:

1990:1994 (3), 1995:2015 (1); *Iceland*: 1998:2016 (1); *Croatia*: 2001:2016 (1); *United States*: 1960:1969 (4), 1970:2015 (2);

Table 8: NOMINAL GOVERNMENT CONSUMPTION (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Final consumption expenditure of general government	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Million units of national currency	10/14/17
(2)	General government final consumption expenditure, CARSA	OECD: Quarterly National Accounts	Million units of national currency	10/17/17
(3)	Final consumption expenditure of general government	Eurostat: GDP and main components - volumes [nama_gdp_k], ESA 95	Million units of national currency	12/11/15

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1960:1994 (2), 1995:2016 (1); *Bulgaria*: 1998:2016 (1); *Czech Republic*: 1995:2016 (1); *Denmark*: 1960:1974 (2), 1975:2016 (1); *Germany*: 1991:2016 (1); *Estonia*: 1995:2016 (1); *Ireland*: 1960:1994 (2), 1995:2016 (1); *Greece*: 1960:1994 (2), 1995:2016 (1); *Spain*: 1960:1994 (2), 1995:2016 (1); *France*: 1960:1974 (2), 1975:2016 (1); *Italy*: 1960:1994 (2), 1995:2016 (1); *Cyprus*: 1995:2016 (1); *Latvia*: 1995:2016 (1); *Lithuania*: 1995:2016 (1); *Luxembourg*: 1960:1994 (2), 1995:2016 (1); *Hungary*: 1993:1994 (3), 1995:2016 (1); *Malta*: 1995:2016 (1); *Netherlands*: 1960:1994 (2), 1995:2016 (1); *Austria*: 1960:1994 (2), 1995:2016 (1); *Poland*: 1995:2016 (1); *Portugal*: 1960:1994 (2), 1995:2016 (1); *Romania*: 1998:2016 (1); *Slovenia*: 1992:1994 (3), 1995:2016 (1); *Slovak Republic*: 1992:1992 (3), 1993:1994 (2), 1995:2016 (1); *Finland*: 1960:1979 (2), 1980:2016 (1); *Sweden*: 1960:1992 (2), 1993:2016 (1); *United Kingdom*: 1960:1994 (2), 1995:2016 (1); *Norway*: 1960:1974 (2), 1975:2016 (1); *Switzerland*: 1960:1979 (2), 1980:2016 (1); *Iceland*: 1960:1994 (2), 1995:2016 (1); *Croatia*: 1995:2016 (1); *United States*: 1960:2016 (2);

Table 9: UNEMPLOYMENT RATE (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Civilian Unemployment Rate[UNRATE]	US. Bureau of Labor Statistics, https://research.stlouisfed.org/fred2/series/UNRATE/	Percent	10/16/17
(2)	Unemployment rate: total :- Member States: definition EUROSTAT (ZUTN)[1]	AMECO: 1.3 Population and Employment: Unemployment	Percent	10/16/17
(3)	Unemployment rate: total	ILOSTAT: Employment office records	Percent	02/25/17

Notes: Linking method: linear.
[1] Croatia: prior to 2001, data from ILOSTAT LFO

Data sets used by time and country

Belgium: 1960:2016 (2); *Bulgaria*: 1998:2016 (2); *Czech Republic*: 1993:2016 (2); *Denmark*: 1960:2016 (2); *Germany*: 1991:2016 (2); *Estonia*: 1993:2016 (2); *Ireland*: 1960:2016 (2); *Greece*: 1960:2016 (2); *Spain*: 1960:2016 (2); *France*: 1960:2016 (2); *Italy*: 1960:2016 (2); *Cyprus*: 1992:1996 (3), 1997:2016 (2); *Latvia*: 1995:2016 (2); *Lithuania*: 1995:2016 (2); *Luxembourg*: 1960:2016 (2); *Hungary*: 1995:2016 (2); *Malta*: 1990:2016 (2); *Netherlands*: 1960:2016 (2); *Austria*: 1960:2016 (2); *Poland*: 1992:2016 (2); *Portugal*: 1960:2016 (2); *Romania*: 1998:2016 (2); *Slovenia*: 1995:2016 (2); *Slovak Republic*: 1995:2016 (2); *Finland*: 1960:2016 (2); *Sweden*: 1960:2016 (2); *United Kingdom*: 1960:2016 (2); *Norway*: 1960:2016 (2); *Switzerland*: 1960:2016 (2); *Iceland*: 1960:2016 (2); *Croatia*: 1990:1999 (3), 2000:2016 (2); *United States*: 1960:2016 (1);

Table 10: OUTPUT GAP (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Gap between actual and potential gross domestic product at 2010 reference levels (AVGDGP)	AMECO: 6.5 Domestic Product: Potential Gross Domestic Product at Constant Prices	Percentage of potential gross domestic product at constant prices	02/15/18
(2)	Output gap of the total economy	OECD: OECD Economic Outlook, annual data	Percentage	05/14/15

Notes: Linking method: linear.

Data sets used by time and country

Belgium: 1960:2017 (1); *Bulgaria*: 1998:2017 (1); *Czech Republic*: 1960:2017 (1); *Denmark*: 1960:2017 (1); *Germany*: 1991:2012 (1), 2013:2016 (2); *Estonia*: 1960:2017 (1); *Ireland*: 1960:2017 (1); *Greece*: 1960:2017 (1); *Spain*: 1960:2017 (1); *France*: 1960:2017 (1); *Italy*: 1960:2017 (1); *Cyprus*: 1960:2017 (1); *Latvia*: 1995:2017 (1); *Lithuania*: 1995:2017 (1); *Luxembourg*: 1960:2017 (1); *Hungary*: 1960:2017 (1); *Malta*: 1960:2017 (1); *Netherlands*: 1960:2017 (1); *Austria*: 1960:2017 (1); *Poland*: 1960:2017 (1); *Portugal*: 1960:2017 (1); *Romania*: 1998:2017 (1); *Slovenia*: 1960:2017 (1); *Slovak Republic*: 1996:2016 (2); *Finland*: 1960:2017 (1); *Sweden*: 1960:2017 (1); *United Kingdom*: 1960:2017 (1); *Norway*: 1990:2016 (2); *Switzerland*: 1990:2016 (2); *Croatia*: 1960:2017 (1); *United States*: 1960:2012 (1), 2013:2016 (2);

Table 11: NOMINAL INTEREST RATE ON GOVERNMENT BONDS (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	EMU convergence criterion bond yields	Eurostat: Interest rates ¿ Long-term interest rates ¿ Maastricht criterion interest rates (irt_lt_mcby), ESA 2010	Percent	10/14/17
(2)	Long-term interest rates, Level, ratio or index[1]	OECD: General Statistics ¿ Key Short-Term Economic Indicators	Percent	10/22/17
(3)	10-Year Treasury Constant Maturity Rate[2]	Board of Governors of the Federal Reserve System (US),10-Year Treasury Constant Maturity Rate[DGS10], retrieved from FRED, Federal Reserve Bank of St. Louis https://research.stlouisfed.org/fred2/series/DGS10, February 17, 2016.	Percent	10/17/17
(4)	Interest rates, Government Securities, Government Bonds, Percent per annum	IMF: International Ficial Statistics	Percent	02/09/17

Notes: Linking method: linear.
[1] Interest rate on 10-year government bonds
[2] 1960-01-01 refers to the average of the interest rate in 1960

Data sets used by time and country

Belgium: 1960:1969 (4), 1970:1977 (2), 1978:2016 (1); *Bulgaria*: 1998:2002 (4), 2003:2016 (1); *Czech Republic*: 2000:2000 (4), 2001:2016 (1); *Denmark*: 1960:1982 (4), 1983:2016 (1); *Germany*: 1991:2016 (1); *Estonia*: 1998:2010 (4); *Ireland*: 1960:1970 (4), 1971:1987 (2), 1988:2016 (1); *Greece*: 1984:1991 (4), 1992:2016 (1); *Spain*: 1978:2016 (1); *France*: 1960:1969 (4), 1970:2016 (1); *Italy*: 1960:2016 (1); *Cyprus*: 2001:2016 (1); *Latvia*: 2001:2016 (1); *Lithuania*: 2001:2016 (1); *Luxembourg*: 1970:1984 (4), 1985:2016 (1); *Hungary*: 2000:2000 (2), 2001:2016 (1); *Malta*: 2001:2016 (1); *Netherlands*: 1960:1969 (4), 1970:1985 (2), 1986:2016 (1); *Austria*: 1965:1984 (4), 1985:2016 (1); *Poland*: 2001:2016 (1); *Portugal*: 1960:1985 (4), 1986:2016 (1); *Romania*: 2005:2016 (1); *Slovenia*: 2002:2016 (1); *Slovak Republic*: 2000:2000 (4), 2001:2016 (1); *Finland*: 1987:2016 (1); *Sweden*: 1960:1986 (4), 1987:2016 (1); *United Kingdom*: 1960:1969 (4), 1970:1983 (2), 1984:2016 (1); *Norway*: 1960:1984 (4), 1985:2016 (2); *Switzerland*: 1960:1969 (4), 1970:2016 (2); *Iceland*: 1992:2016 (2); *Croatia*: 2005:2016 (1); *United States*: 1960:1961 (4), 1962:1969 (3), 1970:2016 (2);

Table 12: NOMINAL CAPITAL TAX REVENUE (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Capital taxes, receivable (D91R)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	10/14/17
(2)	GD91R: Capital taxes	OECD: Dataset: 12. Government deficit/surplus, revenue, expenditure and main aggregates	Million units of national currency	10/18/17
(3)	Capital taxes, receivable (D91R)	Eurostat: Government revenue, expenditure and main aggregates [gov_a_main], ESA 95	Million units of national currency	12/12/15

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1970:1994 (3), 1995:2016 (1); *Bulgaria*: 1998:2016 (1); *Czech Republic*: 1995:2016 (1); *Denmark*: 1971:1994 (3), 1995:2016 (1); *Germany*: 1991:1994 (3), 1995:2016 (1); *Estonia*: 1993:1994 (3); *Ireland*: 1985:1994 (3), 1995:2016 (1); *Greece*: 1988:1994 (3), 1995:2016 (1); *Spain*: 1995:2016 (1); *France*: 1978:2016 (1); *Italy*: 1980:1994 (3), 1995:2016 (1); *Cyprus*: 1995:2016 (1); *Latvia*: 1995:2016 (1); *Lithuania*: 1995:2016 (1); *Luxembourg*: 1990:1994 (3), 1995:2016 (1); *Hungary*: 1995:2016 (1); *Malta*: 1995:2016 (1); *Netherlands*: 1969:1994 (3), 1995:2016 (1); *Austria*: 1976:1994 (3), 1995:2016 (1); *Poland*: 1995:2016 (1); *Portugal*: 1977:1994 (3), 1995:2016 (1); *Romania*: 1998:2016 (1); *Slovenia*: 1995:2016 (1); *Slovak Republic*: 1993:1994 (3), 1995:2016 (1); *Finland*: 1975:2016 (1); *Sweden*: 1993:1994 (3), 1995:2016 (1); *United Kingdom*: 1970:1989 (3), 1990:2016 (1); *Norway*: 1990:1994 (3), 1995:2016 (1); *Switzerland*: 1990:1994 (3), 1995:2015 (1); *Iceland*: 1998:2016 (1); *Croatia*: 2001:2016 (1); *United States*: 1970:2015 (2);

Table 13: NOMINAL LABOR TAX REVENUE (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Current taxes on income, wealth, etc., receivable (D5R)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	10/14/17
(2)	GD5R: Current taxes on income, wealth etc., receivable	OECD: Dataset: 12. Government deficit/surplus, revenue, expenditure and main aggregates	Million units of national currency	10/18/17
(3)	Current taxes on income, wealth, etc., receivable (D5R)	Eurostat: Government revenue, expenditure and main aggregates [gov_a_main], ESA 95	Million units of national currency	12/12/15
(4)	Total direct taxes, value	OECD: Dataset: Economic Outlook No 98 - November 2015	National currency	03/07/16
(5)	Total direct taxes, value	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1970:1994 (3), 1995:2016 (1); *Bulgaria*: 1998:2016 (1); *Czech Republic*: 1995:2016 (1); *Denmark*: 1971:1994 (3), 1995:2016 (1); *Germany*: 1991:1994 (3), 1995:2016 (1); *Estonia*: 1993:1994 (3), 1995:2016 (1); *Ireland*: 1960:1984 (5), 1985:1994 (3), 1995:2016 (1); *Greece*: 1960:1987 (5), 1988:1994 (3), 1995:2016 (1); *Spain*: 1964:1994 (4), 1995:2016 (1); *France*: 1960:1977 (4), 1978:2016 (1); *Italy*: 1960:1979 (4), 1980:1994 (3), 1995:2016 (1); *Cyprus*: 1995:2016 (1); *Latvia*: 1995:2016 (1); *Lithuania*: 1995:2016 (1); *Luxembourg*: 1990:1994 (3), 1995:2016 (1); *Hungary*: 1991:1994 (3), 1995:2016 (1); *Malta*: 1995:2016 (1); *Netherlands*: 1969:1994 (3), 1995:2016 (1); *Austria*: 1960:1975 (4), 1976:1994 (3), 1995:2016 (1); *Poland*: 1991:1994 (3), 1995:2016 (1); *Portugal*: 1977:1994 (3), 1995:2016 (1); *Romania*: 1998:2016 (1); *Slovenia*: 1995:2016 (1); *Slovak Republic*: 1993:1994 (3), 1995:2016 (1); *Finland*: 1960:1974 (4), 1975:2016 (1); *Sweden*: 1960:1992 (4), 1993:1994 (3), 1995:2016 (1); *United Kingdom*: 1960:1969 (5), 1970:1989 (3), 1990:2016 (1); *Norway*: 1962:1989 (4), 1990:1994 (3), 1995:2016 (1); *Switzerland*: 1990:1994 (3), 1995:2015 (1); *Iceland*: 1980:1997 (5), 1998:2016 (1); *Croatia*: 2001:2016 (1); *United States*: 1960:1969 (4), 1970:2015 (2);

Table 14: NOMINAL CONSUMPTION TAX REVENUE (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Taxes on production and imports, receivable (D2R)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	10/14/17
(2)	GD2R: Taxes on production and imports, receivable	OECD: Dataset: 12. Government deficit/surplus, revenue, expenditure and main aggregates	Million units of national currency	10/18/17
(3)	Taxes on production and imports, receivable (D2R)	Eurostat: Government revenue, expenditure and main aggregates [gov_a_main], ESA 95	Million units of national currency	12/12/15
(4)	Taxes on production and imports, value	OECD: Dataset: Economic Outlook No 98 - November 2015	National currency	03/07/16
(5)	Indirect taxes, value	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1970:1994 (3), 1995:2014 (1), 2015:2016 (2); *Bulgaria*: 1998:2014 (1); *Czech Republic*: 1995:2014 (1), 2015:2016 (2); *Denmark*: 1971:1994 (3), 1995:2014 (1), 2015:2016 (2); *Germany*: 1991:1994 (3), 1995:2014 (1), 2015:2016 (2); *Estonia*: 1993:1994 (3), 1995:2014 (1), 2015:2016 (2); *Ireland*: 1960:1984 (5), 1985:1994 (3), 1995:2014 (1), 2015:2016 (2); *Greece*: 1960:1987 (5), 1988:1994 (3), 1995:2014 (1), 2015:2016 (2); *Spain*: 1964:1994 (4), 1995:2014 (1), 2015:2016 (2); *France*: 1960:1977 (4), 1978:2014 (1), 2015:2016 (2); *Italy*: 1960:1979 (4), 1980:1994 (3), 1995:2014 (1), 2015:2016 (2); *Cyprus*: 1995:2014 (1); *Latvia*: 1995:2014 (1), 2015:2016 (2); *Lithuania*: 1995:2014 (1); *Luxembourg*: 1990:1994 (3), 1995:2014 (1), 2015:2016 (2); *Hungary*: 1991:1994 (5), 1995:2014 (1), 2015:2016 (2); *Malta*: 1995:2014 (1); *Netherlands*: 1969:1994 (3), 1995:2014 (1), 2015:2016 (2); *Austria*: 1960:1975 (4), 1976:1994 (3), 1995:2014 (1), 2015:2016 (2); *Poland*: 1991:1994 (3), 1995:2014 (1), 2015:2016 (2); *Portugal*: 1977:1994 (3), 1995:2014 (1), 2015:2016 (2); *Romania*: 1998:2014 (1); *Slovenia*: 1995:2014 (1), 2015:2016 (2); *Slovak Republic*: 1993:1994 (3), 1995:2014 (1), 2015:2016 (2); *Finland*: 1960:1974 (4), 1975:2014 (1), 2015:2016 (2); *Sweden*: 1960:1992 (4), 1993:1994 (3), 1995:2014 (1), 2015:2016 (2); *United Kingdom*: 1960:1969 (5), 1970:1989 (3), 1990:2014 (1), 2015:2016 (2); *Norway*: 1960:1989 (4), 1990:1994

(3), 1995:2014 (1), 2015:2016 (2); *Switzerland*: 1990:1994 (3), 1995:2014 (1), 2015:2015 (2); *Iceland*: 1980:1997 (5), 1998:2016 (2); *Croatia*: 2001:2014 (1); *United States*: 1960:1969 (4), 1970:2015 (2);

Table 15: NOMINAL SOCIAL CONTRIBUTIONS (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Social contributions (D61)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	10/14/17
(2)	GD61R: Net social contributions, receivable	OECD: Dataset: 12. Government deficit/surplus, revenue, expenditure and main aggregates	Million units of national currency	10/18/17
(3)	Social contributions (D61)	Eurostat: Government revenue, expenditure and main aggregates [gov_a_main], ESA 95	Million units of national currency	12/16/15
(4)	Social security benefits paid by general government, value	OECD: Dataset: Economic Outlook No 98 - November 2015	National currency	03/07/16
(5)	Social security contribution received by general government, value	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1970:1994 (3), 1995:2016 (1); *Bulgaria*: 1998:2016 (1); *Czech Republic*: 1995:2016 (1); *Denmark*: 1970:1994 (3), 1995:2016 (1); *Germany*: 1991:1994 (3), 1995:2016 (1); *Estonia*: 1993:1994 (3), 1995:2016 (1); *Ireland*: 1960:1984 (5), 1985:1994 (3), 1995:2016 (1); *Greece*: 1960:1987 (5), 1988:1994 (3), 1995:2016 (1); *Spain*: 1964:1994 (4), 1995:2016 (1); *France*: 1960:1977 (4), 1978:2016 (1); *Italy*: 1960:1979 (4), 1980:1994 (3), 1995:2016 (1); *Cyprus*: 1995:2016 (1); *Latvia*: 1995:2016 (1); *Lithuania*: 1995:2016 (1); *Luxembourg*: 1990:1994 (3), 1995:2016 (1); *Hungary*: 1991:1994 (3), 1995:2016 (1); *Malta*: 1995:2016 (1); *Netherlands*: 1969:1994 (3), 1995:2016 (1); *Austria*: 1960:1975 (4), 1976:1994 (3), 1995:2016 (1); *Poland*: 1990:1994 (3), 1995:2016 (1); *Portugal*: 1977:1994 (3), 1995:2016 (1); *Romania*: 1998:2016 (1); *Slovenia*: 1995:2016 (1); *Slovak Republic*: 1993:1994 (3), 1995:2016 (1); *Finland*: 1960:1974 (4), 1975:2016 (1); *Sweden*: 1960:1992 (4), 1993:1994 (3), 1995:2016 (1); *United Kingdom*: 1960:1969 (5), 1970:1989 (3), 1990:2016 (1); *Norway*: 1962:1989 (4), 1990:1994 (3), 1995:2016 (1); *Switzerland*: 1990:1994 (3), 1995:2015 (1); *Iceland*: 1980:1989 (5), 1990:1997 (3), 1998:2016 (1); *Croatia*: 2001:2016 (1); *United States*: 1960:1969 (4), 1970:2015 (2);

Table 16: NOMINAL GOVERNMENT REVENUE (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Total general government revenue (TR)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	10/14/17
(2)	GTR: Total General government revenue	OECD: Dataset: 12. Government deficit/surplus, revenue, expenditure and main aggregates	Million units of national currency	10/18/17
(3)	Total general government revenue (TR)	Eurostat: Government revenue, expenditure and main aggregates [gov_a_main], ESA 95	Million units of national currency	12/12/15
(4)	Total receipts, general government, value	OECD: Dataset: Economic Outlook No 98 - November 2015	National currency	03/07/16
(5)	Total receipts, general government, value	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1970:1994 (3), 1995:2016 (1); *Bulgaria*: 1998:2016 (1); *Czech Republic*: 1995:2016 (1); *Denmark*: 1971:1989 (4), 1990:1994 (3), 1995:2016 (1); *Germany*: 1991:1994 (3), 1995:2016 (1); *Estonia*: 1995:2016 (1); *Ireland*: 1960:1984 (5), 1985:1994 (3), 1995:2016 (1); *Greece*: 1960:1987 (5), 1988:1994 (3), 1995:2016 (1); *Spain*: 1964:1994 (4), 1995:2016 (1); *France*: 1978:2016 (1); *Italy*: 1960:1979 (4), 1980:1994 (3), 1995:2016 (1); *Cyprus*: 1995:2016 (1); *Latvia*: 1995:2016 (1); *Lithuania*: 1995:2016 (1); *Luxembourg*: 1990:1994 (3), 1995:2016 (1); *Hungary*: 1991:1994 (5), 1995:2016 (1); *Malta*: 1995:2016 (1); *Netherlands*: 1969:1994 (3), 1995:2016 (1); *Austria*: 1960:1969 (5), 1970:1975 (4), 1976:1994 (3), 1995:2016 (1); *Poland*: 1995:2016 (1); *Portugal*: 1977:1994 (3), 1995:2016 (1); *Romania*: 1998:2016 (1); *Slovenia*: 1995:2016 (1); *Slovak Republic*: 1993:1994 (3), 1995:2016 (1); *Finland*: 1960:1974 (4), 1975:2016 (1); *Sweden*: 1960:1992 (4), 1993:1994 (3), 1995:2016 (1); *United Kingdom*: 1970:1989 (3), 1990:2016 (1); *Norway*: 1962:1989 (4), 1990:1994 (3), 1995:2016 (1); *Switzerland*: 1990:1994 (3), 1995:2015 (1); *Iceland*: 1998:2016 (1); *Croatia*: 2001:2016 (1); *United States*: 1960:1969 (4), 1970:2015 (2);

Table 17: NOMINAL GOVERNMNET OUTLAYS (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Total general government expenditure (TE)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	10/14/16
(2)	GTE: Total General government expenditure	OECD: Dataset: 12. Government deficit/surplus, revenue, expenditure and main aggregates	Million units of national currency	10/18/17
(3)	Total general government expenditure (TE)	Eurostat: Government revenue, expenditure and main aggregates [gov_a_main], ESA 95	Million units of national currency	12/12/15
(4)	Total disbursements, general government, value	OECD: Dataset: Economic Outlook No 98 - November 2015	National currency	03/07/16
(5)	Total disbursements, general government, value	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1970:1994 (3), 1995:2016 (1); *Bulgaria*: 1998:2016 (1); *Czech Republic*: 1995:2016 (1); *Denmark*: 1971:1989 (4), 1990:1994 (3), 1995:2016 (1); *Germany*: 1991:1994 (3), 1995:2016 (1); *Estonia*: 1995:2016 (1); *Ireland*: 1960:1984 (5), 1985:1994 (3), 1995:2016 (1); *Greece*: 1960:1987 (5), 1988:1994 (3), 1995:2016 (1); *Spain*: 1964:1994 (4), 1995:2016 (1); *France*: 1978:2016 (1); *Italy*: 1960:1979 (4), 1980:1994 (3), 1995:2016 (1); *Cyprus*: 1995:2016 (1); *Latvia*: 1995:2016 (1); *Lithuania*: 1995:2016 (1); *Luxembourg*: 1990:1994 (3), 1995:2016 (1); *Hungary*: 1991:1994 (5), 1995:2016 (1); *Malta*: 1995:2016 (1); *Netherlands*: 1969:1994 (3), 1995:2016 (1); *Austria*: 1960:1975 (5), 1976:1994 (3), 1995:2016 (1); *Poland*: 1995:2016 (1); *Portugal*: 1977:1994 (3), 1995:2016 (1); *Romania*: 1998:2016 (1); *Slovenia*: 1995:2016 (1); *Slovak Republic*: 1993:1994 (3), 1995:2016 (1); *Finland*: 1960:1974 (4), 1975:2016 (1); *Sweden*: 1960:1992 (4), 1993:1994 (3), 1995:2016 (1); *United Kingdom*: 1970:1972 (4), 1973:1989 (3), 1990:2016 (1); *Norway*: 1960:1989 (4), 1990:1994 (3), 1995:2016 (1); *Switzerland*: 1990:1994 (3), 1995:2015 (1); *Iceland*: 1998:2016 (1); *Croatia*: 2001:2016 (1); *United States*: 1960:1969 (4), 1970:2015 (2);

Table 18: NOMINAL GOVERNMENT INTEREST PAYMENTS (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Interest, payable (D41P)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	10/14/17
(2)	GD41P: Interest	OECD: Dataset: 12. Government deficit/surplus, revenue, expenditure and main aggregates	Million units of national currency	10/18/17
(3)	Interest, payable (D41P)	Eurostat: Government revenue, expenditure and main aggregates [gov_a_main], ESA 95	Million units of national currency	12/12/15
(4)	Gross government interest payments, value	OECD: Dataset: Economic Outlook No 98 - November 2015	National currency	03/07/16
(5)	Gross government interest payments, value	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1970:1994 (3), 1995:2016 (1); *Bulgaria*: 1998:2016 (1); *Czech Republic*: 1995:2016 (1); *Denmark*: 1971:1994 (3), 1995:2016 (1); *Germany*: 1991:1994 (3), 1995:2016 (1); *Estonia*: 1993:1994 (3), 1995:2016 (1); *Ireland*: 1960:1984 (5), 1985:1994 (3), 1995:2016 (1); *Greece*: 1960:1987 (5), 1988:1994 (3), 1995:2016 (1); *Spain*: 1964:1994 (4), 1995:2016 (1); *France*: 1960:1977 (4), 1978:2016 (1); *Italy*: 1960:1979 (4), 1980:1994 (3), 1995:2016 (1); *Cyprus*: 1995:2016 (1); *Latvia*: 1995:2016 (1); *Lithuania*: 1995:2016 (1); *Luxembourg*: 1990:1994 (3), 1995:2016 (1); *Hungary*: 1991:1994 (5), 1995:2016 (1); *Malta*: 1995:2016 (1); *Netherlands*: 1969:1994 (3), 1995:2016 (1); *Austria*: 1960:1975 (4), 1976:1994 (3), 1995:2016 (1); *Poland*: 1991:1994 (3), 1995:2016 (1); *Portugal*: 1977:1994 (3), 1995:2016 (1); *Romania*: 1998:2016 (1); *Slovenia*: 1995:2016 (1); *Slovak Republic*: 1993:1994 (3), 1995:2016 (1); *Finland*: 1960:1974 (4), 1975:2016 (1); *Sweden*: 1960:1992 (4), 1993:1994 (3), 1995:2016 (1); *United Kingdom*: 1960:1969 (5), 1970:1989 (3), 1990:2016 (1); *Norway*: 1960:1989 (4), 1990:1994 (3), 1995:2016 (1); *Switzerland*: 1960:1989 (4), 1990:1994 (3), 1995:2015 (1); *Iceland*: 1998:2016 (1); *Croatia*: 2001:2016 (1); *United States*: 1960:1969 (4), 1970:2015 (2);

Table 19: NOMINAL GOVERNMENT INTEREST INCOME (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Interest, receivable (D41R)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	10/14/17
(2)	Gross government interest receipts, value	OECD: Dataset: Economic Outlook No 98 - November 2015	National currency	03/07/16
(3)	Gross government interest receipts, value	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1970:1994 (2), 1995:2016 (1); *Bulgaria*: 1998:2016 (1); *Czech Republic*: 1995:2016 (1); *Denmark*: 1971:1994 (2), 1995:2016 (1); *Germany*: 1991:1994 (2), 1995:2016 (1); *Estonia*: 1995:2016 (1); *Ireland*: 1960:1989 (3), 1990:1994 (2), 1995:2016 (1); *Greece*: 1960:1994 (3), 1995:2016 (1); *Spain*: 1964:1994 (2), 1995:2016 (1); *France*: 1960:1977 (2), 1978:2016 (1); *Italy*: 1960:1994 (2), 1995:2016 (1); *Cyprus*: 1995:2016 (1); *Latvia*: 1995:2016 (1); *Lithuania*: 1995:2016 (1); *Luxembourg*: 1990:1994 (2), 1995:2016 (1); *Hungary*: 1991:1994 (3), 1995:2016 (1); *Malta*: 1995:2016 (1); *Netherlands*: 1969:1994 (2), 1995:2016 (1); *Austria*: 1960:1994 (2), 1995:2016 (1); *Poland*: 1995:1998 (2), 1999:2016 (1); *Portugal*: 1977:1994 (2), 1995:2016 (1); *Romania*: 1998:2016 (1); *Slovenia*: 1995:2016 (1); *Slovak Republic*: 1994:1994 (3), 1995:2016 (1); *Finland*: 1960:1974 (2), 1975:2016 (1); *Sweden*: 1960:1994 (2), 1995:2016 (1); *United Kingdom*: 1970:1989 (2), 1990:2016 (1); *Norway*: 1960:1994 (2), 1995:2016 (1); *Switzerland*: 1960:1994 (2), 1995:2015 (1); *Iceland*: 1998:2016 (1); *Croatia*: 2001:2016 (1); *United States*: 1960:2014 (2);

Table 20: GROSS DEBT OF GOVERNMENT (PERCENT OF GDP) (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Consolidated gross debt[1]	Eurostat: Government deficit/surplus, debt and associated data [gov_10dd_edpt1], ESA 2010	Percentage of GDP	12/17/15
(2)	Gross debt of general government, percentage of GDP	OECD: National Accounts at a Glance	Percentage of GDP	12/16/15
(3)	General government consolidated gross debt :- Excessive deficit procedure (based on ESA 2010) and former definitions (linked series) (UDGGL)	AMECO: 18.2 Gross Public Debt: Based on ESA 2010 and former definitions (linked series)	Percentage of GDP	06/09/16
(4)	Total (domestic plus external) gross general government debt/GDP	Reinhart, Camen M. and Kenneth S. Rogoff, From Financial Crash to Debt Crisis, NBER Working Paper 15795, March 2010. Forthcoming in American Economic Review.	Percentage of GDP	06/09/16
(5)	Federal Debt: Total Public Debt as Percent of Gross Domestic Product[GFDEGDQ188S]	Federal Reserve Bank of St. Louis and US. Office of Management and Budget,Federal Debt: Total Public Debt as Percent of Gross Domestic Product[GFDEGDQ188S], retrieved from FRED, Federal Reserve Bank of St. Louis https://research.stlouisfed.org/fred2/series/GFDEGDQ188S, February 25, 2016.	Percentage of GDP	02/26/16

Notes: Linking method: linear.
[1] End-of-year values; Switzerland: H1 Public finances, Public sector; Swiss National Bank, Monthly Statistics Bulletin August 2015 (downloaded: 15.2.16, https://www.snb.ch/en/iabout/stat/statpub/statmon/stats/statmon/statmon_H1)

Data sets used by time and country

Belgium: 1969:1994 (3), 1995:2014 (1); *Bulgaria*: 1998:2014 (1); *Czech Republic*: 1995:2014 (1); *Denmark*: 1971:1994 (3), 1995:1999 (2), 2000:2014 (1); *Germany*: 1991:1994 (3), 1995:2014 (1); *Estonia*: 1995:2014 (1); *Ireland*: 1970:1994 (3), 1995:2014 (1); *Greece*: 1970:1994 (3), 1995:2014 (1); *Spain*: 1970:1994 (3), 1995:2014 (1); *France*: 1960:1976 (4), 1977:1994 (3), 1995:2014 (1); *Italy*: 1960:1994 (3), 1995:2014 (1); *Cyprus*: 1995:2014 (1); *Latvia*: 1995:2014 (1); *Lithuania*: 1995:2014 (1); *Luxembourg*: 1970:1994 (3),

1995:2014 (1); *Hungary*: 1995:2014 (1); *Malta*: 1995:2014 (1); *Netherlands*: 1960:1974 (4), 1975:1994 (3), 1995:2014 (1); *Austria*: 1970:1994 (3), 1995:2014 (1); *Poland*: 1995:2014 (1); *Portugal*: 1973:1994 (3), 1995:2014 (1); *Romania*: 1998:2014 (1); *Slovenia*: 1995:2014 (1); *Slovak Republic*: 1995:2014 (1); *Finland*: 1970:1994 (3), 1995:2014 (1); *Sweden*: 1970:1994 (3), 1995:2014 (1); *United Kingdom*: 1970:1994 (3), 1995:2014 (1); *Norway*: 1980:1994 (4), 1995:2010 (2), 2011:2014 (1); *Switzerland*: 1983:1994 (4), 1995:2014 (1); *United States*: 1966:1968 (5), 1969:1994 (3), 1995:2014 (2);

Table 21: NOMINAL SOCIAL BENEFITS (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Social benefits other than social transfers in kind (D62)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	12/16/15
(2)	GD62P: Social benefits other than social transfers in kind, payable	OECD: Dataset: 12. Government deficit/surplus, revenue, expenditure and main aggregates	Million units of national currency	02/24/16
(3)	Social benefits other than social transfers in kind (D62)	Eurostat: Government revenue, expenditure and main aggregates [gov_a_main], ESA 95	Million units of national currency	12/16/15
(4)	Social security benefits paid by general government, value	OECD: Dataset: Economic Outlook No 98 - November 2015	National currency	03/07/16
(5)	Social security benefits paid by general government, value	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1970:1994 (3), 1995:2014 (1); *Bulgaria*: 1998:2014 (1); *Czech Republic*: 1995:2014 (1); *Denmark*: 1970:1994 (3), 1995:2014 (1); *Germany*: 1991:1994 (3), 1995:2014 (1); *Estonia*: 1993:1994 (3), 1995:2014 (1); *Ireland*: 1960:1984 (5), 1985:1994 (3), 1995:2014 (1); *Greece*: 1960:1987 (5), 1988:1994 (3), 1995:2014 (1); *Spain*: 1964:1994 (4), 1995:2014 (1); *France*: 1960:1977 (4), 1978:2014 (1); *Italy*: 1960:1979 (4), 1980:1994 (3), 1995:2014 (1); *Cyprus*: 1995:2014 (1); *Latvia*: 1995:2014 (1); *Lithuania*: 1995:2014 (1); *Luxembourg*: 1990:1994 (3), 1995:2014 (1); *Hungary*: 1991:1994 (3), 1995:2014 (1); *Malta*: 1995:2014 (1); *Netherlands*: 1969:1994 (3), 1995:2014 (1); *Austria*: 1960:1975 (4), 1976:1994 (3), 1995:2014 (1); *Poland*: 1991:1994 (3), 1995:2014 (1); *Portugal*: 1977:1994 (3), 1995:2014 (1); *Romania*: 1998:2014 (1); *Slovenia*: 1995:2014 (1); *Slovak Republic*: 1993:1994 (3), 1995:2014 (1); *Finland*: 1960:1974 (4), 1975:2014 (1); *Sweden*: 1960:1992 (4), 1993:1994 (3), 1995:2014 (1); *United Kingdom*: 1960:1969 (5), 1970:1989 (3), 1990:2014 (1); *Norway*: 1960:1989 (4), 1990:1994 (3), 1995:2014 (1); *Switzerland*: 1990:1994 (3), 1995:2014 (1); *United States*: 1960:1969 (4), 1970:2014 (2);

Table 22: NOMINAL GOVERNMENT REVENUE (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Total general government revenue (TR)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	12/12/15
(2)	GTR: Total General government revenue	OECD: Dataset: 12. Government deficit/surplus, revenue, expenditure and main aggregates	Million units of national currency	02/24/16
(3)	Total general government revenue (TR)	Eurostat: Government revenue, expenditure and main aggregates [gov_a_main], ESA 95	Million units of national currency	12/12/15
(4)	Total receipts, general government, value	OECD: Dataset: Economic Outlook No 98 - November 2015	National currency	03/07/16
(5)	Total receipts, general government, value	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1970:1994 (3), 1995:2014 (1); *Bulgaria*: 1998:2014 (1); *Czech Republic*: 1995:2014 (1); *Denmark*: 1971:1989 (4), 1990:1994 (3), 1995:2014 (1); *Germany*: 1991:1994 (3), 1995:2014 (1); *Estonia*: 1995:2014 (1); *Ireland*: 1960:1984 (5), 1985:1994 (3), 1995:2014 (1); *Greece*: 1960:1987 (5), 1988:1994 (3), 1995:2014 (1); *Spain*: 1964:1994 (4), 1995:2014 (1); *France*: 1978:2014 (1); *Italy*: 1960:1979 (4), 1980:1994 (3), 1995:2014 (1); *Cyprus*: 1995:2014 (1); *Latvia*: 1995:2014 (1); *Lithuania*: 1995:2014 (1); *Luxembourg*: 1990:1994 (3), 1995:2014 (1); *Hungary*: 1991:1994 (5), 1995:2014 (1); *Malta*: 1995:2014 (1); *Netherlands*: 1969:1994 (3), 1995:2014 (1); *Austria*: 1960:1969 (5), 1970:1975 (4), 1976:1994 (3), 1995:2014 (1); *Poland*: 1995:2014 (1); *Portugal*: 1977:1994 (3), 1995:2014 (1); *Romania*: 1998:2014 (1); *Slovenia*: 1995:2014 (1); *Slovak Republic*: 1993:1994 (3), 1995:2014 (1); *Finland*: 1960:1974 (4), 1975:2014 (1); *Sweden*: 1960:1992 (4), 1993:1994 (3), 1995:2014 (1); *United Kingdom*: 1970:1989 (3), 1990:2014 (1); *Norway*: 1962:1989 (4), 1990:1994 (3), 1995:2014 (1); *Switzerland*: 1990:1994 (3), 1995:2014 (1); *United States*: 1960:1969 (4), 1970:2014 (2);

Table 23: NOMINAL GOVERNMNET OUTLAYS (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Total general government expenditure (TE)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	12/12/15
(2)	GTE: Total General government expenditure	OECD: Dataset: 12. Government deficit/surplus, revenue, expenditure and main aggregates	Million units of national currency	02/24/16
(3)	Total general government expenditure (TE)	Eurostat: Government revenue, expenditure and main aggregates [gov_a_main], ESA 95	Million units of national currency	12/12/15
(4)	Total disbursements, general government, value	OECD: Dataset: Economic Outlook No 98 - November 2015	National currency	03/07/16
(5)	Total disbursements, general government, value	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1970:1994 (3), 1995:2014 (1); *Bulgaria*: 1998:2014 (1); *Czech Republic*: 1995:2014 (1); *Denmark*: 1971:1989 (4), 1990:1994 (3), 1995:2014 (1); *Germany*: 1991:1994 (3), 1995:2014 (1); *Estonia*: 1995:2014 (1); *Ireland*: 1960:1984 (5), 1985:1994 (3), 1995:2014 (1); *Greece*: 1960:1987 (5), 1988:1994 (3), 1995:2014 (1); *Spain*: 1964:1994 (4), 1995:2014 (1); *France*: 1978:2014 (1); *Italy*: 1960:1979 (4), 1980:1994 (3), 1995:2014 (1); *Cyprus*: 1995:2014 (1); *Latvia*: 1995:2014 (1); *Lithuania*: 1995:2014 (1); *Luxembourg*: 1990:1994 (3), 1995:2014 (1); *Hungary*: 1991:1994 (5), 1995:2014 (1); *Malta*: 1995:2014 (1); *Netherlands*: 1969:1994 (3), 1995:2014 (1); *Austria*: 1960:1975 (5), 1976:1994 (3), 1995:2014 (1); *Poland*: 1995:2014 (1); *Portugal*: 1977:1994 (3), 1995:2014 (1); *Romania*: 1998:2014 (1); *Slovenia*: 1995:2014 (1); *Slovak Republic*: 1993:1994 (3), 1995:2014 (1); *Finland*: 1960:1974 (4), 1975:2014 (1); *Sweden*: 1960:1992 (4), 1993:1994 (3), 1995:2014 (1); *United Kingdom*: 1970:1972 (4), 1973:1989 (3), 1990:2014 (1); *Norway*: 1960:1989 (4), 1990:1994 (3), 1995:2014 (1); *Switzerland*: 1990:1994 (3), 1995:2014 (1); *United States*: 1960:1969 (4), 1970:2014 (2);

Table 24: NOMINAL GOVERNMENT INTEREST PAYMENTS (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Interest, payable (D41P)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	12/12/15
(2)	GD41P: Interest	OECD: Dataset: 12. Government deficit/surplus, revenue, expenditure and main aggregates	Million units of national currency	02/24/16
(3)	Interest, payable (D41P)	Eurostat: Government revenue, expenditure and main aggregates [gov_a_main], ESA 95	Million units of national currency	12/12/15
(4)	Gross government interest payments, value	OECD: Dataset: Economic Outlook No 98 - November 2015	National currency	03/07/16
(5)	Gross government interest payments, value	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1970:1994 (3), 1995:2014 (1); *Bulgaria*: 1998:2014 (1); *Czech Republic*: 1995:2014 (1); *Denmark*: 1971:1994 (3), 1995:2014 (1); *Germany*: 1991:1994 (3), 1995:2014 (1); *Estonia*: 1993:1994 (3), 1995:2014 (1); *Ireland*: 1960:1984 (5), 1985:1994 (3), 1995:2014 (1); *Greece*: 1960:1987 (5), 1988:1994 (3), 1995:2014 (1); *Spain*: 1964:1994 (4), 1995:2014 (1); *France*: 1960:1977 (4), 1978:2014 (1); *Italy*: 1960:1979 (4), 1980:1994 (3), 1995:2014 (1); *Cyprus*: 1995:2014 (1); *Latvia*: 1995:2014 (1); *Lithuania*: 1995:2014 (1); *Luxembourg*: 1990:1994 (3), 1995:2014 (1); *Hungary*: 1991:1994 (5), 1995:2014 (1); *Malta*: 1995:2014 (1); *Netherlands*: 1969:1994 (3), 1995:2014 (1); *Austria*: 1960:1975 (4), 1976:1994 (3), 1995:2014 (1); *Poland*: 1991:1994 (3), 1995:2014 (1); *Portugal*: 1977:1994 (3), 1995:2014 (1); *Romania*: 1998:2014 (1); *Slovenia*: 1995:2014 (1); *Slovak Republic*: 1993:1994 (3), 1995:2014 (1); *Finland*: 1960:1974 (4), 1975:2014 (1); *Sweden*: 1960:1992 (4), 1993:1994 (3), 1995:2014 (1); *United Kingdom*: 1960:1969 (5), 1970:1989 (3), 1990:2014 (1); *Norway*: 1960:1989 (4), 1990:1994 (3), 1995:2014 (1); *Switzerland*: 1960:1989 (4), 1990:1994 (3), 1995:2014 (1); *United States*: 1960:1969 (4), 1970:2014 (2);

Table 25: NOMINAL GOVERNMENT INTEREST INCOME (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Interest, receivable (D41R)	Eurostat: Government revenue, expenditure and main aggregates [gov_10a_main], ESA 2010	Million units of national currency	03/07/16
(2)	Gross government interest receipts, value	OECD: Dataset: Economic Outlook No 98 - November 2015	National currency	03/07/16
(3)	Gross government interest receipts, value	OECD: Dataset: OECD Economic Outlook No. 86 (Edition 2009/2)	National currency	03/07/16

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1970:1994 (2), 1995:2014 (1); *Bulgaria*: 1998:2014 (1); *Czech Republic*: 1995:2014 (1); *Denmark*: 1971:1994 (2), 1995:2014 (1); *Germany*: 1991:1994 (2), 1995:2014 (1); *Estonia*: 1995:2014 (1); *Ireland*: 1960:1989 (3), 1990:1994 (2), 1995:2014 (1); *Greece*: 1960:1994 (3), 1995:2014 (1); *Spain*: 1964:1994 (2), 1995:2014 (1); *France*: 1960:1977 (2), 1978:2014 (1); *Italy*: 1960:1994 (2), 1995:2014 (1); *Cyprus*: 1995:2014 (1); *Latvia*: 1995:2014 (1); *Lithuania*: 1995:2014 (1); *Luxembourg*: 1990:1994 (2), 1995:2014 (1); *Hungary*: 1991:1994 (3), 1995:2014 (1); *Malta*: 1995:2014 (1); *Netherlands*: 1969:1994 (2), 1995:2014 (1); *Austria*: 1960:1994 (2), 1995:2014 (1); *Poland*: 1995:1998 (2), 1999:2014 (1); *Portugal*: 1977:1994 (2), 1995:2014 (1); *Romania*: 1998:2014 (1); *Slovenia*: 1995:2014 (1); *Slovak Republic*: 1994:1994 (3), 1995:2014 (1); *Finland*: 1960:1974 (2), 1975:2014 (1); *Sweden*: 1960:1994 (2), 1995:2014 (1); *United Kingdom*: 1970:1989 (2), 1990:2014 (1); *Norway*: 1960:1994 (2), 1995:2014 (1); *Switzerland*: 1960:1994 (2), 1995:2014 (1); *United States*: 1960:2014 (2);

Table 26: STATUTORY LABOR TAX RATE

#	Series Name	Source	Unit	Download
(1)	Top personal income tax rates	DG Taxation and Customs Union > Statutory tax rates; http://ec.europa.eu/taxation_customs/taxation/gen_info/economic_analysis/data_on_taxation/index_en.htm	Percent Per Annum	03/14/16
(2)	Top statutory personal income tax rates	OECD SNA 2008: OECD: Table I.7. Top statutory personal income tax rate and top marginal tax rates for employees	Percent per Annum	03/13/16

Notes: Linking method: linear.

Data sets used by time and country

Belgium: 1995:2014 (1); *Bulgaria*: 1995:2014 (1); *Czech Republic*: 1995:2014 (1); *Denmark*: 1995:2014 (1); *Germany*: 1995:2014 (1); *Estonia*: 1995:2014 (1); *Ireland*: 1995:2014 (1); *Greece*: 1995:2014 (1); *Spain*: 1995:2014 (1); *France*: 1995:2014 (1); *Italy*: 1995:2014 (1); *Cyprus*: 1995:2014 (1); *Latvia*: 1995:2014 (1); *Lithuania*: 1995:2014 (1); *Luxembourg*: 1995:2014 (1); *Hungary*: 1995:2014 (1); *Malta*: 1995:2014 (1); *Netherlands*: 1995:2014 (1); *Austria*: 1995:2014 (1); *Poland*: 1995:2014 (1); *Portugal*: 1995:2014 (1); *Romania*: 1995:2014 (1); *Slovenia*: 1995:2014 (1); *Slovak Republic*: 2000:2014 (2); *Finland*: 1995:2014 (1); *Sweden*: 1995:2014 (1); *United Kingdom*: 1995:2014 (1); *Norway*: 1995:2014 (1); *Switzerland*: 2000:2014 (2); *United States*: 2000:2014 (2);

Table 27: STATUTORY CAPITAL TAX RATE

#	Series Name	Source	Unit	Download
(1)	Top corporate income tax rate	DG Taxation and Customs Union > Statutory tax rates; http://ec.europa.eu/taxation_customs/taxation/gen_info/economic_analysis/data_on_taxation/index_en.htm	Percent Per Annum	03/14/16
(2)	Combined corporate income tax rate	OECD SNA 2008: OECD: Table II.1. Corporate income tax rate	Percent per Annum	03/13/16

Notes: Linking method: linear.

Data sets used by time and country

Belgium: 1995:2014 (1); *Bulgaria*: 1995:2014 (1); *Czech Republic*: 1995:2014 (1); *Denmark*: 1995:2014 (1); *Germany*: 1995:2014 (1); *Estonia*: 1995:2014 (1); *Ireland*: 1995:2014 (1); *Greece*: 1995:2014 (1); *Spain*: 1995:2014 (1); *France*: 1995:2014 (1); *Italy*: 1995:2014 (1); *Cyprus*: 1995:2014 (1); *Latvia*: 1995:2014 (1); *Lithuania*: 1995:2014 (1); *Luxembourg*: 1995:2014 (1); *Hungary*: 1995:2014 (1); *Malta*: 1995:2014 (1); *Netherlands*: 1995:2014 (1); *Austria*: 1995:2014 (1); *Poland*: 1995:2014 (1); *Portugal*: 1995:2014 (1); *Romania*: 1995:2014 (1); *Slovenia*: 1995:2014 (1); *Slovak Republic*: 2000:2014 (2); *Finland*: 1995:2014 (1); *Sweden*: 1995:2014 (1); *United Kingdom*: 1995:2014 (1); *Norway*: 1995:2014 (1); *Switzerland*: 2000:2014 (2); *United States*: 2000:2014 (2);

Table 28: STATUTORY VAT (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Value added tax, Standard rate	VAT Rates Applied in the Member States of the European Union, Situation at 1st September 2015, Tabel VIII. The Evolution of VAT Rates Applicable in the Member States	Percent Per Annum	9/4/16
(2)	Value added tax, Standard rate	TaxNorway (skatteetaten.no), e-mail by Anders Lund	Percent Per Annum	3/13/16
(3)	Value added tax, Standard rate	Federal Tax Administration, Switzerland; https://www.estv.admin.ch/estv/de/home/mehrwertsteuer/fachinformationen/steuersaetze/entwicklung-mwst.html	Percent Per Annum	3/13/16

Data sets used by time and country

Belgium: 1971:2014.75 (1); *Bulgaria*: 1994.25:2014.75 (1); *Czech Republic*: 1993:2014.75 (1); *Denmark*: 1967.5:2014.75 (1); *Germany*: 1968:2014.75 (1); *Estonia*: 1991:2014.75 (1); *Ireland*: 1972.75:2014.75 (1); *Greece*: 1987:2014.75 (1); *Spain*: 1986:2014.75 (1); *France*: 1970:2014.75 (1); *Italy*: 1973:2014.75 (1); *Cyprus*: 1992.5:2014.75 (1); *Latvia*: 1995.25:2014.75 (1); *Lithuania*: 1994.25:2014.75 (1); *Luxembourg*: 1970:2014.75 (1); *Hungary*: 1988:2014.75 (1); *Malta*: 1995:2014.75 (1); *Netherlands*: 1969:2014.75 (1); *Austria*: 1973:2014.75 (1); *Poland*: 1993.5:2014.75 (1); *Portugal*: 1986:2014.75 (1); *Romania*: 1993.5:2014.75 (1); *Slovenia*: 1999.5:2014.75 (1); *Slovak Republic*: 1993:2014.75 (1); *Finland*: 1994.25:2014.75 (1); *Sweden*: 1969:2014.75 (1); *United Kingdom*: 1973.25:2014.75 (1); *Norway*: 1970:2014.75 (2); *Switzerland*: 1995:2014.75 (3);

Table 29: CONSUMER PRICE INDEX AT CONSTANT TAX RATES (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	All-Items HICP at constant taxes[1]	Eurostat: HICP_ct (2005 = 100) - monthly data (index) [prc_hicp_cind]	Index, 2005=100	9/5/16

Notes:

[1] Monthly data aggregated to quarterly data (log-linear averages)

Data sets used by time and country

Belgium: 2003:2014.75 (1); *Bulgaria*: 2003:2014.75 (1); *Czech Republic*: 2003:2014.75 (1); *Denmark*: 2003:2014.75 (1); *Germany*: 2003:2014.75 (1); *Estonia*: 2003:2014.75 (1); *Ireland*: 2003:2014.75 (1); *Greece*: 2003:2014.75 (1); *Spain*: 2003:2014.75 (1); *France*: 2003:2014.75 (1); *Italy*: 2003:2014.75 (1); *Cyprus*: 2003:2014.75 (1); *Latvia*: 2003:2014.75 (1); *Lithuania*: 2003:2014.75 (1); *Luxembourg*: 2003:2014.75 (1); *Hungary*: 2003:2014.75 (1); *Malta*: 2003:2014.75 (1); *Netherlands*: 2003:2014.75 (1); *Austria*: 2003:2014.75 (1); *Poland*: 2003:2014.75 (1); *Portugal*: 2003:2014.75 (1); *Romania*: 2003:2014.75 (1); *Slovenia*: 2003:2014.75 (1); *Slovak Republic*: 2003:2014.75 (1); *Finland*: 2005:2014.75 (1); *Sweden*: 2003:2014.75 (1); *United Kingdom*: 2003:2014.75 (1); *Norway*: 2012.75:2014.75 (1);

Table 30: STATUTORY LABOR TAX RATE (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Top personal income tax rates	DG Taxation and Customs Union ¿ Statutory tax rates; http://ec.europa.eu/taxation_customs/taxation/gen_info/economic_analysis/data_on_taxation/index_en.htm	Percent Per Annum	03/14/16
(2)	Top statutory personal income tax rates	OECD SNA 2008: OECD: Table I.7. Top statutory personal income tax rate and top marginal tax rates for employees	Percent per Annum	03/13/16

Notes: Linking method: linear.

Data sets used by time and country

Belgium: 1995:2014 (1); *Bulgaria*: 1995:2014 (1); *Czech Republic*: 1995:2014 (1); *Denmark*: 1995:2014 (1); *Germany*: 1995:2014 (1); *Estonia*: 1995:2014 (1); *Ireland*: 1995:2014 (1); *Greece*: 1995:2014 (1); *Spain*: 1995:2014 (1); *France*: 1995:2014 (1); *Italy*: 1995:2014 (1); *Cyprus*: 1995:2014 (1); *Latvia*: 1995:2014 (1); *Lithuania*: 1995:2014 (1); *Luxembourg*: 1995:2014 (1); *Hungary*: 1995:2014 (1); *Malta*: 1995:2014 (1); *Netherlands*: 1995:2014 (1); *Austria*: 1995:2014 (1); *Poland*: 1995:2014 (1); *Portugal*: 1995:2014 (1); *Romania*: 1995:2014 (1); *Slovenia*: 1995:2014 (1); *Slovak Republic*: 2000:2014 (2); *Finland*: 1995:2014 (1); *Sweden*: 1995:2014 (1); *United Kingdom*: 1995:2014 (1); *Norway*: 1995:2014 (1); *Switzerland*: 2000:2014 (2); *Iceland*: 1995:2014 (1); *Croatia*: 1995:2014 (1); *United States*: 2000:2014 (2);

Table 31: STATUTORY CAPITAL TAX RATE (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Top corporate income tax rate	DG Taxation and Customs Union ¿ Statutory tax rates; http://ec.europa.eu/taxation_customs/taxation/gen_info/economic_analysis/data_on_taxation/index_en.htm	Percent Per Annum	03/14/16
(2)	Combined corporate income tax rate	OECD SNA 2008: OECD: Table II.1. Corporate income tax rate	Percent per Annum	03/13/16

Notes: Linking method: linear.

Data sets used by time and country

Belgium: 1995:2014 (1); *Bulgaria*: 1995:2014 (1); *Czech Republic*: 1995:2014 (1); *Denmark*: 1995:2014 (1); *Germany*: 1995:2014 (1); *Estonia*: 1995:2014 (1); *Ireland*: 1995:2014 (1); *Greece*: 1995:2014 (1); *Spain*: 1995:2014 (1); *France*: 1995:2014 (1); *Italy*: 1995:2014 (1); *Cyprus*: 1995:2014 (1); *Latvia*: 1995:2014 (1); *Lithuania*: 1995:2014 (1); *Luxembourg*: 1995:2014 (1); *Hungary*: 1995:2014 (1); *Malta*: 1995:2014 (1); *Netherlands*: 1995:2014 (1); *Austria*: 1995:2014 (1); *Poland*: 1995:2014 (1); *Portugal*: 1995:2014 (1); *Romania*: 1995:2014 (1); *Slovenia*: 1995:2014 (1); *Slovak Republic*: 2000:2014 (2); *Finland*: 1995:2014 (1); *Sweden*: 1995:2014 (1); *United Kingdom*: 1995:2014 (1); *Norway*: 1995:2014 (1); *Switzerland*: 2000:2014 (2); *Iceland*: 1995:2014 (1); *Croatia*: 1995:2014 (1); *United States*: 2000:2014 (2);

Table 32: HOUSEHOLD DEBT (ANNUAL)

#	Series Name	Source	Unit	Download
(1)	Total credit to households and NPISHs, adjusted for breaks [...H:A:M:XDC:A][1]	Bank of International Settlements: Long series on total credit to the non-financial sectors	Domestic currency (billions)	7/29/16
(2)	Household Debt Securities (F3), Liabilities + Household Loans (F4), Liabilities	Eurostat: Annual sector accounts > Financial flows and stocks > Financial balance sheets (nasa_10_f_bs), ESA 2010	Million units of national currency	7/29/16
(3)	Total credit to private sector, adjusted for breaks [...P:A:M:XDC:A][1]	Bank of International Settlements: Long series on total credit to the non-financial sectors	Domestic currency (billions)	7/29/16

Notes: Linking method: growth.
[1] Data has been annualized by retaining the last quarter of a year.

Data sets used by time and country

Belgium: 1970:1979 (3), 1980:2014 (1); *Bulgaria*: 2000:2014 (2); *Czech Republic*: 1993:1994 (3), 1995:2014 (1); *Denmark*: 1960:1993 (3), 1994:2014 (1); *Germany*: 1960:1969 (3), 1970:2014 (1); *Estonia*: 1995:2014 (2); *Ireland*: 1971:2000 (3), 2001:2001 (2), 2002:2014 (1); *Greece*: 1960:1993 (3), 1994:2014 (1); *Spain*: 1970:1979 (3), 1980:2014 (1); *France*: 1969:1976 (3), 1977:2014 (1); *Italy*: 1960:2014 (1); *Cyprus*: 1995:2014 (2); *Latvia*: 1995:2014 (2); *Lithuania*: 1995:2014 (2); *Luxembourg*: 2002:2014 (1); *Hungary*: 1989:2014 (1); *Malta*: 2004:2014 (2); *Netherlands*: 1961:1989 (3), 1990:2014 (1); *Austria*: 1960:1994 (3), 1995:2014 (1); *Poland*: 1992:1994 (3), 1995:2014 (1); *Portugal*: 1960:1978 (3), 1979:2014 (1); *Romania*: 1998:2014 (2); *Slovenia*: 2001:2014 (2); *Slovak Republic*: 1995:2014 (2); *Finland*: 1970:2014 (1); *Sweden*: 1961:1979 (3), 1980:2014 (1); *United Kingdom*: 1963:1965 (3), 1966:2014 (1); *Norway*: 1960:1974 (3), 1975:2014 (1); *Switzerland*: 1960:1998 (3), 1999:2014 (1); *United States*: 1960:2014 (1);

B.3 Quarterly Data

When reporting time periods for quarterly data, we write e.g. 2004.75 to refer to the fourth quarter of 2004, and 2004 to refer to the first quarter of 2004.

Annual population data is interpolated to quarterly data using log-linear interpolation.

Table 33: REAL GDP (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Gross domestic product (line 1), s.a.[1]	BEA: Table 1.1.6. Real Gross Domestic Product, Chained Dollars	Billions of chained (2009) dollars	06/23/15
(2)	Gross domestic product at market prices, s.a. and adj. for working days	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Chain linked volumes (2010), million euro	02/15/18
(3)	Gross domestic product at market prices, s.a.	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Chain linked volumes (2010), million euro	02/14/18
(4)	Gross domestic product - expenditure approach, VPVOBARSA[2]	OECD: Quarterly National Accounts	US Dollar, millions, 2010	12/12/15
(5)	Gross domestic product at market prices, s.a. and adj. for working days[3]	Eurostat: GDP and main components - volumes [nama_gdp_k], ESA 95	Million euro, chain-linked volumes, reference year 2005 (at 2005 exchange rates)	12/15/15

Notes: Linking method: growth.
[1] Data has been converted into 2010 million euro using the conversion factor 867.33.
[2] Data has been converted into 2010 million euro using the conversion factor 0.85687.
[3] Data has been converted into 2010 million euro using the conversion factor 4.3415.

Data sets used by time and country

Belgium: 1960:1994.75 (4), 1995:2017.5 (2); *Bulgaria*: 1998:1999.75 (5), 2000:2017.5 (2); *Czech Republic*: 1995:1995.75 (4), 1996:2017.5 (2); *Denmark*: 1960:1994.75 (4), 1995:2017.5 (2); *Germany*: 1991:2017.5 (2); *Estonia*: 1995:2017.5 (2); *Ireland*: 1960:1994.75 (4), 1995:2017.5 (2); *Greece*: 1960:1994.75 (4), 1995:2017.5 (2); *Spain*: 1960:1994.75 (4), 1995:2017.5 (2); *France*: 1960:1974.75 (4), 1975:2017.5 (2); *Italy*: 1960:1994.75 (4), 1995:2017.5 (2); *Cyprus*: 1995:2017.5 (2); *Latvia*: 1995:2017.5 (2); *Lithuania*: 1995:2017.5 (2); *Luxembourg*: 1960:1994.75 (4), 1995:2017.5 (2); *Hungary*: 1995:2017.5 (2); *Malta*: 2000:2017.5 (2); *Netherlands*: 1960:1995.75 (4), 1996:2017.5 (2); *Austria*: 1960:1995.75 (4), 1996:2017.5 (2); *Poland*: 1995:2001.75 (4), 2002:2017.5 (2); *Portugal*: 1960:1994.75 (4), 1995:2017.5 (2); *Romania*: 1998:2017.5 (2); *Slovenia*: 1995:2017.5 (2); *Slovak Republic*: 1993:1994.75 (4), 1995:2017.5 (3); *Finland*: 1960:1989.75 (4), 1990:2017.5 (2); *Sweden*: 1960:1992.75 (4), 1993:2017.5 (2);

United Kingdom: 1960:1974.75 (4), 1975:2017.5 (2); *Norway*: 1960:1977.75 (4), 1978:2017.5 (2); *Switzerland*: 1960:1979.75 (4), 1980:2017.5 (2); *Iceland*: 1997:2017.5 (3); *Croatia*: 2000:2017.5 (2); *United States*: 1960:2015 (1);

Table 34: GROSS DEBT OF GOVERNMENT (PERCENT OF GDP) (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Government consolidated gross debt, n.s.a.	Eurostat: Quarterly government debt [gov_10q_ggdebt], ESA 2010	Percentage of GDP	12/17/15
(2)	General government: Total gross debt, n.s.a.	OECD: Public Sector Debt, consolidated, nominal value	Percentage of GDP	12/17/15
(3)	Government consolidated gross debt, n.s.a.	Eurostat: Quarterly government debt [gov_q_ggdebt], ESA 95	Percentage of GDP	12/17/15

Notes: Linking method: linear.

Data sets used by time and country

Belgium: 1995.75:1999.75 (2), 2000:2015.25 (1); *Bulgaria*: 2000:2015.25 (1); *Czech Republic*: 2000:2015.25 (1); *Denmark*: 2000:2015.25 (1); *Germany*: 2000:2015.25 (1); *Estonia*: 1995.75:1999.75 (2), 2000:2015.25 (1); *Ireland*: 1997.75:1999.75 (2), 2000:2015.25 (1); *Greece*: 2000:2005.5 (3), 2005.75:2015.25 (1); *Spain*: 1995.75:1999.75 (2), 2000:2015.25 (1); *France*: 1995.75:1999.75 (2), 2000:2015.25 (1); *Italy*: 1995.75:1999.75 (2), 2000:2015.25 (1); *Cyprus*: 2000:2015.25 (1); *Latvia*: 2000:2015.25 (1); *Lithuania*: 2000:2015.25 (1); *Luxembourg*: 2000:2000.5 (3), 2000.75:2015.25 (1); *Hungary*: 1995.75:1999.75 (2), 2000:2015.25 (1); *Malta*: 2000.75:2015.25 (1); *Netherlands*: 1995.75:1999.75 (2), 2000:2015.25 (1); *Austria*: 2000:2015.25 (1); *Poland*: 2000:2002.5 (3), 2002.75:2015.25 (1); *Portugal*: 1995.75:1999.75 (2), 2000:2015.25 (1); *Romania*: 2000:2015.25 (1); *Slovenia*: 2000:2015.25 (1); *Slovak Republic*: 2000:2015.25 (1); *Finland*: 2000:2015.25 (1); *Sweden*: 1995.75:1999.75 (2), 2000:2015.25 (1); *United Kingdom*: 1995:1999.75 (2), 2000:2015.25 (1); *Norway*: 2000:2015.25 (1); *Switzerland*: 1995.75:2014.75 (2); *Croatia*: 2001.75:2015.25 (1); *United States*: 1960.75:2014.75 (2);

Table 35: NOMINAL GDP (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Gross domestic product (line 1), s.a.	BEA: Table 1.1.5. Gross Domestic Product	Billions of dollars	06/23/15
(2)	Gross domestic product at market prices, s.a. and adj. for working days	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Million units of national currency	02/15/18
(3)	Gross domestic product at market prices, s.a.	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Million units of national currency	02/14/18
(4)	Gross domestic product at market prices, s.a. and adj. for working days	Eurostat: GDP and main components - volumes [nama_gdp_k], ESA 95	Million units of national currency	12/15/15
(5)	Gross domestic product - expenditure approach, CARSA	OECD: Quarterly National Accounts	Million units of national currency	12/12/15

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1960:1979.75 (5), 1980:1994.75 (4), 1995:2017.5 (2); *Bulgaria*: 1998:1999.75 (4), 2000:2017.5 (2); *Czech Republic*: 1995:2017.5 (2); *Denmark*: 1960:1989.75 (5), 1990:1994.75 (4), 1995:2017.5 (2); *Germany*: 1991:2017.5 (2); *Estonia*: 1995:2017.5 (2); *Ireland*: 1960:1994.75 (5), 1995:2017.5 (2); *Greece*: 1960:1994.75 (5), 1995:2017.5 (2); *Spain*: 1960:1979.75 (5), 1980:1994.75 (4), 1995:2017.5 (2); *France*: 1960:1974.75 (5), 1975:2017.5 (2); *Italy*: 1960:1989.75 (5), 1990:1994.75 (4), 1995:2017.5 (2); *Cyprus*: 1995:2017.5 (2); *Latvia*: 1995:2017.5 (2); *Lithuania*: 1995:2017.5 (2); *Luxembourg*: 1960:1994.75 (5), 1995:2017.5 (2); *Hungary*: 1995:2017.5 (2); *Malta*: 2000:2017.5 (2); *Netherlands*: 1960:1986.75 (5), 1987:1994.75 (4), 1995:2017.5 (2); *Austria*: 1960:1987.75 (5), 1988:1995.75 (4), 1996:2017.5 (2); *Poland*: 1995:2001.75 (4), 2002:2017.5 (2); *Portugal*: 1960:1994.75 (5), 1995:2017.5 (2); *Romania*: 1998:2017.5 (2); *Slovenia*: 1995:2017.5 (2); *Slovak Republic*: 1993:1994.75 (4), 1995:2017.5 (3); *Finland*: 1960:1974.75 (5), 1975:1989.75 (4), 1990:2017.5 (2); *Sweden*: 1960:1992.75 (5), 1993:2017.5 (2); *United Kingdom*: 1960:1994.75 (4), 1995:2017.5 (2); *Norway*: 1960:1977.75 (5), 1978:2017.5 (2); *Switzerland*: 1960:1979.75 (5), 1980:2017.5 (2); *Iceland*: 1997:2017.5 (3); *Croatia*: 2000:2017.5 (2); *United States*: 1960:2015 (1);

Table 36: REAL CONSUMPTION (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Personal consumption expenditures (line 2), s.a.[1]	BEA: Table 1.1.6. Real Gross Domestic Product, Chained Dollars	Billions of chained (2009) dollars	06/23/15
(2)	Household and NPISH final consumption expenditure, s.a. and adj. for working days	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Chain linked volumes (2010), million euro	02/15/18
(3)	Household and NPISH final consumption expenditure, s.a.	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Chain linked volumes (2010), million euro	02/14/18
(4)	Household and NPISH final consumption expenditure, s.a. and adj. for working days[2]	Eurostat: GDP and main components - volumes [nama_gdp_k], ESA 95	Million euro, chain-linked volumes, reference year 2005 (at 2005 exchange rates)	12/15/15
(6)	Private final consumption expenditure, VPVOBARSA[3]	OECD: Quarterly National Accounts	US Dollar, millions, 2010	12/12/15

Notes: Linking method: growth.
[1] Data has been converted into 2010 million euro using the conversion factor 867.33.
[2] Data has been converted into 2010 million euro using the conversion factor 4.3415.
[3] Data has been converted into 2010 million euro using the conversion factor 0.85687.

Data sets used by time and country

Belgium: 1960:1979.75 (6), 1980:1994.75 (4), 1995:2017.5 (2); *Bulgaria*: 1998:1999.75 (4), 2000:2017.5 (2); *Czech Republic*: 1995:1995.75 (6), 1996:2017.5 (2); *Denmark*: 1960:1989.75 (6), 1990:1994.75 (4), 1995:2017.5 (2); *Germany*: 1991:2017.5 (2); *Estonia*: 1995:2017.5 (2); *Ireland*: 1960:1994.75 (6), 1995:2017.5 (2); *Greece*: 1960:1994.75 (6), 1995:2017.5 (2); *Spain*: 1960:1994.75 (6), 1995:2017.5 (2); *France*: 1960:1979.75 (6), 1980:2017.5 (2); *Italy*: 1960:1990.75 (6), 1991:1995.75 (4), 1996:2017.5 (2); *Cyprus*: 1995:2017.5 (2); *Latvia*: 1995:2017.5 (2); *Lithuania*: 1995:2017.5 (2); *Luxembourg*: 1960:1994.75 (6), 1995:2017.5 (2); *Hungary*: 1995:2017.5 (2); *Malta*: 2000:2017.5 (2); *Netherlands*: 1960:1987.75 (6), 1988:1995.75 (4), 1996:2017.5 (2); *Austria*: 1960:1987.75 (6), 1988:1995.75 (4), 1996:2017.5 (2); *Poland*: 1995:2001.75 (4), 2002:2017.5 (2); *Portugal*: 1960:1994.75 (6), 1995:2017.5 (2); *Romania*: 1998:2017.5 (2); *Slovenia*: 1995:2017.5 (2); *Slovak Republic*: 1993:1994.75 (6), 1995:2017.5 (3); *Finland*: 1960:1974.75 (6),

1975:1989.75 (4), 1990:2017.5 (2); *Sweden*: 1960:1992.75 (6), 1993:2017.5 (2); *United Kingdom*: 1960:1962.75 (6), 1963:1994.75 (4), 1995:2017.5 (2); *Norway*: 1960:1977.75 (6), 1978:2017.5 (2); *Switzerland*: 1960:1979.75 (6), 1980:2017.5 (2); *Iceland*: 1997:2017.5 (3); *Croatia*: 2000:2017.5 (2); *United States*: 1960:2015 (1);

Table 37: REAL GROSS FIXED CAPITAL FORMATION (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Gross fixed capital formation, s.a. and adj. for working days	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Chain linked volumes (2010), million euro	02/15/18
(2)	Gross fixed capital formation, s.a.	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Chain linked volumes (2010), million euro	02/14/18
(3)	Gross fixed capital formation, s.a. and adj. for working days[1]	Eurostat: GDP and main components - volumes [nama_gdp_k], ESA 95	Million euro, chain-linked volumes, reference year 2005 (at 2005 exchange rates)	12/15/15
(5)	Gross fixed capital formation, VPVOBARSA[2]	OECD: Quarterly National Accounts	US Dollar, millions, 2010	12/12/15

Notes: Linking method: growth.
[1] Data has been converted into 2010 million euro using the conversion factor 4.3415.
[2] Data has been converted into 2010 million euro using the conversion factor 0.85687.

Data sets used by time and country

Belgium: 1960:1979.75 (5), 1980:1994.75 (3), 1995:2017.5 (1); *Bulgaria*: 1998:1999.75 (3), 2000:2017.5 (1); *Czech Republic*: 1995:1995.75 (5), 1996:2017.5 (1); *Denmark*: 1960:1989.75 (5), 1990:1994.75 (3), 1995:2017.5 (1); *Germany*: 1991:2017.5 (1); *Estonia*: 1995:2017.5 (1); *Ireland*: 1960:1994.75 (5), 1995:2017.5 (1); *Greece*: 1960:1994.75 (5), 1995:2017.5 (1); *Spain*: 1960:1994.75 (5), 1995:2017.5 (1); *France*: 1960:1974.75 (5), 1975:2017.5 (1); *Italy*: 1960:1990.75 (5), 1991:1995.75 (3), 1996:2017.5 (1); *Cyprus*: 1995:2017.5 (1); *Latvia*: 1995:2017.5 (1); *Lithuania*: 1995:2017.5 (1); *Luxembourg*: 1960:1994.75 (5), 1995:2017.5 (1); *Hungary*: 1995:2017.5 (1); *Malta*: 2000:2017.5 (1); *Netherlands*: 1960:1987.75 (5), 1988:1995.75 (3), 1996:2017.5 (1); *Austria*: 1960:1987.75 (5), 1988:1995.75 (3), 1996:2017.5 (1); *Poland*: 1995:2001.75 (3), 2002:2017.5 (1); *Portugal*: 1960:1994.75 (5), 1995:2017.5 (1); *Romania*: 1998:2017.5 (1); *Slovenia*: 1995:2017.5 (1); *Slovak Republic*: 1993:1994.75 (5), 1995:2017.5 (2); *Finland*: 1960:1974.75 (5), 1975:1989.75 (3), 1990:2017.5 (1); *Sweden*: 1960:1992.75 (5), 1993:2017.5 (1); *United Kingdom*: 1960:1962.75 (5), 1963:1994.75 (3), 1995:2017.5 (1); *Norway*: 1960:1977.75 (5), 1978:2017.5 (1); *Switzerland*: 1960:1979.75 (5), 1980:2017.5 (1); *Iceland*: 1997:2017.5

(2); *Croatia*: 2000:2017.5 (1); *United States*: 1960:2014.75 (5), 1970:2014.25 (3);

Table 38: NOMINAL EXPORTS (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Exports (line 16), s.a.	BEA: Table 1.1.5. Gross Domestic Product	Billions of dollars	06/23/15
(2)	Exports of goods and services, s.a. and adj. for working days	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Million units of national currency	02/15/18
(3)	Exports of goods and services, s.a.	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Million units of national currency	02/14/18
(4)	Exports of goods and services, s.a. and adj. for working days	Eurostat: GDP and main components - volumes [nama_gdp_k], ESA 95	Million units of national currency	12/15/15
(5)	Exports of goods and services, CARSA	OECD: Quarterly National Accounts	Million units of national currency	12/12/15

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1960:1979.75 (5), 1980:1994.75 (4), 1995:2017.5 (2); *Bulgaria*: 1998:1999.75 (4), 2000:2017.5 (2); *Czech Republic*: 1995:2017.5 (2); *Denmark*: 1960:1989.75 (5), 1990:1994.75 (4), 1995:2017.5 (2); *Germany*: 1991:2017.5 (2); *Estonia*: 1995:2017.5 (2); *Ireland*: 1960:1994.75 (5), 1995:2017.5 (2); *Greece*: 1960:1994.75 (5), 1995:2017.5 (2); *Spain*: 1960:1979.75 (5), 1980:1994.75 (4), 1995:2017.5 (2); *France*: 1960:1974.75 (5), 1975:2017.5 (2); *Italy*: 1960:1989.75 (5), 1990:1994.75 (4), 1995:2017.5 (2); *Cyprus*: 1995:2017.5 (2); *Latvia*: 1995:2017.5 (2); *Lithuania*: 1995:2017.5 (2); *Luxembourg*: 1960:1994.75 (5), 1995:2017.5 (2); *Hungary*: 1995:2017.5 (2); *Malta*: 2000:2017.5 (2); *Netherlands*: 1960:1987.75 (5), 1988:1994.75 (4), 1995:2017.5 (2); *Austria*: 1960:1987.75 (5), 1988:1995.75 (4), 1996:2017.5 (2); *Poland*: 1995:2001.75 (4), 2002:2017.5 (2); *Portugal*: 1960:1994.75 (5), 1995:2017.5 (2); *Romania*: 1998:2017.5 (2); *Slovenia*: 1995:2017.5 (2); *Slovak Republic*: 1993:1994.75 (5), 1995:2017.5 (3); *Finland*: 1960:1974.75 (5), 1975:1989.75 (4), 1990:2017.5 (2); *Sweden*: 1960:1992.75 (5), 1993:2017.5 (2); *United Kingdom*: 1960:1994.75 (4), 1995:2017.5 (2); *Norway*: 1960:1977.75 (5), 1978:2017.5 (2); *Switzerland*: 1960:1979.75 (5), 1980:2017.5 (2); *Iceland*: 1997:2017.5 (3); *Croatia*: 2000:2017.5 (2); *United States*: 1960:2015 (1);

Table 39: NOMINAL IMPORTS (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Imports (line 19), s.a.	BEA: Table 1.1.5. Gross Domestic Product	Billions of dollars	06/23/15
(2)	Imports of goods and services, s.a. and adj. for working days	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Million units of national currency	02/15/18
(3)	Imports of goods and services, s.a.	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Million units of national currency	02/14/18
(4)	Imports of goods and services, s.a. and adj. for working days	Eurostat: GDP and main components - volumes [nama_gdp_k], ESA 95	Million units of national currency	12/15/15
(5)	Imports of goods and services, CARSA	OECD: Quarterly National Accounts	Million units of national currency	12/12/15

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1960:1979.75 (5), 1980:1994.75 (4), 1995:2017.5 (2); *Bulgaria*: 1998:1999.75 (4), 2000:2017.5 (2); *Czech Republic*: 1995:2017.5 (2); *Denmark*: 1960:1989.75 (5), 1990:1994.75 (4), 1995:2017.5 (2); *Germany*: 1991:2017.5 (2); *Estonia*: 1995:2017.5 (2); *Ireland*: 1960:1994.75 (5), 1995:2017.5 (2); *Greece*: 1960:1994.75 (5), 1995:2017.5 (2); *Spain*: 1960:1979.75 (5), 1980:1994.75 (4), 1995:2017.5 (2); *France*: 1960:1974.75 (5), 1975:2017.5 (2); *Italy*: 1960:1989.75 (5), 1990:1994.75 (4), 1995:2017.5 (2); *Cyprus*: 1995:2017.5 (2); *Latvia*: 1995:2017.5 (2); *Lithuania*: 1995:2017.5 (2); *Luxembourg*: 1960:1994.75 (5), 1995:2017.5 (2); *Hungary*: 1995:2017.5 (2); *Malta*: 2000:2017.5 (2); *Netherlands*: 1960:1987.75 (5), 1988:1994.75 (4), 1995:2017.5 (2); *Austria*: 1960:1987.75 (5), 1988:1995.75 (4), 1996:2017.5 (2); *Poland*: 1995:2001.75 (4), 2002:2017.5 (2); *Portugal*: 1960:1994.75 (5), 1995:2017.5 (2); *Romania*: 1998:2017.5 (2); *Slovenia*: 1995:2017.5 (2); *Slovak Republic*: 1993:1994.75 (5), 1995:2017.5 (3); *Finland*: 1960:1974.75 (5), 1975:1989.75 (4), 1990:2017.5 (2); *Sweden*: 1960:1992.75 (5), 1993:2017.5 (2); *United Kingdom*: 1960:1994.75 (4), 1995:2017.5 (2); *Norway*: 1960:1977.75 (5), 1978:2017.5 (2); *Switzerland*: 1960:1979.75 (5), 1980:2017.5 (2); *Iceland*: 1997:2017.5 (3); *Croatia*: 2000:2017.5 (2); *United States*: 1960:2015 (1);

Table 40: REAL EXPORTS (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Exports (line 16), s.a.[1]	BEA: Table 1.1.6. Real Gross Domestic Product, Chained Dollars	Billions of chained (2009) dollars	06/23/15
(2)	Exports of goods and services, s.a. and adj. for working days	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Chain linked volumes (2010), million euro	02/15/18
(3)	Exports of goods and services, s.a.	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Chain linked volumes (2010), million euro	02/14/18
(4)	Exports of goods and services, s.a. and adj. for working days[2]	Eurostat: GDP and main components - volumes [nama_gdp_k], ESA 95	Million euro, chain-linked volumes, reference year 2005 (at 2005 exchange rates)	12/15/15
(6)	Exports of goods and services, VPVOBARSA[3]	OECD: Quarterly National Accounts	US Dollar, millions, 2010	12/12/15

Notes: Linking method: growth.
[1] Data has been converted into 2010 million euro using the conversion factor 867.33.
[2] Data has been converted into 2010 million euro using the conversion factor 4.3415.
[3] Data has been converted into 2010 million euro using the conversion factor 0.85687.

Data sets used by time and country

Belgium: 1960:1979.75 (6), 1980:1994.75 (4), 1995:2017.5 (2); *Bulgaria*: 1998:1999.75 (4), 2000:2017.5 (2); *Czech Republic*: 1995:1995.75 (6), 1996:2017.5 (2); *Denmark*: 1960:1989.75 (6), 1990:1994.75 (4), 1995:2017.5 (2); *Germany*: 1991:2017.5 (2); *Estonia*: 1995:2017.5 (2); *Ireland*: 1960:1994.75 (6), 1995:2017.5 (2); *Greece*: 1960:1994.75 (6), 1995:2017.5 (2); *Spain*: 1960:1994.75 (6), 1995:2017.5 (2); *France*: 1960:1974.75 (6), 1975:2017.5 (2); *Italy*: 1960:1990.75 (6), 1991:1995.75 (4), 1996:2017.5 (2); *Cyprus*: 1995:2017.5 (2); *Latvia*: 1995:2017.5 (2); *Lithuania*: 1995:2017.5 (2); *Luxembourg*: 1960:1994.75 (6), 1995:2017.5 (2); *Hungary*: 1995:2017.5 (2); *Malta*: 2000:2017.5 (2); *Netherlands*: 1960:1987.75 (6), 1988:1995.75 (4), 1996:2017.5 (2); *Austria*: 1960:1987.75 (6), 1988:1995.75 (4), 1996:2017.5 (2); *Poland*: 1995:2001.75 (4), 2002:2017.5 (2); *Portugal*: 1960:1994.75 (6), 1995:2017.5 (2); *Romania*: 1998:2017.5 (2); *Slovenia*: 1995:2017.5 (2); *Slovak Republic*: 1993:1994.75 (6), 1995:2017.5 (3); *Finland*: 1960:1974.75 (6),

1975:1989.75 (4), 1990:2017.5 (2); *Sweden*: 1960:1992.75 (6), 1993:2017.5 (2); *United Kingdom*: 1960:1962.75 (6), 1963:1994.75 (4), 1995:2017.5 (2); *Norway*: 1960:1977.75 (6), 1978:2017.5 (2); *Switzerland*: 1960:1979.75 (6), 1980:2017.5 (2); *Iceland*: 1997:2017.5 (3); *Croatia*: 2000:2017.5 (2); *United States*: 1960:2015 (1);

Table 41: REAL IMPORTS (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Imports (line 19), s.a.[1]	BEA: Table 1.1.6. Real Gross Domestic Product, Chained Dollars	Billions of chained (2009) dollars	06/23/15
(2)	Imports of goods and services, s.a. and adj. for working days	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Chain linked volumes (2010), million euro	02/15/18
(3)	Imports of goods and services, s.a.	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Chain linked volumes (2010), million euro	02/14/18
(4)	Imports of goods and services, s.a. and adj. for working days[2]	Eurostat: GDP and main components - volumes [nama_gdp_k], ESA 95	Million euro, chain-linked volumes, reference year 2005 (at 2005 exchange rates)	12/15/15
(6)	Imports of goods and services, VPVOBARSA[3]	OECD: Quarterly National Accounts	US Dollar, millions, 2010	12/12/15

Notes: Linking method: growth.
[1] Data has been converted into 2010 million euro using the conversion factor 867.33.
[2] Data has been converted into 2010 million euro using the conversion factor 4.3415.
[3] Data has been converted into 2010 million euro using the conversion factor 0.85687.

Data sets used by time and country

Belgium: 1960:1979.75 (6), 1980:1994.75 (4), 1995:2017.5 (2); *Bulgaria*: 1998:1999.75 (4), 2000:2017.5 (2); *Czech Republic*: 1995:1995.75 (6), 1996:2017.5 (2); *Denmark*: 1960:1989.75 (6), 1990:1994.75 (4), 1995:2017.5 (2); *Germany*: 1991:2017.5 (2); *Estonia*: 1995:2017.5 (2); *Ireland*: 1960:1994.75 (6), 1995:2017.5 (2); *Greece*: 1960:1994.75 (6), 1995:2017.5 (2); *Spain*: 1960:1994.75 (6), 1995:2017.5 (2); *France*: 1960:1974.75 (6), 1975:2017.5 (2); *Italy*: 1960:1990.75 (6), 1991:1995.75 (4), 1996:2017.5 (2); *Cyprus*: 1995:2017.5 (2); *Latvia*: 1995:2017.5 (2); *Lithuania*: 1995:2017.5 (2); *Luxembourg*: 1960:1994.75 (6), 1995:2017.5 (2); *Hungary*: 1995:2017.5 (2); *Malta*: 2000:2017.5 (2); *Netherlands*: 1960:1987.75 (6), 1988:1995.75 (4), 1996:2017.5 (2); *Austria*: 1960:1987.75 (6), 1988:1995.75 (4), 1996:2017.5 (2); *Poland*: 1995:2001.75 (4), 2002:2017.5 (2); *Portugal*: 1960:1994.75 (6), 1995:2017.5 (2); *Romania*: 1998:2017.5 (2); *Slovenia*: 1995:2017.5 (2); *Slovak Republic*: 1993:1994.75 (6), 1995:2017.5 (3); *Finland*: 1960:1974.75 (6),

1975:1989.75 (4), 1990:2017.5 (2); *Sweden*: 1960:1992.75 (6), 1993:2017.5 (2); *United Kingdom*: 1960:1962.75 (6), 1963:1994.75 (4), 1995:2017.5 (2); *Norway*: 1960:1977.75 (6), 1978:2017.5 (2); *Switzerland*: 1960:1979.75 (6), 1980:2017.5 (2); *Iceland*: 1997:2017.5 (3); *Croatia*: 2000:2017.5 (2); *United States*: 1960:2015 (1);

Table 42: NOMINAL GOVERNMENT GROSS FIXED CAPITAL FORMATION (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Government: Gross investment (line 36), s.a.	BEA: Table 3.1. Government Current Receipts and Expenditures	Billions of dollars	06/23/15
(2)	Gross fixed capital formation (P51), s.a.	Eurostat: Quarterly non-financial accounts for general government [gov_10q_ggnfa], ESA 2010	Million units of national currency	12/15/15
(3)	Gross fixed capital formation (P51), n.s.a.[1]	Eurostat: Quarterly non-financial accounts for general government [gov_10q_ggnfa], ESA 2010	Million units of national currency	12/15/15
(4)	Gross fixed capital formation (P51), n.s.a.[2]	Eurostat: Quarterly non-financial accounts for general government [gov_q_ggnfa], ESA 95	Million units of national currency	12/15/15

Notes: Linking method: growth.
[1] converted into seasonally adjusted data using TRAMO-SEATS
[2] converted into seasonally adjusted data using TRAMO-SEATS

Data sets used by time and country

Belgium: 1991:1994.75 (4), 1995:1998.75 (3), 1999:2015.25 (2); *Bulgaria*: 1999:2015.25 (3); *Czech Republic*: 1999:2015.25 (3); *Denmark*: 1999:2015.25 (3); *Germany*: 1995:2001.75 (4), 2002:2015.25 (3); *Estonia*: 1995:2001.75 (4), 2002:2015.25 (3); *Ireland*: 1999:2001.75 (4), 2002:2015.25 (3); *Greece*: 1999:2005.75 (4), 2006:2015.25 (3); *Spain*: 1995:2001.75 (4), 2002:2015.25 (3); *France*: 1980:2015.25 (2); *Italy*: 1999:2015.25 (3); *Cyprus*: 1995:1998.75 (4), 1999:2015.25 (3); *Latvia*: 1999:2015.25 (3); *Lithuania*: 1999:2003.75 (4), 2004:2015.25 (3); *Luxembourg*: 1999:2001.75 (4), 2002:2015.25 (3); *Hungary*: 1999:2015.25 (3); *Malta*: 1999:2015.25 (3); *Netherlands*: 1999:2015.25 (3); *Austria*: 1999:2000.75 (4), 2001:2015.25 (3); *Poland*: 1999:2015.25 (3); *Portugal*: 1999:2015.25 (3); *Romania*: 1998:1998.75 (4), 1999:2015.25 (3); *Slovenia*: 1999:2015.25 (3); *Slovak Republic*: 1999:2015.25 (3); *Finland*: 1998:1998.75 (4), 1999:2015.25 (2); *Sweden*: 1993:1998.75 (4), 1999:2015.25 (3); *United Kingdom*: 1987:2015.25 (3); *Norway*: 1996:2001.75 (4), 2002:2015.25 (3); *Switzerland*: 1990:1994.75 (4), 1995:2015 (2), 2015.25:2015.25 (3); *Croatia*: 2012:2015.25 (3); *United States*: 1960:2015 (1);

Table 43: NOMINAL GOVERNMENT CONSUMPTION (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Government: Consumption expenditure (line 18), s.a.	BEA: Table 3.1. Government Current Receipts and Expenditures	Billions of dollars	06/23/15
(2)	Final consumption expenditure of general government, s.a. and adj. for working days	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Million units of national currency	02/15/18
(3)	Final consumption expenditure of general government, s.a.	Eurostat: GDP and main components (output, expenditure and income) [nama_10_gdp], ESA 2010	Million units of national currency	02/14/18
(4)	Final consumption expenditure of general government, s.a. and adj. for working days	Eurostat: GDP and main components - volumes [nama_gdp_k], ESA 95	Million units of national currency	12/15/15
(5)	General government final consumption expenditure, CARSA	OECD: Quarterly National Accounts	Million units of national currency	12/12/15

Notes: Linking method: growth.

Data sets used by time and country

Belgium: 1960:1979.75 (5), 1980:1994.75 (4), 1995:2017.5 (2); *Bulgaria*: 1998:1999.75 (4), 2000:2017.5 (2); *Czech Republic*: 1995:2017.5 (2); *Denmark*: 1960:1989.75 (5), 1990:1994.75 (4), 1995:2017.5 (2); *Germany*: 1991:2017.5 (2); *Estonia*: 1995:2017.5 (2); *Ireland*: 1960:1994.75 (5), 1995:2017.5 (2); *Greece*: 1960:1994.75 (5), 1995:2017.5 (2); *Spain*: 1960:1979.75 (5), 1980:1994.75 (4), 1995:2017.5 (2); *France*: 1960:1977.75 (5), 1978:1979.75 (4), 1980:2017.5 (2); *Italy*: 1960:1989.75 (5), 1990:1994.75 (4), 1995:2017.5 (2); *Cyprus*: 1995:2017.5 (2); *Latvia*: 1995:2017.5 (2); *Lithuania*: 1995:2017.5 (2); *Luxembourg*: 1960:1994.75 (5), 1995:2017.5 (2); *Hungary*: 1995:2017.5 (2); *Malta*: 2000:2017.5 (2); *Netherlands*: 1960:1987.75 (5), 1988:1994.75 (4), 1995:2017.5 (2); *Austria*: 1960:1987.75 (5), 1988:1995.75 (4), 1996:2017.5 (2); *Poland*: 1995:2001.75 (4), 2002:2017.5 (2); *Portugal*: 1960:1994.75 (5), 1995:2017.5 (2); *Romania*: 1998:2017.5 (2); *Slovenia*: 1995:2017.5 (2); *Slovak Republic*: 1993:1994.75 (5), 1995:2017.5 (3); *Finland*: 1960:1974.75 (5), 1975:1989.75 (4), 1990:2017.5 (2); *Sweden*: 1960:1992.75 (5), 1993:2017.5 (2); *United Kingdom*: 1960:1994.75 (4), 1995:2017.5 (2); *Norway*: 1960:1977.75 (5), 1978:2017.5 (2); *Switzerland*: 1960:1979.75 (5), 1980:2017.5 (2);

Iceland: 1997:2017.5 (3); *Croatia*: 2000:2017.5 (2); *United States*: 1960:2015 (1);

Table 44: UNEMPLOYMENT RATE (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Unemployment rate: total, s.a.[1]	Eurostat: Unemployment rate by sex and age groups - quarterly average, [une_rt_q]	Percent	01/29/15
(2)	Civilian Unemployment Rate[UNRATE], s.a.	US. Bureau of Labor Statistics, https://research.stlouisfed.org/fred2/series/UNRATE/	Percent	06/23/15
(3)	Unemployment rate by sex and age, seasonally adjusted series, s.a.	ILOStat	Percent	02/08/18
(4)	Unemployment rate, s.a.	Statistics Estonia: Dataset:TT469: Labour status of population aged 15-69 (quarters)	Percent	02/08/18

Notes: Linking method: linear.
[1] for Switzerland: "Erwerbslosenquote gemss ILO nach Geschlecht, Nationalitt und Altersgruppen, brutto- und saisonbereinigte Werte. Durchschnittliche Monats-, Quartals- und Jahreswerte", www.bfs.admin.ch/bfs/portal/de/index/themen/03/03/blank/data/01.html

Data sets used by time and country

Belgium: 1986.25:2017 (1), 2017.25:2017.5 (3); *Bulgaria*: 2000:2017 (1); *Czech Republic*: 1993:2017 (1), 2017.25:2017.5 (3); *Denmark*: 1983:2017 (1), 2017.25:2017.5 (3); *Germany*: 1991:2017 (1), 2017.25:2017.5 (3); *Estonia*: 1989:1999.75 (4), 2000:2016.75 (1), 2017:2017.5 (3); *Ireland*: 1983:2017 (1), 2017.25:2017.25 (3); *Greece*: 1990:2017.5 (3), 1998.25:2017 (1); *Spain*: 1986.25:2017 (1), 2017.25:2017.5 (3); *France*: 1983:2017 (1), 2017.25:2017.5 (3); *Italy*: 1983:2016.75 (1), 2017:2017.5 (3); *Cyprus*: 2000:2017 (1), 2017.25:2017.5 (3); *Latvia*: 1998.25:2017 (1), 2017.25:2017.5 (3); *Lithuania*: 1998:2017 (1), 2017.25:2017.5 (3); *Luxembourg*: 1983:2017 (1), 2017.25:2017.5 (3); *Hungary*: 1996:2017 (1), 2017.25:2017.5 (3); *Malta*: 2000:2017 (1), 2017.25:2017.5 (3); *Netherlands*: 1983:2017 (1), 2017.25:2017.5 (3); *Austria*: 1990:2017.5 (3), 1995:2017 (1); *Poland*: 1992.25:2017.5 (3), 1997:2017 (1); *Portugal*: 1983:2017 (1), 2017.25:2017.5 (3); *Romania*: 1998:2017 (1), 2017.25:2017.5 (3); *Slovenia*: 1996:2017 (1), 2017.25:2017.5 (3); *Slovak Republic*: 1998:2017 (1); *Finland*: 1988:2017 (1), 2017.25:2017.5 (3); *Sweden*: 1983:2017 (1), 2017.25:2017.5 (3); *United Kingdom*: 1983:2016.75 (1), 2017:2017.5 (3); *Norway*: 1989:2017 (1), 2017.25:2017.5 (3); *Switzerland*: 1991:2017 (1), 2017.25:2017.5 (3); *Iceland*: 2003:2017 (1), 2017.25:2017.5 (3); *Croatia*: 2000:2017 (1); *United States*: 1960:1982.75 (2), 1983:2017 (1);

Table 45: NOMINAL EFFECTIVE EXCHANGE RATE (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Nominal Effective Exchange Rate - 42 trading partners, s.a.	Eurostat: Industrial countries' effective exchange rates including new Member States - quarterly data [ert_eff_ic_q]	Index, 2005=100	05/21/15

Notes: Linking method: linear.

Data sets used by time and country

Belgium: 1994:2014.75 (1); *Bulgaria*: 1998:2014.75 (1); *Czech Republic*: 1994:2014.75 (1); *Denmark*: 1994:2014.75 (1); *Germany*: 1994:2014.75 (1); *Estonia*: 1994:2014.75 (1); *Ireland*: 1994:2014.75 (1); *Greece*: 1994:2014.75 (1); *Spain*: 1994:2014.75 (1); *France*: 1994:2014.75 (1); *Italy*: 1994:2014.75 (1); *Cyprus*: 1994:2014.75 (1); *Latvia*: 1995:2014.75 (1); *Lithuania*: 1995:2014.75 (1); *Luxembourg*: 1994:2014.75 (1); *Hungary*: 1994:2014.75 (1); *Malta*: 1994:2014.75 (1); *Netherlands*: 1994:2014.75 (1); *Austria*: 1994:2014.75 (1); *Poland*: 1994:2014.75 (1); *Portugal*: 1994:2014.75 (1); *Romania*: 1998:2014.75 (1); *Slovenia*: 1994:2014.75 (1); *Slovak Republic*: 1994:2014.75 (1); *Finland*: 1994:2014.75 (1); *Sweden*: 1994:2014.75 (1); *United Kingdom*: 1994:2014.75 (1); *Norway*: 1994:2014.75 (1); *Switzerland*: 1994:2014.75 (1); *Croatia*: 1994:2014.75 (1); *United States*: 1994:2014.75 (1);

Table 46: CONSUMER PRICE INDEX (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Personal Consumption Expenditures: Chain-type Price Index Less Food and Energy[JCXFE]	US. Bureau of Economic Analysis, https://research.stlouisfed.org/fred2/series/JCXFE	Index, 2009=100	06/22/15
(2)	HICP, Overall index excluding energy, food, alcohol and tobacco (TOT_X_NRG_FOOD)[1]	Eurostat: HICP (2005 = 100) - monthly data (index) [prc_hicp_midx]	Index, 2005=100	06/23/15
(3)	Consumer prices - all items non-food, non-energy	OECD: Main Economic Indicators	Index, 2010=100	05/12/15

Notes: Linking method: growth.
[1] Monthly data aggregated to quarterly data (log-linear averages)

Data sets used by time and country

Belgium: 1976.5:1995.75 (3), 1996:2015 (2); *Bulgaria*: 1998:2015 (2); *Czech Republic*: 1996:1999.75 (3), 2000:2015 (2); *Denmark*: 1970:1995.75 (3), 1996:2015 (2); *Germany*: 1991:1995.75 (3), 1996:2015 (2); *Estonia*: 1998:2015 (2); *Ireland*: 1976:1995.75 (3), 1996:2015 (2); *Greece*: 1970:1995.75 (3), 1996:2015 (2); *Spain*: 1976:1995.75 (3), 1996:2015 (2); *France*: 1970:1995.75 (3), 1996:2015 (2); *Italy*: 1960:1995.75 (3), 1996:2015 (2); *Cyprus*: 1996:2015 (2); *Latvia*: 1995:1995.75 (3), 1996:2015 (2); *Lithuania*: 1996:2015 (2); *Luxembourg*: 1967:1995.75 (3), 1996:2015 (2); *Hungary*: 2001:2015 (2); *Malta*: 1996:2015 (2); *Netherlands*: 1960.25:1995.75 (3), 1996:2015 (2); *Austria*: 1966:1995.75 (3), 1996:2015 (2); *Poland*: 1995:1995.75 (3), 1996:2015 (2); *Portugal*: 1988:1995.75 (3), 1996:2015 (2); *Romania*: 2001:2015 (2); *Slovenia*: 2000:2015 (2); *Slovak Republic*: 1995:1995.75 (3), 1996:2015 (2); *Finland*: 1960:1995.75 (3), 1996:2015 (2); *Sweden*: 1970:1995.75 (3), 1996:2015 (2); *United Kingdom*: 1970:1995.75 (3), 1996:2015 (2); *Norway*: 1979:1995.75 (3), 1996:2015 (2); *Switzerland*: 1960:2004.75 (3), 2005:2015 (2); *Croatia*: 2005:2015 (2); *United States*: 1960:2015 (1);

Table 47: OUTPUT GAP (QUARTERLY)

#	Series Name	Source	Unit	Download
(1)	Real Potential Gross Domestic Product[GDPPOT], n.s.a.[1]	US. Congressional Budget Office,ED, Federal Reserve Bank of St. Louis https://research.stlouisfed.org/fred2/series/GDPPOT, March 2, 2016.	[Billions of chained (2009) dollars]	03/03/16

Notes: Linking method: growth.
[1] Transformed into output gap using real GDP data: gap = 100*(GDP - pot GDP)/pot GDP

Data sets used by time and country

United States: 1960:2015 (1);

B.4 Implicit Tax Rates

Calculation of tax rates for consumption, labor and capital builds on Mendoza et al. (1994) and Eurostat (2014) and are based on data from the National Tax Lists. Implicit tax rates are calculated as[3]

$$\tau_c = \left[\frac{T_C}{C + GM - T_C}\right] \times 100$$
$$\tau_l = \left[\frac{T_{PI} \times \theta_{LEES} + T_{LEES} + T_{LEYRS} + D611C + D613CE}{CE + T_{LEYRS}}\right] \times 100$$
$$\tau_k = \left[\frac{\theta_K T_{PI} + T_{KS} + T_{KIC} + T_{KIH} + T_{KISE} + D613CS}{NOSMI + NPI}\right] \times 100,$$

where T_j is revenue from tax j defined, where j is:

T_C = Consumption tax

T_{PI} = Personal income tax: Split between LEES, LNON, KIH, KISE

T_{LEES} = Labor tax on employees

T_{LEYRS} = Labor tax on employers

T_{KS} = Capital tax on stocks of wealth

T_{KIC} = Capital tax on the income of corporations

T_{KIH} = Capital tax on the income of households

T_{KISE} = Capital tax on the income of the self-employed.

compulsory social contributions consist of

D611C = Compulsory employers' actual social contributions

D613CE = Compulsory employees' actual social contributions

D613CS = Compulsory actual social contributions by the self-employed

and the tax base variables are taken from national accounts and sector accounts: *Sector accounts / National accounts*

[3]For the consumption tax rate, the original formula proposed by Eurostat (2014) does not include government intermediate consumption in the tax base.

C = Final consumption expenditure, Households and NPISH (P31, S14_15)

GM = Intermediate consumption expenditure, General government (P2, S13)

CE = Compensation of employees, Total economy (D1, S1)

NOSMI = Net operating surplus, All sectors except for general government (B2n, S11_12_14_15) and
Mixed income, Households (B3n, S14)

NPI = Net property income:
Net property income (except for reinvested earnings on direct foreign investment), All sectors except for general government (D41n, D42n, D44n, D45n, S11_12_14_15);
Distributed income of corporations, General government and Rest of the world, (D42r, S13_2).

The personal income tax T_{PI} is split between the labor tax on employees (LEES), labor tax on the non-employed (LNON), capital tax on the income of households (KIH), and capital tax on the income of the self-employed (KISE). Denoting these shares by θ, we therefore have

$$1 = \theta_{LEES} + \theta_{LNON} + \theta_{KIH} + \theta_{KISE}.$$

We also define $\theta_K = \theta_{KIH} + \theta_{KISE}$ as the share allocated to capital taxes. Estimates of this decomposition based on micro-data are provided for 1995 - 2016 in Eurostat (2014) (see Tables F.2 - F.4 in the 2014 publication and Tables F.1-F.3 in the 2018 publication). Although there is substantial variation in the estimated shares across countries, the estimates are fairly stable across time and we extrapolate the data backwards.

Data on tax revenue and social contributions is taken from the National Tax Lists published on http://ec.europa.eu/eurostat/statistics-explained/index.php/Tax_revenue_statistics. Data for the U.S. is taken from the OECD Revenue Statistics.

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

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1 Steady State

We solve the model in a neighborhood of a non-stochastic steady state with zero inflation. Because inflation is zero, the Euler equations associated with the uncontingent nominal bonds imply that the nominal interest rate is $1 + i_n = \frac{1}{\beta}$ for all n. Next, we use the entrepreneurs' first-order condition for capital,

$$(1 + i_n)F(\lambda_n) = \frac{(1 - \tau_n^K)u_n R_n + \mu_n \left(1 - \delta(1 - \tau_n^K)\right) - P_n a\left(u_n\right)}{\mu_n}.$$

Note that the households' first-order condition for investment,

$$\frac{U_{1,n}}{1 + \tau_n^C} = \frac{\mu_n}{P_n}\frac{U_{1,n}}{1 + \tau_n^C}\left(1 - f - f'\right) + \beta\left[\frac{\mu_n}{P_n}\frac{U_{1,n}}{1 + \tau_n^C}f'\right]$$

implies that $\mu_n = P_n$ because $f = f' = 0$ in steady state. Inserting this back into the entrepreneurs' first-order condition for capital and noting that $a(u_n) = 0$ and $u_n = 1$ gives

$$\begin{aligned}\frac{F_n}{\beta} &= (1 - \tau_n^K)\left(r_n + 1 - \delta\right)\\ r_n &= \frac{1}{1 - \tau_n^K}\left(\frac{F_n}{\beta} - 1\right) + \delta,\end{aligned} \tag{1.1}$$

where we have defined the steady state interest rate spreads $F_n \equiv F_n\left(\lambda\right)$. Below we calibrate these spreads to match their observable counterparts. Once we have calibrated F_n, the equation above determines the real rental price of capital $r_n \equiv R_n/P_n$ in each country.

With zero inflation, the steady state price of intermediates is a constant markup over the nominal marginal cost,

$$p_n = \frac{\psi_q}{\psi_q - 1}MC_n.$$

This can be seen from the reset equation and the law of motion for the nominal price of the intermediate good.

Next, cost minimization of the first-stage producers implies

$$
\begin{aligned}
R_n &= MC_n \alpha Z_n \left[\frac{K_n}{L_n}\right]^{\alpha-1} \\
r_n &= \frac{\psi_q - 1}{\psi_q} \frac{p_n}{P_n} \alpha Z_n \left[\frac{K_n}{L_n}\right]^{\alpha-1} \\
\frac{p_n}{P_n} &= r_n \frac{\psi_q}{\psi_q - 1} \frac{1}{\alpha Z_n} \left[\frac{K_n}{L_n}\right]^{1-\alpha}
\end{aligned}
$$

We adjust the technology levels Z_n so that all intermediate goods prices equal the price of the respective final good: $p_n = P_n$.

Then, the price index formula for the final good states

$$
\begin{aligned}
P_n &= \left(\sum_{j=1}^{N} \omega_n^j \left[\frac{E_j}{E_n} p_j\right]^{1-\psi_y}\right)^{\frac{1}{1-\psi_y}} \\
P_n E_n &= \left(\sum_{j=1}^{N} \omega_n^j \left[P_j E_j \frac{p_j}{P_j}\right]^{1-\psi_y}\right)^{\frac{1}{1-\psi_y}}
\end{aligned}
$$

One can easily verify that $P_n E_n = 1$ solves this equation, that is the real exchange rate $e_n = P_n E_n$ is unity.[1]

We directly calibrate some steady-state variables to match their empirical counterparts. Those are the shares of government purchases, G_n, the relative country sizes, $\frac{\mathbb{N}_j Y_j}{\mathbb{N}_n Y_n}$ and the bilateral import shares $\frac{y_n^j}{Y_n}$. We now derive the shares of the remaining variables, NX_n, C_n and X_n.

To derive the share of net exports, we first use the demand equation for intermediate goods,

$$
\begin{aligned}
y_n^j &= Y_n \omega_n^j \left[\frac{E_j}{E_n} \frac{p_j}{P_n}\right]^{-\psi_y} \\
&= Y_n \omega_n^j \left[\frac{e_j}{e_n} \frac{p_j}{P_j}\right]^{-\psi_y}.
\end{aligned}
$$

It follows that ω_n^j is country n's import share of country j's good, measured in terms of the

[1] We can also set $e_n = \frac{1}{\varrho}$ for any constant $\varrho > 0$.

final good Y_n:

$$\omega_n^j = \frac{y_n^j}{Y_n}.$$

It is also useful to define import shares in terms of *domestic absorption*, $P_n Y_{n,T} = P_n Y_n + \upsilon_n p_n G_n$:[2]

$$\omega_{n,T}^j = \frac{y_n^j}{Y_{n,T}} \quad \forall j \neq n \qquad \text{and} \qquad \omega_{n,T}^n = \frac{y_n^n}{Y_{n,T}} + \frac{\upsilon_n G_n}{Y_{n,T}}.$$

The implied net export share can then be expressed in terms of country sizes and the import preference parameters. Inserting the market clearing condition for Q_n into the definition of net exports, $NX_n = p_n Q_n - P_n Y_{n,T}$, we have[3]

$$\frac{NX_n}{P_n Y_{n,T}} = \left(\sum_{j=1}^{N} \frac{\mathbb{N}_j Y_{j,T}}{\mathbb{N}_n Y_{n,T}} \omega_{j,T}^n \right) - 1 \tag{1.2}$$

To derive the share of investment, we insert the marginal product of capital equation, $p_n Q_n = \frac{\psi_q}{\psi_q - 1} \frac{R_n}{\alpha} K_n$, into the definition of net exports, $NX_n = p_n Q_n - P_n Y_{n,T}$:

$$\begin{aligned} \frac{\psi_q}{\psi_q - 1} \frac{R_n}{\alpha\delta} X_n &= P_n Y_{n,T} + NX_n \\ \frac{X_n}{Y_{n,T}} &= \frac{\alpha\delta}{\frac{\psi_q}{\psi_q - 1} r_n} \left(1 + \frac{NX_n}{P_n Y_{n,T}} \right), \end{aligned} \tag{1.3}$$

[2]Remember that $P_n = p_n$ in steady state.

[3]

$$\begin{aligned} NX_n &= p_n \left(\sum_{j=1}^{N} \frac{\mathbb{N}_j}{\mathbb{N}_n} y_j^n \right) - p_n \upsilon_n G_n - P_n Y_{n,T} \\ \frac{NX_n}{P_n Y_{n,T}} &= \left(\sum_{j=1}^{N} \frac{\mathbb{N}_j p_n y_j^n}{\mathbb{N}_n P_n Y_{n,T}} \right) + \frac{p_n \upsilon_n G_n}{P_n Y_{n,T}} - 1 \\ &= \left(\sum_{j=1}^{N} \frac{\mathbb{N}_j Y_{j,T}}{\mathbb{N}_n Y_{n,T}} \frac{y_j^n}{Y_{j,T}} \right) + \frac{\upsilon_n G_n}{Y_{n,T}} - 1 \\ &= \left(\sum_{j=1}^{N} \frac{\mathbb{N}_j Y_{j,T}}{\mathbb{N}_n Y_{n,T}} \omega_{j,T}^n \right) - 1 \end{aligned}$$

where $X_n = \delta K_n$.

Finally, the consumption share is the residual of the market clearing condition $Y_{n,T} = C_n + X_n + G_n$:

$$\frac{C_n}{Y_{n,T}} = 1 - \frac{X_n}{Y_{n,T}} - \frac{G_n}{Y_{n,T}}. \tag{1.4}$$

To summarize, we solve for the steady state values as follows:

1. Calibrate the tax rate τ_n^K, the risk premium F_n and the government expenditure share $\frac{G_n}{Y_{n,T}}$ to their counterparts in the data.

2. Solve for the real rental price r_n using equation (1.1).

3. Calibrate the import preference parameters $\omega_{n,T}^j$ using data on country j's share of country n's imports, and calibrate the relative size of countries in terms of their domestic absorption, $\frac{\mathbb{N}_j Y_{j,T}}{\mathbb{N}_n Y_{n,T}}$.

4. Solve for the net export share $\frac{NX_n}{Y_{n,T}}$ using equation (1.2), the investment share $\frac{X_n}{Y_{n,T}}$ using equation (1.3) and the consumption share $\frac{C_n}{Y_{n,T}}$ using equation (1.4)

5. Solve for the parameters ω_n^j and υ_n using data on bilateral trade data on total trade and data on the import share of G relative to the total import share, $m_n^G \equiv (1 - \omega_{n,G}^n)/(1 - \hat{\omega}_{n,T}^n)$:[4]

$$\begin{aligned}
\upsilon_n &= \frac{1 - m_n^G}{1 - m_n^G \frac{G_n}{Y_{n,T}}} \\
\omega_n^n &= 1 - \frac{1 - \omega_{n,T}^n}{1 - \upsilon_n \frac{G_n}{Y_{n,T}}} \\
\omega_n^j &= \omega_{n,T}^j \frac{1 - \omega_n^n}{1 - \omega_{n,T}^n} \qquad \forall j \neq n
\end{aligned}$$

[4]First, note that

$$\begin{aligned}
\omega_{n,G}^n &= \upsilon_n + (1 - \upsilon_n)\omega_n^n \\
\omega_n^n &= \frac{\omega_{n,G}^n - \upsilon_n}{1 - \upsilon_n}
\end{aligned}$$

2 Log-Linearized Equilibrium Conditions

2.1 Equilibrium Conditions

1. Domestic Euler equation

$$\frac{U_{1,n,t}}{(1+\tau^C_{n,t})P_{n,t}} = (1+i_{n,t})\sum_{s^{t+1}} \pi(s^{t+1}|s^t)\beta \frac{U_{1,n,t+1}}{(1+\tau^C_{n,t+1})P_{n,t+1}}$$

$$\beta \Delta i_{n,t} - \tilde{\pi}_{n,t+1} = \tilde{U}_{1,n,t} - \tilde{U}_{1,n,t+1} - \frac{\Delta\tau^C_{n,t} - \Delta\tau^C_{n,t+1}}{1+\tau_n}$$

Then,

$$\begin{aligned}
\omega^n_{n,T} &= \omega^n_n \frac{Y_n}{Y_{n,T}} + \frac{\upsilon_n G_n}{Y_{n,T}} \\
\omega^n_{n,T} &= \frac{\omega^n_{n,G} - \upsilon_n}{1-\upsilon_n}\frac{Y_{n,T} - \upsilon_n G_n}{Y_{n,T}} + \frac{\upsilon_n G_n}{Y_{n,T}} \\
&= \frac{\omega^n_{n,G} - \upsilon_n}{1-\upsilon_n} + \left(1 - \frac{\omega^n_{n,G} - \upsilon_n}{1-\upsilon_n}\right)\frac{\upsilon_n G_n}{Y_{n,T}} \\
(1-\upsilon_n)\omega^n_{n,T} &= \omega^n_{n,G} - \upsilon_n + \left(1-\omega^n_{n,G}\right)\frac{\upsilon_n G_n}{Y_{n,T}} \\
\left[1 - \omega^n_{n,T} - \left(1-\omega^n_{n,G}\right)\frac{G_n}{Y_{n,T}}\right]\upsilon_n &= \omega^n_{n,G} - \omega^n_{n,T} \\
\left[1 - \frac{1-\omega^n_{n,G}}{1-\omega^n_{n,T}}\frac{G_n}{Y_{n,T}}\right]\upsilon_n &= 1 - \frac{1-\omega^n_{n,G}}{1-\omega^n_{n,T}} \\
\upsilon_n &= \frac{1-m^G_n}{1-m^G_n\frac{G_n}{Y_{n,T}}}
\end{aligned}$$

And then

$$\begin{aligned}
1-\omega^n_{n,G} &= (1-\upsilon_n)(1-\omega^n_n) \\
\omega^n_n &= 1 - m^G_n\frac{1-\omega^n_{n,T}}{1-\upsilon_n} \\
\omega^n_n &= 1 - \frac{1-\omega^n_{n,T}}{1-\upsilon_n\frac{G_n}{Y_{n,T}}}
\end{aligned}$$

2. Wage Phillips curve ($w_{n,t} \equiv \frac{W_{n,t}}{P_{n,t}}$) [5]

$$\theta_w \tilde{\pi}^w_{n,t} = (1-\theta_w)(1-\theta_w\beta)\left[\widetilde{U}_{2,n,t} - \widetilde{U}_{1,n,t} + \frac{\Delta\tau^L_{n,t}}{1-\tau^L_n} + \frac{\Delta\tau^C_{n,t}}{1+\tau^C_n} - \widetilde{w}_{n,t}\right] + \theta_w\beta\tilde{\pi}^w_{n,t+1}$$

[5]The reset equation and law of motion for the nominal price in log-linearized form:

$$\widetilde{W}_{n,t} = \theta_w\widetilde{W}_{n,t-1} + (1-\theta_w)\tilde{w}^*_{n,t}$$
$$\widetilde{w}^*_{n,t} = \frac{1-\theta_w\beta}{1+\frac{\psi_l}{\eta}}\left(\tilde{U}_{2,n,t} - \tilde{U}_{1,n,t} + \tilde{P}_{n,t} + \frac{\Delta\tau^L_{n,t}}{1-\tau^L_n} + \frac{\Delta\tau^C_{n,t}}{1+\tau^C_n}\right) + \theta_w\beta\tilde{w}^*_{n,t+1}$$

Solving the reset equation for $\widetilde{w}^*_{n,t}$

$$(1-\theta_w)\widetilde{w}^*_{n,t} = \widetilde{W}_{n,t} - \theta_w\widetilde{W}_{n,t-1}$$

and substituting into the law of motion:

$$\widetilde{W}_{n,t} - \theta_w\widetilde{W}_{n,t-1} = \frac{(1-\theta_w)(1-\theta_w\beta)}{1+\frac{\psi_l}{\eta}}\left(\tilde{U}_{2,n,t} - \tilde{U}_{1,n,t} + \tilde{P}_{n,t} + \frac{\Delta\tau^L_{n,t}}{1-\tau^L_n} + \frac{\Delta\tau^C_{n,t}}{1+\tau^C_n}\right) + \theta_w\beta\left(\widetilde{W}_{n,t+1} - \theta_w\widetilde{W}_{n,t}\right)$$

Using $\widetilde{W}_{n,t} - \widetilde{W}_{n,t-1} = \tilde{\pi}^w_{n,t}$:

$$(1-\theta_w)\widetilde{W}_{n,t} + \theta_w\tilde{\pi}^w_{n,t} = \frac{(1-\theta_w)(1-\theta_w\beta)}{1+\frac{\psi_l}{\eta}}\left(\tilde{U}_{2,n,t} - \tilde{U}_{1,n,t} + \tilde{P}_{n,t} + \frac{\Delta\tau^L_{n,t}}{1-\tau^L_n} + \frac{\Delta\tau^C_{n,t}}{1+\tau^C_n}\right) + \theta_w\beta\left[(1-\theta_w)\widetilde{W}_{n,t} + \tilde{\pi}^w_{n,t+1}\right]$$
$$\theta_w\tilde{\pi}^w_{n,t} = \frac{(1-\theta_w)(1-\theta_w\beta)}{1+\frac{\psi_l}{\eta}}\left(\tilde{U}_{2,n,t} - \tilde{U}_{1,n,t} + \frac{\Delta\tau^L_{n,t}}{1-\tau^L_n} + \frac{\Delta\tau^C_{n,t}}{1+\tau^C_n} - \widetilde{w}_{n,t}\right) + \theta_w\beta\tilde{\pi}^w_{n,t+1}$$

3. Capital Euler equation[6]

$$(1+i_{n,t})F(\lambda_{n,t})e^{\epsilon^F_{n,t}} = \frac{\sum_{s^{t+1}}\pi(s^{t+1}|s_t)\left[(1-\tau^K_{n,t+1})u_{n,t+1}R_{n,t+1}+\mu_{n,t+1}\left(1-\delta(1-\tau^K_{n,t+1})\right)-P_{n,t+1}a\left(u_{n,t+1}\right)\right]}{\mu_{n,t}}$$

$$\frac{\beta}{F_n}\left((1-\tau^K_n)u_n r_n \tilde{r}_{n,t+1}-(u_n r_n-\delta)\Delta\tau^K_{n,t+1}\right) = \beta\Delta i_{n,t}-\tilde{\pi}_{n,t+1}+\frac{\Delta sp_{n,t}}{F_n}+\widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)}-\frac{\beta}{F_n}(1-\delta(1-\tau^K_n))\widetilde{\left(\frac{\mu_{n,t+1}}{P_{n,t+1}}\right)}$$

[6]Log-linearizing gives

$$\begin{aligned}F_n\mu_n(1+i)\left(\tilde{\mu}_{n,t}+\frac{\Delta i_{n,t}}{1+i}+\frac{F'_n}{F_n}\lambda_n\tilde{\lambda}_{n,t}+\Delta\epsilon^F_{n,t}\right) &= (1-\tau^K_n)u_nR_n\left(\tilde{u}_{n,t+1}+\tilde{R}_{n,t+1}\right)-(u_nR_n-\delta)\Delta\tau^K_{n,t+1}\\ &\quad+(1-\delta(1-\tau^K_n))\mu_n\tilde{\mu}_{n,t+1}-a(u_n)P_n\tilde{P}_{n,t+1}-(1-\tau^K_n)R_n\tilde{u}_{n,t+1}\end{aligned}$$

Simplifying:

$$\tilde{\mu}_{n,t}+\beta\Delta i_{n,t}+F_\epsilon\tilde{\lambda}_{n,t}+\Delta\epsilon^F_{n,t} = \frac{\beta}{F_n}\left((1-\tau^K_n)u_nr_n\tilde{R}_{n,t+1}-(u_nr_n-\delta)\Delta\tau^K_{n,t+1}+(1-\delta(1-\tau^K_n))\tilde{\mu}_{n,t+1}-a(u_n)\tilde{P}_{t+1}\right)$$

We replace $\Delta sp_{n,t}/F = F_\epsilon\tilde{\lambda}_{it}+\delta\epsilon^F_{n,t}$:

$$\widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)}-\tilde{\pi}_{n,t+1}+\beta\Delta i_{n,t}+\Delta sp_{n,t}/F = \frac{\beta}{F_n}\left((1-\tau^K_n)u_nr_n\tilde{R}_{n,t+1}-(u_nr_n-\delta)\Delta\tau^K_{n,t+1}+(1-\delta(1-\tau^K_n))\tilde{\mu}_{n,t+1}-\left(\frac{F_n}{\beta}+a(u_n)\right)\tilde{P}_{n,t+1}\right)$$

Notice that $\frac{F(\lambda_n)}{\beta}+a\left(u_n\right) = (1-\tau^K_n)u_nr_n+\left(1-\delta(1-\tau^K_n)\right)$.

$$\beta\Delta i_{n,t}-\tilde{\pi}_{n,t+1}+\Delta sp_{n,t}/F+\widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)} = \frac{\beta}{F_n}\left((1-\tau^K_n)u_nr_n\tilde{r}_{n,t+1}+(1-\delta(1-\tau^K_n))\widetilde{\left(\frac{\mu_{n,t+1}}{P_{n,t+1}}\right)}+(u_nr_n-\delta)\Delta\tau^K_{n,t+1}\right)$$

4. Price of capital[7]

$$\frac{U_{1,n,t}}{1+\tau^C_{n,t}} = \frac{\mu_{n,t}}{P_{n,t}}\frac{U_{1,n,t}}{1+\tau^C_{n,t}}\left(1-f-f'\frac{X_{n,t}}{X_{n,t-1}}\right)+\beta\sum_{s^{t+1}}\pi(s^{t+1}|s^t)\left[\frac{\mu_{n,t+1}}{P_{n,t+1}}\frac{U_{1,n,t+1}}{1+\tau^C_{n,t+1}}f'\left(\frac{X_{n,t+1}}{X_{n,t}}\right)^2\right]$$

$$\widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)} = f''\left[(1+\beta)\widetilde{X}_{n,t}-\widetilde{X}_{n,t-1}-\beta\widetilde{X}_{n,t+1}\right]$$

5. Optimal capital utilization

$$(1-\tau^K_{n,t})r_{n,t} = a'\left(u_{n,t}\right)$$

$$r_n\left(-\Delta\tau^K_{n,t}+(1-\tau^K_n)\tilde{r}_{n,t}\right) = a''u_n\tilde{u}_{n,t}$$

6. Optimal factor employment

$$\frac{\alpha}{1-\alpha}\frac{w_{n,t}}{r_{n,t}} = \frac{u_{n,t}K_{n,t-1}}{L_{n,t}}$$

$$\tilde{r}_{n,t}-\widetilde{w}_{n,t} = \tilde{L}_{n,t}-\tilde{u}_{n,t}-\tilde{K}_{n,t-1}$$

7. Real marginal costs

$$MC_{n,t} = \frac{W^{1-\alpha}_{n,t}R^{\alpha}_{n,t}}{Z_{n,t}}\left(\frac{1}{1-\alpha}\right)^{1-\alpha}\left(\frac{1}{\alpha}\right)^{\alpha}$$

$$\widetilde{mc}_{n,t} = -\tilde{Z}_{n,t}+\alpha\tilde{r}_{n,t}+(1-\alpha)\widetilde{w}_{n,t}$$

[7]Recall the FOC:

$$C_{n,t}: \quad U_{1,n,t} = \lambda_{n,t}P_{n,t}(1+\tau^C_{n,t})$$

$$X_{n,t}: \quad \lambda_{n,t}P_{n,t} = v_{n,t}\left(1-f-f'\frac{X_{n,t}}{X_{n,t-1}}\right)+\beta\sum_{s^{t+1}}\pi(s^{t+1}|s^t)\left[v_{n,t+1}f'\left(\frac{X_{n,t+1}}{X_{n,t}}\right)^2\right]$$

$$K_{n,t+1}: \quad \lambda_{n,t}\mu_{n,t}-v_{n,t} = \beta\lambda_{n,t+1}(1-\delta)\mu_{n,t+1}-\beta v_{n,t+1}(1-\delta),$$

where $\lambda_{n,t}$ and $v_{n,t}$ are the multipliers on the budget constraint and the law of motion for capital. The last FOC implies that $v_{n,t} = \lambda_{n,t}\mu_{n,t}$. Inserting into the FOC for $X_{n,t}$ gives

$$\frac{U_{1,n,t}}{1+\tau^C_{n,t}} = \frac{\mu_{n,t}}{P_{n,t}}\frac{U_{1,n,t}}{1+\tau^C_{n,t}}\left(1-f-f'\frac{X_{n,t}}{X_{n,t-1}}\right)+\beta\sum_{s^{t+1}}\pi(s^{t+1}|s^t)\left[\frac{\mu_{n,t+1}}{P_{n,t+1}}\frac{U_{1,n,t+1}}{1+\tau^C_{n,t+1}}f'\left(\frac{X_{n,t+1}}{X_{n,t}}\right)^2\right]$$

8. Real marginal costs

$$MC_{n,t} = \frac{W_{n,t}^{1-\alpha} R_{n,t}^{\alpha}}{Z_{n,t}} \left(\frac{1}{1-\alpha}\right)^{1-\alpha} \left(\frac{1}{\alpha}\right)^{\alpha}$$
$$\widetilde{mc}_{n,t} = -\tilde{Z}_{n,t} + \alpha \tilde{r}_{n,t} + (1-\alpha)\widetilde{w}_{n,t}$$

9. FOC wrt $y_{n,t}^{j}$

$$y_{n,t}^{j} = Y_{n,t}\omega_{n}^{j}\left[\frac{E_{j,t}}{E_{n,t}}\frac{p_{j,t}}{P_{n,t}}\right]^{-\psi_y}$$
$$\widetilde{\left(\frac{p_{j,t}}{P_{j,t}}\right)} + \tilde{e}_{j,t} - \tilde{e}_{n,t} = \frac{1}{\psi_y}\left(\tilde{Y}_{n,t} - \tilde{y}_{n,t}^{j}\right) \quad \forall j$$

10. Production of $Q_{n,t}$

$$Q_{n,t} = Z_{n,t}\left(u_{n,t}K_{n,t-1}\right)^{\alpha} L_{n,t}^{1-\alpha}$$
$$\tilde{Q}_{n,t} = \tilde{Z}_{n,t} + \alpha\tilde{u}_{n,t} + \alpha\tilde{K}_{n,t-1} + (1-\alpha)\tilde{L}_{n,t}$$

11. Production of $Y_{n,t}$[8]

$$Y_{n,t} = \left(\sum_{j=1}^{N}\left(\omega_{n}^{j}\right)^{\frac{1}{\psi_y}}\left(y_{n,t}^{j}\right)^{\frac{\psi_y-1}{\psi_y}}\right)^{\frac{\psi_y}{\psi_y-1}}$$
$$\tilde{Y}_{n,t} = \sum_{j=1}^{N}\omega_{n}^{j}\tilde{y}_{n,t}^{j}$$

[8]Our calibration of the shares ω_{n}^{j} is $\omega_{n}^{j} = \frac{y_{n}^{j}}{Y_{n}}$, so that

$$Y^{\frac{\psi_y-1}{\psi_y}}\tilde{Y}_{n,t} = \sum_{j=1}^{N}\left(\omega_{n}^{j}\right)^{\frac{1}{\psi_y}} y_{n}^{j\,\frac{\psi_y-1}{\psi_y}}\tilde{y}_{n,t}^{j}$$

can be simplified.

12. Market clearing for intermediate goods[9]

$$Q_{n,t} = \sum_{j=1}^{N} \frac{\mathbb{N}_j}{\mathbb{N}_n} y_{j,t}^n + \upsilon_n G_{n,t}$$

$$\frac{Q_n}{Y_n}\tilde{Q}_{n,t} = \sum_{j=1}^{N} \frac{\mathbb{N}_j Y_j}{\mathbb{N}_n Y_n} \omega_j^n \tilde{y}_{j,t}^n + \frac{\upsilon_n G_n}{Y_n}\tilde{G}_{n,t}$$

13. Market clearing for final goods[10]

$$Y_{n,t} = C_{n,t} + X_{n,t} + (1-\upsilon_n)G_{n,t} + a\left(u_{n,t}\right)K_{n,t}$$

$$Y_n\tilde{Y}_{n,t} = C_n\tilde{C}_{n,t} + X_n\tilde{X}_{n,t} + (1-\upsilon_n)G_n\tilde{G}_{n,t} + r_n(1-\tau_n^K)K_n\tilde{u}_{n,t} + a(u_n)K_n\tilde{K}_{n,t}$$

[9]Note that

$$Q_n\tilde{Q}_{n,t} = \sum_{j=1}^{N} \frac{\mathbb{N}_j}{\mathbb{N}_n} y_j^n \tilde{y}_{j,t}^n + \upsilon_n G_n \tilde{G}_{n,t}$$

[10]Note that

$$a(u_n) = u_n(1-\tau_n^K)r_n + 1 - \frac{F_n}{\beta} - \delta(1-\theta^K\tau_n^K)$$

and is zero if $u_n = 1$.

14. Phillips curve [11]

$$\theta_p\left(\tilde{\pi}_{n,t}+\widetilde{ToT}_{n,t}\right)=(1-\theta_p)(1-\theta_p\beta)\left[\widetilde{mc}_{n,t}-\left(\widetilde{\frac{p_{n,t}}{P_{n,t}}}\right)\right]+\theta_p\beta\left(\tilde{\pi}_{n,t+1}+\widetilde{ToT}_{n,t+1}\right)$$

15. Monetary Policy

[11] First, derive the log-linearized form of the reset equation:

$$\varphi^*_{n,t}=\frac{\psi_q}{\psi_q-1}\frac{\sum_{j=0}^{\infty}(\theta_p\beta)^j\sum_{s^{t+j}}\pi(s^{t+j}|s^t)\frac{C_{n,t+j}^{-\frac{1}{\sigma}}}{(1+\tau^C_{n,t+j})P_{n,t+j}}\left(p_{n,t+j}\right)^{\psi_q}MC_{n,t+j}Q_{n,t+j}}{\sum_{j=0}^{\infty}(\theta_p\beta)^j\sum_{s^{t+j}}\pi(s^{t+j}|s^t)\frac{C_{n,t+j}^{-\frac{1}{\sigma}}}{(1+\tau^C_{n,t+j})P_{n,t+j}}\left(p_{n,t+j}\right)^{\psi_q}Q_{n,t+j}}\equiv\frac{A_{n,t}}{B_{n,t}}.$$

Then, $\tilde{\varphi}_{n,t}=\tilde{A}_{n,t}-\tilde{B}_{n,t}$. Note that

$$A_{n,t}=\frac{\psi_q}{\psi_q-1}\frac{C_{n,t}^{-\frac{1}{\sigma}}}{(1+\tau^C_{n,t})P_{n,t}}p_{n,t}^{\psi_q}MC_{n,t}Q_{n,t}+\theta_p\beta E_tA_{t+1},$$

and similarly for $B_{n,t}$. Log-linearizing gives

$$\tilde{A}_{n,t}=(1-\theta_p\beta)\left(-\frac{1}{\sigma}\tilde{C}_{n,t}-\frac{\Delta\tau^C_{n,t}}{1+\tau^C_n}\tilde{P}_{n,t}+\psi_q\tilde{p}_{n,t}+\widetilde{MC}_{n,t}+\tilde{Q}_{n,t}\right)+\theta_p\beta E_t\tilde{A}_{n,t+1},$$

and similarly for $\tilde{B}_{n,t}$. It follows that

$$\tilde{\varphi}^*_{n,t}=(1-\theta_p\beta)\widetilde{MC}_{n,t}+\theta_p\beta\tilde{\varphi}^*_{n,t+1}.$$

Solving for $\tilde{\varphi}^*_{n,t}$

$$(1-\theta_p)\tilde{\varphi}^*_{n,t}=\tilde{p}_{n,t}-\theta_p\tilde{p}_{n,t-1}$$

Substituting into the law of motion

$$\tilde{p}_{n,t}=\theta_p\tilde{p}_{n,t-1}+(1-\theta_p)\tilde{\varphi}^*_{n,t}$$

gives

$$\tilde{p}_{n,t}-\theta_p\tilde{p}_{n,t-1}=(1-\theta_p)(1-\theta_p\beta)\widetilde{MC}_{n,t}+\theta_p\beta\left(\tilde{p}_{n,t+1}-\theta_p\tilde{p}_{n,t}\right)$$

Using $\tilde{p}_{n,t}-\tilde{p}_{n,t-1}=\tilde{\pi}_{n,t}+\widetilde{ToT}_{n,t}$:

$$(1-\theta_p)\tilde{p}_{n,t}+\theta_p\left(\tilde{\pi}_{n,t}+\widetilde{ToT}_{n,t}\right)=(1-\theta_p)(1-\theta_p\beta)\widetilde{mc}_{n,t}+(1-\theta_p)(1-\theta_p\beta)\tilde{P}_{n,t}+\theta_p\beta\left[(1-\theta_p)\tilde{p}_{n,t}+\left(\tilde{\pi}_{n,t+1}+\widetilde{ToT}_{n,t+1}\right)\right]$$

$$\theta_p\left(\tilde{\pi}_{n,t}+\widetilde{ToT}_{n,t}\right)=(1-\theta_p)(1-\theta_p\beta)\left[\widetilde{mc}_{n,t}-\left(\widetilde{\frac{p_{n,t}}{P_{n,t}}}\right)\right]+\theta_p\beta\left(\tilde{\pi}_{n,t+1}+\widetilde{ToT}_{n,t+1}\right)$$

- Floating exchange rate:

$$\Delta i_{n,t} = \phi_i \Delta i_{n,t-1} + (1-\phi_i)\left(\phi_Q \widetilde{Q}_{n,t} + \phi_\pi \tilde{\pi}_{n,t} + \epsilon^i_{n,t}\right)$$

- Fixed exchange rate:
  - Leader n:

$$\Delta i_{n,t} = \phi_i \Delta i_{n,t-1} + (1-\phi_i) \sum_{j \in CU} weight_j \left(\phi_Q \widetilde{Q}_{j,t} + \phi_\pi \tilde{\pi}_{j,t} + \epsilon^i_{n,t}\right),$$

    where $weight_j$ is the share of Q_j in the gdp of the currency union.
  - Follower j:

$$\widetilde{\Delta E}_{j,t} = \widetilde{\Delta E}_{n,t}$$

16. International Euler equation

- Complete markets

$$\tilde{U}_{1,n,t} = \tilde{e}_{n,t}$$

- Incomplete markets (Uncovered interest rate parity)

$$0 = \tilde{e}_{1,t}$$

$$\beta \Delta i_{n,t} - \tilde{\pi}_{n,t+1} + \tilde{e}_{n,t+1} - \tilde{e}_{n,t} = \beta \Delta i_{1,t} - \tilde{\pi}_{1,t+1} + \tilde{e}_{1,t+1} - \tilde{e}_{1,t} + \iota \frac{S^*_1}{Y_1} \tilde{S}^*_{1,t}. \qquad \text{for} \quad n > 1$$

17. Definition of change in nominal exchange rate

$$\widetilde{\Delta E}_{n,t} = (\tilde{e}_{n,t} - \tilde{e}_{n,t-1}) - \tilde{\pi}_{n,t}$$

18. Definition of Terms of Trade

$$\widetilde{ToT}_{n,t} = \widetilde{\left(\frac{p_{n,t}}{P_{n,t}}\right)} - \widetilde{\left(\frac{p_{n,t-1}}{P_{n,t-1}}\right)}$$

19. Definition of wage inflation

$$\tilde{\pi}^{w}_{n,t} = \tilde{\pi}_{n,t} + \widetilde{w}_{n,t} - \widetilde{w}_{n,t-1}$$

20. Law of motion for net worth of entrepreneurs [12]

$$NW_{n,t} = \frac{\beta}{F_n}\left\{K_{n,t-1}\left[(1-\tau^K_n)u_{n,t}R^k_{n,t} + \mu_{n,t}(1-\delta(1-\tau^K_n)) - P_{n,t}a\left(u_{n,t}\right)\right] - (1+i_{n,t-1})F_{n,t-1}B^e_{n,t-1}\right\}$$

$$\widetilde{NW}_{n,t} = \frac{\beta}{F_n}(1-\tau^K)r^k_n\lambda_n\tilde{r}^k_{n,t} + \frac{\beta}{F_n}(1-\delta(1-\tau^K_n))\lambda_n\widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)} - (\lambda_n-1)\left(\Delta i_{n,t-1} - \tilde{\pi}_t + \frac{\Delta sp_{n,t-1}}{F_n}\right)$$
$$- \lambda_n\widetilde{\left(\frac{\mu_{n,t-1}}{P_{n,t-1}}\right)} + \widetilde{NW}_{n,t-1}$$

21. Leverage of entrepreneurs

$$\lambda_{n,t} = \frac{\mu_{n,t}K_{n,t+1}}{P_{n,t}NW_{n,t}}$$

$$\tilde{\lambda}_{n,t} = \widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)} + \tilde{K}_{n,t+1} - \widetilde{NW}_{n,t}$$

[12] Dividing through by P_t gives

$$NW_{n,t}\frac{F_n}{\beta} = K_{n,t-1}\left[(1-\tau^K_n)u_{n,t}r^k_{n,t} + \frac{\mu_{n,t}}{P_{n,t}}(1-\delta(1-\tau^K_n)) - a\left(u_{n,t}\right)\right] - \frac{1+i_{n,t-1}}{\pi_{n,t}}F_{n,t-1}\left(\frac{\mu_{n,t-1}}{P_{n,t-1}}K_{n,t-1} - NW_{n,t-1}\right)$$

Log-linearizing gives

$$NW\frac{F_n}{\beta}\widetilde{NW}_{n,t} = \left(\frac{F_n}{\beta} - \frac{F_n}{\beta}\right)K_n\tilde{K}_{n,t-1} + (1-\tau^K)K_nr^k_n\tilde{r}^k_{n,t} + (1-\delta(1-\tau^K_n))K_n\widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)}$$
$$- (K-NW)\frac{F_n}{\beta}\left(\Delta i_{n,t-1} - \tilde{\pi}_t + \tilde{F}_{n,t-1}\right) - \frac{F_n}{\beta}K_n\widetilde{\left(\frac{\mu_{n,t-1}}{P_{n,t-1}}\right)} + \frac{F_n}{\beta}NW\widetilde{NW}_{n,t-1}$$

$$\widetilde{NW}_{n,t} = \frac{\beta}{F_n}(1-\tau^K)r^k_n\lambda_n\tilde{r}^k_{n,t} + \frac{\beta}{F_n}(1-\delta(1-\tau^K_n))\lambda_n\widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)}$$
$$- (\lambda_n-1)\left(\Delta i_{n,t-1} - \tilde{\pi}_t + \tilde{F}_{n,t-1}\right) - \lambda_n\widetilde{\left(\frac{\mu_{n,t-1}}{P_{n,t-1}}\right)} + \widetilde{NW}_{n,t-1}$$

where we used that $u_n = 1$, $a'(1) = (1-\tau^K_n)r^k_n$, $\mu = P$, $\pi = 1$, $1+i = \frac{1}{\beta}$ and $(1-\tau^K_n)r^k_n + 1 - \delta(1-\tau^K_n) = \frac{F_n}{\beta}$ in steady state.

22. Definition of investment

$$\delta \tilde{X}_{n,t} = \tilde{K}_{n,t+1} - (1-\delta)\tilde{K}_{n,t}$$

23. Definition of interest rate spread

$$\begin{aligned} sp_{n,t} &= F(\lambda_{n,t})e^{\epsilon^F_{n,t}} - 1 \\ \Delta sp_{n,t} &= F_n\left(F_\epsilon \tilde{\lambda}_{n,t} + \Delta\epsilon^F_{n,t}\right) \end{aligned}$$

24. Marginal utility of consumption[13] With separable:

$$\widetilde{U}_{1,n,t} = -\frac{1}{\sigma}\tilde{c}_{n,t}$$

[13] **Separable preferences:**

$$\begin{aligned} U_{1,n,t} &= c_{n,t}^{-\frac{1}{\sigma}} \\ \tilde{U}_{1,n,t} &= -\frac{1}{\sigma}\tilde{c}_{n,t} \end{aligned}$$

GHH preferences:

$$\begin{aligned} U_{n,t} &= \frac{1}{1-\frac{1}{\sigma}}\left(c_{n,t} - \kappa_n \frac{L_{n,t}^{1+\frac{1}{\eta}}}{1+\frac{1}{\eta}}\right)^{1-\frac{1}{\sigma}} \\ (U_{1,n,t})^{-\sigma} &= c_{n,t} - \kappa_n \frac{L_{n,t}^{1+\frac{1}{\eta}}}{1+\frac{1}{\eta}} \end{aligned}$$

$$\begin{aligned} -\sigma\tilde{U}_{1,n,t} &= \frac{C_n}{(U_{1,n})^{-\sigma}}\tilde{c}_{n,t} + \frac{L_n}{(U_{1,n})^{-\sigma}}\left(-\kappa_n L_n^{\frac{1}{\eta}}\right)\tilde{L}_{n,t} \\ -\sigma\tilde{U}_{1,n,t} &= \frac{C_n}{(U_{1,n})^{-\sigma}}\tilde{c}_{n,t} - \frac{C_n}{(U_{1,n})^{-\sigma}}\frac{\kappa_n L_n^{1+\frac{1}{\eta}}}{Q_n}\frac{Q_n}{Y_n}\frac{Y_n}{C_n}\tilde{L}_{n,t} \end{aligned}$$

Note that labor supply in steady state is

$$\kappa_n L_n^{\frac{1}{\eta}} = \frac{1-\tau_n^L}{1+\tau_n^C}\frac{W_n}{P_n} = \frac{1-\tau_n^L}{1+\tau_n^C}(1-\alpha)\frac{\psi_q - 1}{\psi_q}\frac{Q_n}{L_n},$$

so that

$$\frac{\kappa_n L_n^{1+\frac{1}{\eta}}}{Q_n} = \frac{1-\tau_n^L}{1+\tau_n^C}(1-\alpha)\frac{\psi_q - 1}{\psi_q}.$$

with GHH:

$$-\sigma\left(1-\frac{1-\alpha}{1+\frac{1}{\eta}}\frac{1-\tau_n^L}{1+\tau_n^C}\frac{\psi_q-1}{\psi_q}\frac{Q_n}{C_n}\right)\tilde{U}_{1,n,t}$$
$$=\tilde{c}_{n,t}-(1-\alpha)\frac{1-\tau_n^L}{1+\tau_n^C}\frac{\psi_q-1}{\psi_q}\frac{Q_n}{C_n}\tilde{L}_{n,t}$$

with CD:

$$\widetilde{U}_{1,n,t}=\left(\left(1-\frac{1}{\sigma}\right)\kappa-1\right)\tilde{c}_{n,t}$$
$$-\left(1-\frac{1}{\sigma}\right)\kappa(1-\alpha)\frac{1-\tau_n^L}{1+\tau_n^C}\frac{\psi_q-1}{\psi_q}\frac{Q_n}{C_n}\tilde{L}_{n,t}$$

Also:

$$\frac{C_n}{(U_{1,n})^{-\sigma}}=\frac{C_n}{C_n-\kappa_n\frac{L_n^{1+\frac{1}{\eta}}}{1+\frac{1}{\eta}}}$$
$$=\left(1-\frac{1}{1+\frac{1}{\eta}}\frac{Y_n}{C_n}\frac{\kappa_n L_n^{1+\frac{1}{\eta}}}{Q_n}\frac{Q_n}{Y_n}\right)^{-1}$$
$$=\left(1-\frac{1-\alpha}{1+\frac{1}{\eta}}\frac{1-\tau_n^L}{1+\tau_n^C}\frac{\psi_q-1}{\psi_q}\frac{Y_n}{C_n}\frac{Q_n}{Y_n}\right)^{-1}$$

Cobb-Douglas preferences:

$$U_{n,t}=\frac{\left(c_{n,t}^{\kappa}(1-L_{n,t})^{1-\kappa}\right)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}$$

$$U_{1,n,t}=\kappa c_{n,t}^{(1-\frac{1}{\sigma})\kappa-1}(1-L_{n,t})^{(1-\kappa)(1-\frac{1}{\sigma})}$$
$$\widetilde{U}_{1,n,t}=\left[\left(1-\frac{1}{\sigma}\right)\kappa-1\right]\tilde{c}_{n,t}-\frac{L_n}{1-L_n}(1-\kappa)(1-\frac{1}{\sigma})\tilde{L}_{n,t}$$

Labor supply in steady state is

$$\frac{1-\kappa}{\kappa}\frac{C_n}{L_n}=(1-\alpha)\frac{1-\tau_n^L}{1+\tau_n^C}\frac{\psi_q-1}{\psi_q}\frac{Q_n}{L_n}$$
$$\frac{L_n}{1-L_n}=\frac{\kappa}{1-\kappa}(1-\alpha)\frac{1-\tau_n^L}{1+\tau_n^C}\frac{\psi_q-1}{\psi_q}\frac{Q_n}{Y_n}\frac{Y_n}{C_n}$$

25. Marginal rate of substitution[14]

$$\tilde{U}_{2,n,t} - \tilde{U}_{1,n,t} = \frac{1}{\eta}\tilde{L}_{n,t} - \tilde{U}_{1,n,t}$$

With GHH:

$$\tilde{U}_{2,n,t} - \tilde{U}_{1,n,t} = \frac{1}{\eta}\tilde{L}_{n,t}$$

With CD:

$$\tilde{U}_{2,n,t} - \tilde{U}_{1,n,t} = \tilde{c}_{n,t} - \frac{\kappa}{1-\kappa}(1-\alpha)\frac{\psi_q - 1}{\psi_q}\frac{Q_n}{C_n}\tilde{L}_{n,t}$$

26. Hand-to-Mouth consumers[15]

$$C_{n,t} = (1-\chi)c_{n,t} + \chi m_n^{htm}\left(Y_{n,t} + \upsilon_n G_{n,t}\right)$$
$$\tilde{c}_{n,t} = \frac{1}{1-\chi}\widetilde{C}_{n,t} - \frac{\chi}{1-\chi}\frac{1}{Y_n + \upsilon_n G_n}\left(Y_n\tilde{Y}_{n,t} + \upsilon_n G_n\tilde{G}_{n,t}\right)$$

[14]**GHH preferences:**

$$U_{2,n,t} = -\kappa_n L_{n,t}^{\frac{1}{\eta}} U_{1,n,t}^h.$$

And log-linearizing gives

$$\tilde{U}_{2,n,t} - \tilde{U}_{1,n,t} = \frac{1}{\eta}\tilde{L}_{n,t}$$

Cobb-Douglas preferences:

$$U_{2,n,t} = -\frac{1-\kappa}{\kappa}\frac{c_{n,t}}{1-L_{n,t}}U_{1,n,t}.$$

And log-linearizing gives

$$\tilde{U}_{2,n,t} - \tilde{U}_{1,n,t} = \tilde{c}_{n,t} - \frac{L_n}{1-L_n}\tilde{L}_{n,t}$$

[15]We define hand-to-mouth consumption as

$$c_{n,t}^{htm} = m_n^{htm}\left(Y_{n,t} + \upsilon_n G_{n,t}\right),$$

with $m_n^{htm} = \frac{C_n}{Y_n + \upsilon_n G_n}$ in steady state.

27. Budget constraint (for incomplete market case)[16]

$$\frac{\Delta S^*_{1,t}}{Y_{1,t}} = 0$$

$$\tilde{Y}_{n,t} - \frac{Q_n}{Y_n}\left(\widetilde{\left(\frac{p_{n,t}}{P_{n,t}}\right)} + \widetilde{Q}_{n,t}\right) = \sum_{j\neq n}\frac{S^j_n}{Y_n}\left(\Delta i_{j,t-1} + \frac{1-\beta}{\beta}\left(\tilde{E}_{j,t} - \tilde{e}_{n,t}\right)\right) + \frac{1}{\beta}\frac{\Delta S^*_{n,t-1}}{Y_{n,t-1}} - \frac{\Delta S^*_{n,t}}{Y_{n,t}} \qquad \text{for} \quad n > 1$$

[16]Note that the quadratic penalty term on foreign bond holdings does not affect the log-linearized solution to the budget constraint. The full household budget constraint with incomplete markets is

$$\begin{aligned} &P_{n,t}\left[C_{n,t} + X_{n,t}\right] + (1-\delta)\,\mu_{n,t}K_{n,t} + B_{n,t} + \frac{S^*_{n,t}}{E_{n,t}} \\ &\quad = \mu_{n,t}K_{n,t+1} + W_{n,t}L_{n,t} + \Pi^f_{n,t} + \Pi^e_{n,t} + (1+i_{t-1})F(\lambda_{n,t-1})e^{\epsilon^F_{n,t-1}}B_{n,t-1} + \frac{(1+i^*_{t-1})S^*_{n,t-1}}{E_{n,t}} - T_{n,t}, \end{aligned}$$

where $B_{n,t}$ are loans extended to domestic entrepreneurs. Use

$$\begin{aligned} T_{n,t} &= G_{n,t} \\ C_{n,t} + X_{n,t} + G_{n,t} + a(u_{n,t})K_{n,t} &= Y_{n,t} \\ W_{n,t}L_{n,t} + \Pi^f_{n,t} &= p_{n,t}Q_{n,t} - R_{n,t}u_{n,t}K_{n,t} \end{aligned}$$

to rewrite the budget constraint as

$$\begin{aligned} P_{n,t}Y_{n,t} - P_{n,t}a(u_{n,t})K_{n,t} + R_{n,t}u_{n,t}K_{n,t} + (1-\delta)\,\mu_{n,t}K_{n,t} - p_{n,t}Q_{n,t} - \frac{(1+i^*_{t-1})S^*_{n,t-1}}{E_{n,t}} + \frac{S^*_{n,t}}{E_{n,t}} \\ = \mu_{n,t}K_{n,t+1} + \Pi^e_{n,t} + (1+i_{t-1})F(\lambda_{n,t-1})e^{\epsilon^F_{n,t-1}}B_{n,t-1} - B_{n,t}. \end{aligned}$$

For entrepreneurs, the budget constraint is

$$\mu_{n,t}K_{n,t+1} + \Pi^e_{n,t} + (1+i_{t-1})F(\lambda_{n,t-1})e^{\epsilon^F_{n,t-1}}B_{n,t-1} = R_{n,t}u_{n,t}K_{n,t} - P_{n,t}a(u_{n,t})K_{n,t} + (1-\delta)\mu_{n,t}K_{n,t} + B_{n,t}.$$

Inserting this into the households' budget constraint gives

$$P_{n,t}Y_{n,t} - p_{n,t}Q_{n,t} = \frac{(1+i^*_{t-1})S^*_{n,t-1}}{E_{n,t}} - \frac{S^*_{n,t}}{E_{n,t}}.$$

Collecting terms and dividing by $P_{n,t}$ gives

$$Y_{n,t} - \frac{p_{n,t}}{P_{n,t}}Q_{n,t} = \frac{(1+i^*_{t-1})S^*_{n,t-1} - S^*_{n,t}}{e_{n,t}},$$

which can be log-linearized to

$$\tilde{Y}_{n,t} - \frac{Q_n}{Y_n}\left(\widetilde{\left(\frac{p_{n,t}}{P_{n,t}}\right)} + \widetilde{Q}_{n,t}\right) = \frac{S^*_n}{Y_n}\Delta i^*_{t-1} + \frac{1}{\beta}\frac{\Delta S^*_{n,t-1}}{Y_{n,t-1}} - \frac{\Delta S^*_{n,t}}{Y_{n,t}} - \frac{S^*_n}{Y_n}\frac{1-\beta}{\beta}\tilde{e}_{n,t}.$$

Finally, we assume that net foreign asset positions are proportional to net export positions:

$$\tilde{Y}_{n,t} - \frac{Q_n}{Y_n}\left(\widetilde{\left(\frac{p_{n,t}}{P_{n,t}}\right)} + \widetilde{Q}_{n,t}\right) = \sum_{j\neq n}\frac{S^j_n}{Y_n}\left(\Delta i_{j,t-1} + \frac{1-\beta}{\beta}\left(\tilde{E}_{j,t} - \tilde{e}_{n,t}\right)\right) + \frac{1}{\beta}\frac{\Delta S^*_{n,t-1}}{Y_{n,t-1}} - \frac{\Delta S^*_{n,t}}{Y_{n,t}},$$

where we used the definition of $i^*_{t-1} = \sum_{j\neq n} E_{j,t}(1+i_{j,t-1})$.

2.2 Redundant Variables

1. Nominal net exports (in percent of steady-state GDP)

$$\begin{aligned} NX_{n,t} &= p_{n,t}\left(Q_{n,t} - \upsilon_n G_{n,t}\right) - P_{n,t}Y_{n,t} \\ \Delta NX_{n,t} &= (Q_n - \upsilon_n G_n)\tilde{p}_{n,t} + Q_n\widetilde{Q}_{n,t} - \upsilon_n G_n \tilde{G}_{n,t} - Y_n\left(\tilde{P}_{n,t} + \tilde{Y}_{n,t}\right) \\ \frac{\Delta NX_{n,t}}{Q_n} &= \left(1 - \frac{\upsilon_n G_n}{Q_n}\right)\tilde{p}_{n,t} + \widetilde{Q}_{n,t} - \frac{\upsilon_n G_n}{Q_n}\tilde{G}_{n,t} - \frac{Y_n}{Q_n}\left(\tilde{Y}_{n,t} - \tilde{P}_{n,t}\right) \end{aligned}$$

2. Change in real effective exchange rate

$$\begin{aligned} ee_{n,t} &= \sum_{j=1}^{N} sh_{n,j}\frac{e_n}{e_j} \\ \Delta\widetilde{ee}_{n,t} &= \Delta\tilde{e}_{n,t} - \sum_{j=1}^{N} sh_{n,j}\Delta\tilde{e}_{j,t} \end{aligned}$$

   where $sh_{n,j} = \left(\frac{1}{2}\frac{\mathbb{N}_n y_n^j + \mathbb{N}_j y_j^n}{\mathbb{N}_n(Y_n + \upsilon_n G_n)}\right)$ is the average trade weight.

3. Change in nominal effective exchange rate

$$\begin{aligned} EE_{n,t} &= \sum_{j=1}^{N} sh_{n,j}\frac{E_n}{E_j} \\ \Delta\widetilde{EE}_{n,t} &= \Delta\tilde{E}_{n,t} - \sum_{j=1}^{N} sh_{n,j}\Delta\tilde{E}_{j,t} \end{aligned}$$

4. Price index of good purchased by government

$$\tilde{P}^G_{n,t} = \upsilon_n\tilde{p}_{n,t} + (1 - \upsilon_n)\tilde{P}_{n,t}.$$

5. Primary balance (in percent of steady-state GDP)[17]

$$
\begin{aligned}
PB_{n,t} &= \tau^C_{n,t} P_{n,t} C_{n,t} + \tau^L_{n,t} W_{n,t} L_{n,t} + \tau^K_{n,t} \left(P_{n,t} Q_{n,t} - W_{n,t} L_{n,t} - \delta K_{n,t} \right) - P^G_{n,t} G_{n,t} \\
\Delta PB_{n,t} &= \tau^C_n C_n \left(\tilde{\tau}^C_{n,t} + \tilde{P}_{n,t} + \tilde{C}_{n,t} \right) + \tau^L_n W_n L_n \left(\tilde{\tau}^L_{n,t} + \widetilde{W}_{n,t} + \tilde{L}_{n,t} \right) - G_n \left(\tilde{P}^G_{n,t} + \widetilde{G}_{n,t} \right) \\
&\quad + \tau^K_n \left[\left(Q_n - W_n L_n - \delta K_n \right) \tilde{\tau}^K_{n,t} + Q_n \widetilde{Q}_{n,t} - W_n L_n \left(\widetilde{W}_{n,t} + \tilde{L}_{n,t} \right) - \delta K_n \widetilde{K}_{n,t} \right] \\
\frac{\Delta PB_{n,t}}{GDP_n} &= \tau^C_n \frac{C_n}{GDP_n} \left(\tilde{\tau}^C_{n,t} + \tilde{C}_{n,t} \right) + \tau^L_n \frac{W_n L_n}{GDP_n} \left(\tilde{\tau}^L_{n,t} + \widetilde{w}_{n,t} + \tilde{L}_{n,t} \right) - \frac{G_n}{GDP_n} \widetilde{G}_{n,t} \\
&\quad + \tau^K_n \left[\left(1 - \frac{W_n L_n + X_n}{GDP_n} \right) \tilde{\tau}^K_{n,t} + \widetilde{Q}_{n,t} - \frac{W_n L_n}{GDP_n} \left(\widetilde{W}_{n,t} + \tilde{L}_{n,t} \right) - \frac{X_n}{GDP_n} \widetilde{K}_{n,t} \right]
\end{aligned}
$$

6. Static primary balance (in percent of steady-state GDP)

$$
\frac{\Delta PB^{stat}_{n,t}}{GDP_n} = \tau^C_n \frac{C_n}{GDP_n} \tilde{\tau}^C_{n,t} + \tau^L_n \frac{W_n L_n}{GDP_n} \tilde{\tau}^L_{n,t} + \tau^K_n \left(1 - \frac{W_n L_n + X_n}{GDP_n} \right) \tilde{\tau}^K_{n,t} - \frac{G_n}{GDP_n} \widetilde{G}_{n,t}
$$

2.3 Combining Log-Linearized Equations

Production of the final good (11) Inserting the FOC wrt $y^j_{n,t}$

$$
\widetilde{\left(\frac{p_{j,t}}{P_{j,t}} \right)} + \tilde{e}_{j,t} - \tilde{e}_{n,t} = \frac{1}{\psi_y} \left(\tilde{Y}_{n,t} - \tilde{y}^j_{n,t} \right) \quad \forall j
$$

into the Production of the final good (11)

$$
\tilde{Y}_{n,t} = \sum_{j=1}^{N} \omega^j_n \tilde{y}^j_{n,t}
$$

gives

$$
0 = \sum_{j=1}^{N} \omega^j_n \left(\widetilde{\left(\frac{p_{j,t}}{P_{j,t}} \right)} + \tilde{e}_{j,t} - \tilde{e}_{n,t} \right)
$$

[17] We simplify by setting $PB_n = 0$, so that nominal price changes drop out. Capital taxes apply to all non-labor income. Depreciation costs are tax-deductible.

Market clearing for intermediate good (12) Inserting the FOC wrt $y^n_{j,t}$

$$\widetilde{\left(\frac{p_{n,t}}{P_{n,t}}\right)} + \tilde{e}_{n,t} - \tilde{e}_{j,t} = \frac{1}{\psi_y}\left(\tilde{Y}_{j,t} - \tilde{y}^n_{j,t}\right) \quad \forall n$$

into the Market clearing for intermediate good (12)

$$\frac{Q_n}{Y_n}\tilde{Q}_{n,t} = \sum_{j=1}^{N} \frac{\mathbb{N}_j Y_j}{\mathbb{N}_n Y_n}\omega^n_j \tilde{y}^n_{j,t} + \frac{\upsilon_n G_n}{Y_n}\tilde{G}_{n,t}$$

gives

$$\frac{Q_n}{Y_n}\tilde{Q}_{n,t} - \frac{\upsilon_n G_n}{Y_n}\tilde{G}_{n,t} = \sum_{j=1}^{N} \frac{\mathbb{N}_j Y_j}{\mathbb{N}_n Y_n}\omega^n_j \left[\tilde{Y}_{j,t} - \psi_y\left(\widetilde{\left(\frac{p_{n,t}}{P_{n,t}}\right)} + \tilde{e}_{n,t} - \tilde{e}_{j,t}\right)\right]$$

Phillips curve (14) Inserting the Real marginal costs (7)

$$\widetilde{mc}_{i,t} = -\tilde{Z}_{i,t} + \alpha\tilde{r}_{i,t} + (1-\alpha)\widetilde{w}_{i,t}$$

and the Definition of Terms of Trade (18)

$$\widetilde{ToT}_{i,t} = \widetilde{\left(\frac{p_{i,t}}{P_{i,t}}\right)} - \widetilde{\left(\frac{p_{i,t-1}}{P_{i,t-1}}\right)}$$

into the Phillips curve (14)

$$\theta_p\left(\tilde{\pi}_{i,t} + \widetilde{ToT}_{i,t}\right) = (1-\theta_p)(1-\theta_p\beta)\left[\widetilde{mc}_{i,t} - \widetilde{\left(\frac{p_{i,t}}{P_{i,t}}\right)}\right] + \theta_p\beta\left(\tilde{\pi}_{i,t+1} + \widetilde{ToT}_{i,t+1}\right)$$

gives

$$\theta_p\left(\tilde{\pi}_{i,t} - \widetilde{\left(\frac{p_{i,t-1}}{P_{i,t-1}}\right)}\right) = (1-\theta_p)(1-\theta_p\beta)\left(-\tilde{Z}_{i,t} + \alpha\tilde{r}^k_{i,t} + (1-\alpha)\widetilde{w}^f_{i,t}\right) - (1+\theta_p^2\beta)\widetilde{\left(\frac{p_{i,t}}{P_{i,t}}\right)} + \theta_p\beta\left(\tilde{\pi}_{i,t+1} + \widetilde{\left(\frac{p_{i,t+1}}{P_{i,t+1}}\right)}\right)$$

Monetary policy (15) Inserting the Definition of change in nominal exchange rate (17)

$$\widetilde{\Delta E}_{i,t} = (\tilde{e}_{i,t} - \tilde{e}_{i,t-1}) - \tilde{\pi}_{i,t}$$

into the monetary policy rule for followers under fixed exchange rates (15)

$$\widetilde{\Delta E}_{j,t} = \widetilde{\Delta E}_{i,t}$$

gives

$$(\tilde{e}_{j,t} - \tilde{e}_{j,t-1}) - \tilde{\pi}_{j,t} = (\tilde{e}_{i,t} - \tilde{e}_{i,t-1}) - \tilde{\pi}_{i,t}$$

Wage Phillips curve (2) Inserting the Definition of wage inflation

$$\tilde{\pi}^w_{n,t} = \tilde{\pi}_{n,t} + \widetilde{w}_{n,t} - \widetilde{w}_{n,t-1}$$

into the Wage Phillips curve (2)

$$\theta_w \tilde{\pi}^w_t = (1-\theta_w)(1-\theta_w\beta)\left[\widetilde{U}_{2,n,t} - \widetilde{U}_{1,n,t} + \frac{\Delta\tau^L_{n,t}}{1-\tau^L_n} + \frac{\Delta\tau^C_{n,t}}{1+\tau^C_n} - \widetilde{w}_{n,t}\right] + \theta_w\beta\tilde{\pi}^w_{t+1}$$

gives

$$\begin{aligned}\theta_w\left(\tilde{\pi}_{n,t} - \widetilde{w}_{n,t-1}\right) = (1-\theta_w)(1-\theta_w\beta)\left[\widetilde{U}_{2,n,t} - \widetilde{U}_{1,n,t} + \frac{\Delta\tau^L_{n,t}}{1-\tau^L_n} + \frac{\Delta\tau^C_{n,t}}{1+\tau^C_n}\right] - \left(1+\theta^2_w\beta\right)\widetilde{w}_{n,t} \\ + \theta_w\beta\left(\tilde{\pi}_{n,t+1} + \widetilde{w}_{n,t+1}\right)\end{aligned}$$

Capital Euler equation (3) Inserting the Definition of the Leverage of entrepreneurs (21)

$$\widetilde{\lambda}_{n,t} = \widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)} + \tilde{K}_{n,t} - \widetilde{NW}_{n,t}$$

into the Definition of interest rate spread (23)

$$\frac{\Delta sp_{n,t}}{F_n} = F_\epsilon\widetilde{\lambda}_{n,t} + \Delta\epsilon^F_{n,t}$$

gives

$$\frac{\Delta sp_{n,t}}{F_n} = F_\epsilon \left(\widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)} + \tilde{K}_{n,t} - \widetilde{NW}_{n,t} \right) + \Delta \epsilon^F_{n,t}.$$

Inserting this into the Capital Euler equation (3)

$$\frac{\beta}{F_n}\left((1-\tau^K_n) r_n \tilde{r}_{n,t+1} - (r_n - \delta)\Delta\tau^K_{n,t+1}\right) = \beta \Delta i_{n,t} - \tilde{\pi}_{n,t+1} + \frac{\Delta sp_{n,t}}{F_n} + \widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)} - \frac{\beta}{F_n}(1-\delta(1-\tau^K_n))\widetilde{\left(\frac{\mu_{n,t+1}}{P_{n,t+1}}\right)}$$

gives

$$\begin{aligned}\frac{\beta}{F_n}\left((1-\tau^K_n) r_n \tilde{r}_{n,t+1} - (r_n - \delta)\Delta\tau^K_{n,t+1}\right) = \beta \Delta i_{n,t} - \tilde{\pi}_{n,t+1} + F_\epsilon \left(\widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)} + \tilde{K}_{n,t} - \widetilde{NW}_{n,t} \right) + \Delta \epsilon^F_{n,t} \\ + \widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)} - \frac{\beta}{F_n}(1-\delta(1-\tau^K_n))\widetilde{\left(\frac{\mu_{n,t+1}}{P_{n,t+1}}\right)}.\end{aligned}$$

Law of motion for net worth of entrepreneurs (20) Similarly, inserting the expression for the spread into the Law of motion for net worth of entrepreneurs (20)

$$\begin{aligned}\widetilde{NW}_{n,t} = \frac{\beta}{F_n}(1-\tau^K) r^k_n \lambda_n \tilde{r}^k_{n,t} + \frac{\beta}{F_n}(1-\delta(1-\tau^K_n))\lambda_n \widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)} - (\lambda_n - 1)\left(\Delta i_{n,t-1} - \tilde{\pi}_t + \frac{\Delta sp_{n,t-1}}{F_n}\right) \\ - \lambda_n \widetilde{\left(\frac{\mu_{n,t-1}}{P_{n,t-1}}\right)} + \widetilde{NW}_{n,t-1}\end{aligned}$$

gives

$$\begin{aligned}\widetilde{NW}_{n,t} = \frac{\beta}{F_n}(1-\tau^K) r^k_n \lambda_n \tilde{r}^k_{n,t} + \frac{\beta}{F_n}(1-\delta(1-\tau^K_n))\lambda_n \widetilde{\left(\frac{\mu_{n,t}}{P_{n,t}}\right)} - (\lambda_n - 1)\left(\Delta i_{n,t-1} - \tilde{\pi}_t\right) \\ - (\lambda_n - 1)\left(F_\epsilon \left(\widetilde{\left(\frac{\mu_{n,t-1}}{P_{n,t-1}}\right)} + \tilde{K}_{n,t-1} - \widetilde{NW}_{n,t-1} \right) + \Delta \epsilon^F_{n,t-1} \right) - \lambda_n \widetilde{\left(\frac{\mu_{n,t-1}}{P_{n,t-1}}\right)} + \widetilde{NW}_{n,t-1}\end{aligned}$$