Online Annex for Zsolt Darvas, Lennard Welslau, and Jeromin Zettelmeyer, "Sovereign Debt and Fiscal Integration in the European Union"

A1. Event study on the effect of ECB program announcements on CDS spreads

We conduct an event study to assess the effects of OMT and TPI-related announcements made by the ECB on sovereign and bank credit default swap (CDS) spreads in Italy, Spain, and Germany. We estimate the following regression country-by-country for two separate periods: January 2011–December 2013 and January 2021–December 2023.

$$\Delta CDS_{i,t} = \alpha + \beta D_t + \varepsilon_{i,t},$$

Here, $\Delta CDS_{t,i}$ is the daily change in the 5-year CDS spread for entity i (sovereign or bank) on day t, $\alpha$is a common intercept, D_t is a vector of event dummies, and $\varepsilon_{i,t}$ is the error term. The vector of slope coefficients, β, measures the events' average impact.
Our specification is based on Altavilla et al. (2016), who study the effect of OMT announcements on sovereign bond yields.[1] Their analysis includes additional controls for unanticipated components of macroeconomic news, which they find to have a negligible effect on the event dummy coefficients. Following this result, we adopt a more parsimonious model and exclude additional macroeconomic controls. Because constant-maturity yields are not available for banks, we instead use 5-year CDS spreads on senior unsecured debt as dependent variable for both banks and sovereigns. Following Altavilla et al. (2016), our event dummies take a value of one on the announcement day and the subsequent day to capture any delayed market reactions, and zero otherwise.

The banking sector sample includes Deutsche Bank AG and Commerzbank AG (Germany); UniCredit SpA, Intesa Sanpaolo SpA, and Mediobanca SpA (Italy); and Banco Santander SA and Banco Bilbao Vizcaya Argentaria SA (Spain). To address potential market illiquidity or gaps in Euro-denominated CDS data (defined as spreads remaining unchanged for over 20 consecutive days), we use US Dollar-denominated spreads for Intesa Sanpaolo SpA and BBVA SA.

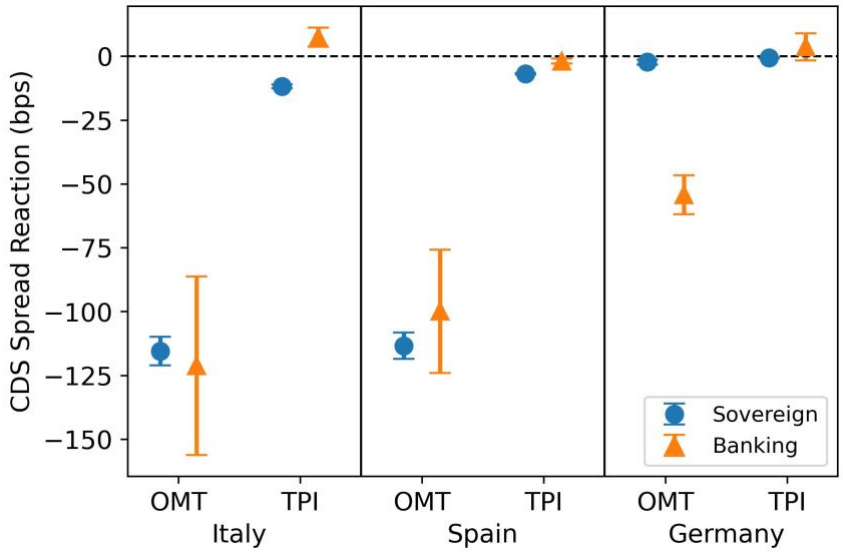
For the TPI, the June 2022 announcement was unexpected, occurring at an ad hoc ECB Governing Council meeting. In contrast, the formal launch in July 2022 was largely anticipated. We include both announcements to test the impact of the initial surprise and its subsequent confirmation, though we expect the coefficient for the June announcement to be more informative.

The results are summarized in Figure A1 and Table A1 and confirm the visual evidence from Figure 3 in the main text. During the 2012 OMT announcements, both sovereign and bank CDS spreads declined significantly in Italy and Spain. Following the 2022 TPI

[1] Altavilla, Carlo, Domenico Giannone, and Michele Lenza (2016). The financial and macroeconomic effects of OMT announcements. International Journal of Central Banking, 12(3), 29–57, https://www.ijcb.org/journal/ijcb16q3a1.htm.

announcements, however, sovereign spreads fell while bank spreads either remained unchanged or rose. This divergence suggests a decoupling of sovereign and bank credit risk in response to the TPI, a policy primarily aimed at supporting sovereigns.

Figure A1: The effects of OMT and TPI announcements on sovereign and bank CDS spreads in Italy, Spain and Germany



Source: Authors' calculations using CDS data from Refinitiv and information about announcement dates.
Notes: Point estimates and 95% confidence intervals for sum of the estimated coefficients for six OMT-related dummy variables and four TPI-related dummy variables for day of and day after program related announcements in 2012 and 2022.

Table A1. Regression Results for CDS Spread Reaction to ECB Announcements

	Italy				Spain				Germany			
	Sovereign		Banks		Sovereign		Banks		Sovereign		Banks	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
OMT (26.07.2012)	-29.26***		-16.06**		-27.57***		-27.68***		0.0896		-20.39***	
	(0.476)		(7.072)		(0.438)		(0.917)		(0.0861)		(2.416)	
OMT (27.07.2012)	-21.15***		-16.49**		-25.87***		-20.62***		-3.334***		-9.486***	
	(0.476)		(8.013)		(0.438)		(4.519)		(0.0861)		(1.591)	
OMT (02.08.2012)	32.76***		17.39**		34.25***		25.81***		3.138***		13.11***	
	(0.476)		(7.212)		(0.438)		(2.513)		(0.0861)		(1.520)	
OMT (03.08.2012)	-44.61***		-17.05**		-32.75***		-14.57***		-2.322***		-12.23***	
	(0.476)		(7.117)		(0.438)		(0.364)		(0.0861)		(0.396)	
OMT (06.09.2012)	-46.03***		-33.23***		-54.52***		-37.70***		-0.242***		-9.346***	
	(0.476)		(9.801)		(0.438)		(10.91)		(0.0861)		(1.114)	
OMT (06.09.2012)	-7.133***		-55.70***		-6.895***		-25.08***		0.398***		-15.91***	
	(0.476)		(1.599)		(0.438)		(1.424)		(0.0861)		(1.352)	
TPI (15.06.2022)		-10.94***		-6.101***		-3.353***		-2.079***		-0.0998***		0.744
		(0.0941)		(0.130)		(0.0382)		(0.154)		(0.0156)		(2.326)
TPI (16.06.2022)		-8.827***		4.815***		-1.793***		1.326***		-0.530***		3.524***
		(0.0941)		(0.607)		(0.0382)		(0.414)		(0.0156)		(1.074)
TPI (21.07.2022)		8.563***		9.192***		0.977***		-0.00444		0.600***		-0.441
		(0.0941)		(1.306)		(0.0382)		(0.0583)		(0.0156)		(0.350)
TPI (22.07.2022)		-0.567***		-0.378		-2.613***		-1.104***		-0.600***		-0.106
		(0.0941)		(1.228)		(0.0382)		(0.191)		(0.0156)		(0.771)
Observations	625	624	1875	1872	625	624	1250	1248	625	624	1250	1248

Source: Authors' calculations using CDS data from Refinitiv and information about announcement dates.
Notes: Point estimates and standard errors for six OMT-related dummy variables and four TPI-related dummy variables for day of and day after program related announcements. Robust standard errors in parentheses (* p<0.10, ** p<0.05, *** p<0.01).

A2. Stochastic DSA methodology

The following describes the methodology, data sources, and implementation of the stochastic debt sustainability analysis. The code and all publicly available data for reproduction of our results are available in the accompanying replication package.[2]

A2.1. Deterministic debt projections

The starting point for the DSA methodology applied in the paper is the European Commission's Debt Sustainability Monitor (DSM) 2022 (European Commission, 2023). Annex A3 of the DSM describes debt dynamics and the projection of implicit interest rate government debt. The debt ratio in a given year, d_t, is calculated as

$$d_t = \alpha^n \cdot d_{t-1} \cdot \frac{(1+iir_t)}{(1+g_t)} + \alpha^f \cdot d_{t-1} \cdot \frac{(1+iir_t)}{(1+g_t)} \cdot \frac{e_t}{e_{t-1}} - pb_t + f_t,$$

where α^n represents the share of total government debt denominated in domestic currency, α^f represents the share of total government debt denominated in other currencies, iir_t represents the implicit interest rate on government debt, g_t represents the nominal growth rate of GDP (in national currency), e_t represents the nominal exchange rate (expressed as national currency per foreign currency)[3], pb_t represents the primary balance ratio, and f_t represents stock-flow adjustments over GDP.

Data sources. Shares of euro-denominated debt are calculated based on ECB data. Bond level debt data are taken form the Refinitiv Eikon database. Exchange rates are taken from Eurostat. Both variables are assumed to remain constant over the projection horizon. Stock-flow adjustments are taken from the AMECO database and based on projections by the European Commission's DG ECFIN, which are available up to 2024; from 2025, stock-flow adjustments are assumed to be zero, except for Finland and Luxembourg, where future stock-flow adjustments take into account respective pension balances. Nominal GDP growth, the primary balance, and the implicit interest rate on government debt are endogenous model variables. They build on medium-term real growth, output gap, and GDP-deflator projections by the European Commission's Output Gap Working Group, long-term growth and ageing-cost projections based on the European Commission's 2024 Ageing report, long-term market expectations for inflation from Bloomberg, structural primary balance projections from the AMECO database, fiscal multiplier data based on Carnot and de Castro (2015), and budget balance semi-elasticities based on Mourre et al. (2019). The projection of the implicit interest rate on government debt further relies on ECB data on government debt stocks, shares of short- and long-term debt issuance, and average annual debt redemption,

2 Darvas, Zsolt, Lennard Welslau, and Jeromin Zettelmeyer. 2025. Data and Code for: "Sovereign Debt and Fiscal Integration in the European Union." Nashville, TN: American Economic Association; distributed by Inter-university Consortium for Political and Social Research, Ann Arbor, MI. https://doi.org/10.3886/E238402V1.

[3] More precisely, we model debt dynamics differently for euro-members and non-members. Only US dollar debt is considered for euro members, while only euro debt is considered for foreign US debt. Both euro and US dollar debt are considered for other non-euro members.

as well as market expectations for interest rates from Bloomberg. All data sources are described in detail in the "README" file of the replication package.

Projecting nominal growth. The effect of fiscal stimulus and the cyclical dependence of the budget balance make growth and primary balance projections mutually dependent. These dependencies affect the variables from the beginning of the adjustment period in 2025. Prior to the adjustment period, i.e. up to 2024, the model relies directly on projections for the primary balance and nominal growth taken from the AMECO database. From 2025, real growth, as forecasted by the European Commission, is affected by annual adjustments of the structural primary balance. Specifically, in a given year, the effect of the fiscal multiplier effect is proportional to annual adjustments in the structural primary balance relative to its baseline trajectory:

$$m_t = 0.75 * (\Delta spb_t - \Delta spb_t^{BL})$$

Here, 0.75 is the fiscal multiplier of Carnot and de Castro (2015) and Δspb_t^{BL} denotes the annual change in baseline structural primary balance, which is based on the DG ECFIN projections up to 2024 and held constant thereafter. The multiplier m_t affects real growth via its persistent effect on the output gap, narrowing the output gap by m_t in the year of the adjustment t, and reducing its impact by one-third of its initial effect in the two consecutive periods. Thus, the total impact on the output gap in a particular year is the sum of the impact in that year plus 2/3 of the impact from the previous year plus 1/3 of the impact from two years before. This definition differs slightly from the implementation of the fiscal multiplier by the European Commission. For euro area countries, Bulgaria, Czechia, Denmark and Sweden, inflation numbers used to compute nominal growth rates are based on the European Commission's forecast up to 2026 (GDP deflator), which are linearly interpolated with market expectations for 2035 implied by euro area inflation swaps (HICP)[4], before converging to the 2% HICP inflation targets of these countries by 2054, in line with the Commission's methodology[5]. For Hungary, Poland and Romania, where the central banks have higher inflation target, the Commission's methodology assumes that half of the spread vis-à-vis euro area inflation observed in 2026 remains by 2035, which in turn gradually converges to the national inflation targets by 2054.

Projecting the primary balance. The primary balance ratio is the sum of the structural primary balance ratio, a cyclical component, a property income component, and an ageing cost component. Importantly, the latter component, ageing costs net of pension tax revenues, is not separated out during the adjustment period. After the end of the adjustment period, it is assumed that the structural primary balance without the change in ageing costs remains the same, thus, the change in ageing costs changes the structural

[4] Inflation expectations are based on October 2024 averages of daily data collected from Bloomberg on 1 November.

[5] Beyond the DSM, further details about the inflation projection methodology are presented in Box I.2.1 of European Commission (2022) 'Fiscal Sustainability Report 2021', INSTITUTIONAL PAPER 171, Directorate General of Economic Affairs, European Commission.

primary balance after the end of the adjustment. The cyclical component is defined as the product of country-specific budget balance elasticities and the output gap.

Projecting the implicit (average) interest rate. The implicit (average) interest rate on the public debt stock, iir_t, is calculated as the weighted average of the short-term market interest rate i_t^{ST} and the long-term implicit interest rate iir_t^{LT}:

$$iir_t = \alpha_{t-1} * i_t^{ST} + (1 - \alpha_{t-1}) * iir_t^{LT}.$$

Here, α_{t-1} is the share of short-term debt in the total debt stock in t-1 and iir_t^{LT} is calculated as the weighted average of the long-term market rate i_t^{LT} and the long-term implicit market interest rate in t-1:

$$iir_t^{LT} = \beta_{t-1} * i_t^{LT} + (1 - \beta_{t-1}) * iir_{t-1}^{LT},$$

where β_{t-1} is the share of new long-term debt issuance in total long-term debt stock in t-1. Long-term market rates are projected by linearly interpolating from Bloomberg 10-year government bond benchmark rates to 10Y10Y forward rates[6]. Between t+10 and t+30, long-term market rates converge linearly to 2% plus national inflation targets, which yields 4.5%for Poland and Romania, 5% for Hungary and 4% for all other countries. Short-term market rates are calculated using 3 months benchmark rates, 3M10Y forward rates, and 0.5 times the country-specific values for the long-term rate in t+30.

To project the implicit interest rate forward, we calculate the new issuance and total stock of short-term and long-term debt in each period t. Gross financing needs, i.e. the size of new issuance, are the sum of all interest and amortization payments, and the primary balance. Here, interest on short-term debt is the product of short-term market rates and the stock of short-term debt in t-1. Interest on long-term debt is the product of the implied interest rate on long-term debt $iir_t^{LT}$and the long-term debt stock in t-1. Short-term debt is redeemed entirely each period. The share of long-term debt maturing each year is based on bond-level data, as well as the eventual maturing of projected new issuance of long-term debt. Given gross financing needs, the share of newly issued short- and long-term debt is calculated such that the share of short-term debt in total debt is held constant. The resulting debt issuances and stocks in period t are then used to calculate the implicit interest rate in t+1.[7]

A2.2. Stochastic debt projections

Stochastic projections of the debt ratio differ from the methodology by the European Commission.[8] Similar to the Commission, our approach consists in drawing multiple shock

[6] Interest rate expectations are based on October 2024 averages of daily data collected from Bloomberg on 1 September.

[7] In the periods up to 2024, the implicit interest rate is assumed to be equal to DG ECFIN projections from the AMECO database and the implicit long-term interest rate is constructed to be in line with this assumption.

[8] The Commission DSM methodology is in turn based on Berti (2013) “Stochastic public debt projections using the historical variance-covariance matrix approach for EU countries” European Economy. Economic Papers No. 480. and on Beynet and Paviot (2012) "Assessing the sensitivity of Hungarian debt sustainability to macroeconomic shocks under two fiscal policy reactions" OECD Economics Department Working Paper No. 946.

series distribution of historical quarterly shocks for the primary balance, nominal short- and long-term interest rates, nominal GDP growth, and the exchange rates. Rather than drawing from an estimated joint normal distribution, however, we construct shock series using a VAR. Each period of a projected shock series is the result of combining shocks in previous periods with estimated coefficients and a random error component obtained from bootstrapping the residual term of the VAR. Like Bouabdallah et al. (2017), we choose the lag length according to the Schwarz information criterion, which results in a single lag for all countries. After transforming the shocks to annual frequency and constructing the shocks to the implicit interest rate, each series is combined with the projected deterministic path of the respective variable. Recalculating the debt ratio path for each draw using the equation in Section A.II.1 above produces the probability distribution of debt ratio projections. We calculate the distribution based on 100,000 draws.

Definition of shocks. Quarterly shocks are defined as the first differences in the historical quarterly time series. We correct for outliers by winsorizing historical series at the 5th and 95th percentile. Nominal GDP series of EU countries are constructed by combining series for real GDP growth and the GDP deflator from Eurostat and the IMF's International Financial Statistics database. For the US, we use data by the Bureau of Economic Analysis. UK data is taken from the Office for National Statistics. Short- and long-term interest rates are collected from the IMF's International Financial Statistics and the OECD's Key short-term economic indicators. Exchange rates are obtained from Eurostat. Primary balance series are constructed by combining net lending/borrowing and payable interest data from Eurostat for EU countries. For the US, we combine payable interest data from the Bureau of Economic Analysis with net lending/borrowing data from the Board of Governors of the Federal Reserve System. For the UK, we source interest and overall balance data from the Office for National Statistics. These data sources are described in detail in the "README" file referenced above.

Aggregation of shocks. Quarterly shocks for nominal GDP growth, the primary balance, the nominal exchange rate, and the short-term interest rate are transformed to annual frequency by summing the historical shocks in each year. In the first projection year, shocks to the long-term interest rate are transformed in the same way. However, because a change in long-term interest rate in a t quarter will affect overall interest on government debt until the debt issued in that quarter has matured, aggregating quarterly long-term interest rate shocks must account for such persistence. A shock in year t is assumed to carry over to subsequent years, proportionally to the share of maturing debt that is progressively rolled over. Thus, shocks to the implicit long-term interest rate $\varepsilon_t^{i^{LT}}$, from the second projection year onward, are defined as

$$\varepsilon_t^{i^{LT}} = \frac{t}{T} \sum_{q=-4t}^{4} \varepsilon_q^{i^{LT}},$$

where T denotes the average maturity of long-term debt in years, calculated as one over the historical average share of long-term debt maturing, and q denotes the quarters of historical shocks being aggregated. Finally, shocks to the implicit interest rate on government debt are calculated as weighted average of annualized shocks to the short- and long-term interest rate:

$$\varepsilon_t^{iir} = \alpha^{ST}\varepsilon_t^{i^{ST}} + (1 - \alpha^{ST})\varepsilon_t^{i^{LT}}$$

Here, α^{ST} is the share of short-term debt in total government debt, calculated based on ECB data. The variance-covariance matrix of the resulting annual shock series is then used to estimate a joint normal distribution with zero mean from which the shocks used in the stochastic projection are drawn.

A2.3. Assessing debt stabilization

We define debt to be stable with a given probability p, if the slope of p-th percentile of our 20-year debt fanchart is flat on average over the final 5 years of the fanchart projection. Assuming adjustment over n years, the structural primary balance required to achieve stabilization with probability p is given by $SPB^*(n, p)$. Here, adjustment need not be linear as temporary deviations from a linear adjustment path will almost exclusively affect the level of debt and thus leave the slope of the future debt ratio unchanged. Exceptions are effects of additional interest costs, which are negligible in size.

Combined, our fanchart methodology using VAR bootstrap and our definition of debt stabilization described above have implications for countries adjustment requirements that differ from those by the European Commission. First, using a bootstrap abstracts from the assumption of normally distributed shocks. A country which has historically experienced more negative shocks to debt drivers, will thus exhibit negative deviations from the deterministic debt ratio projection.

Table A2. Debt stabilizing structural primary balances, adjustment requirement, and benchmark comparisons

	2024 outcomes according to May 2025 European Commission data			Debt-stabilising structural primary balances		Required adjustment relative to 2024		Comparison with medium-term fiscal plans (MTPs)		Comparison with October 2025 IMF forecasts for 2030		
	Debt	Fiscal balance	SPB	SPB*	SPB*(EC)	SPB*	SPB*(EC)	SPB*(MTP)	SPB*(MTP) - SPB*	SPB^e(IMF)	SPB^e(IMF) - SPB*(MTP)	SPB^e(IMF) - SPB*
	(1)	(2)	(3)	(4)	(5)	(6)=(4)-(3)	(7)=(5)-(3)	(8)	(9)=(8)-(4)	(10)	(11)=(10)-(8)	(12)=(10)-(4)
Greece	154	1.3	4.0	3.2	1.9	-0.8	-2.2	2.3	-0.9	2.0	-0.3	-1.3
Italy	135	-3.4	-0.3	2.5	2.3	2.7	2.5	3.2	0.7	2.0	-1.2	-0.5
United States	124	-7.5	-4.0	1.8	1.8	5.7	5.8	-4.0	-5.7	-3.4	0.6	-5.2
France	113	-5.8	-3.7	1.2	1.2	4.9	4.9	1.8	0.6	…	…	…
Spain	102	-3.2	-0.7	2.3	1.5	3.0	2.2	2.3	0.0	0.6	-1.7	-1.7
Belgium	105	-4.5	-2.0	1.7	1.0	3.7	2.9	1.6	-0.1	-3.6	-5.2	-5.3
United Kingdom	101	-6.0	-2.5	1.7	1.8	4.3	4.3	1.0	-0.7	0.7	-0.3	-1.0
Portugal	95	0.7	2.4	2.9	2.2	0.5	-0.2	2.9	0.0	0.7	-2.2	-2.2
Finland	82	-4.4	-1.1	0.6	1.6	1.7	2.7	2.6	2.0	-2.7	-5.3	-3.3
Austria	82	-4.7	-2.5	0.6	0.9	3.1	3.4	1.2	0.6	-1.6	-2.8	-2.2
Hungary	73	-4.9	0.5	3.7	3.7	3.2	3.2	2.8	-0.9	0.1	-2.7	-3.6
Cyprus	65	4.3	4.1	1.4	2.0	-2.8	-2.2	2.4	1.1	2.3	-0.2	0.9
Slovenia	67	-0.9	0.1	1.8	0.8	1.7	0.7	0.5	-1.3	0.0	-0.5	-1.8
Germany	62	-2.8	-1.0	0.3	0.6	1.3	1.6	1.1	0.8	-2.7	-3.8	-3.1
Slovakia	59	-5.3	-3.8	1.7	1.2	5.5	4.9	1.0	-0.7	0.0	-1.0	-1.7
Poland	55	-6.6	-3.9	1.8	1.5	5.7	5.4	0.4	-1.4	0.0	-0.4	-1.8
Romania	55	-9.3	-6.4	2.3	2.0	8.7	8.5	1.7	-0.6	-2.1	-3.8	-4.4

Source: Authors' calculations based on October 2025 IMF World Economic Outlook, European Commission May 2025 forecasts, the April 2024 EU Ageing report, Bloomberg, ECB, Refinitiv Eikon, U.S. Congressional Budget Office, and UK Office for Budget Responsibility. Note: SPB denotes structural primary balance; SPB* the structural primary balance at the end of a 7 year adjustment period that stabilizes debt with 70 percent probability according to DSA methodology described in the text, and SPB*(EC) the structural primary balance at the end of a 7 year adjustment period that stabilizes debt with 70 percent probability based on the European Commission's (2024) methodology. For the EU countries, SPB*(MTP) refers to the structural primary balance promised after 4-7 years in the EU countries' medium term fiscal plans agreed with the European Commission in late 2024 for most countries and in 2025 for Belgium, Austria, and Germany, for the UK, to March 2025 projections based on the fiscal plans announced by the UK government, and for the U.S., to May 2025 CBO projections. SPB^e(IMF) denotes IMF 2030 structural primary balance forecasts based on October 2025 World Economic Outlook projections. Values for France are missing because WEO fiscal forecasts for France are conditional on legislated policies and hence cannot be interpreted as forecasts (unlike the WEO projections for the remaining countries shown in the table). Debt and deficit numbers refer to the general government for all countries except the United States, for which only the federal government is considered. Pink shading highlights SPB* or SPB*(EC) in excess of 2 percent of GDP; yellow shading highlights adjustment requirement in excess of 3 percent of GDP.

A3. Fiscal Reaction Function Estimation

A3.1. Regression Specification

The estimated fiscal reaction function for EU countries, the UK, and the US, over a period from 1990 to 2024 can be written as

$$s_{it} = \phi s_{it-1} + \rho d_{it-1} + \gamma \left(\frac{Y_{it}}{\overline{Y}_{it}} - 1\right) + \theta' Z_{it} + \eta_i + \varepsilon_{it},$$

Where s_{it} denotes the primary balance of country i in year t , $d_{it-1}$the lagged debt to GDP ratio, $\overline{Y}_{it}$is potential output, $Y_{it}$is real output, $Z_{it}$is a vector of controls, $\eta_i$is a country fixed effect, and $\varepsilon_{it}$is an independent error term. We follow Plödt and Reicher (2015) and Checherita-Westphal and Žďárek (2017) in employing an instrumental variable (IV) approach to control for the endogeneity of the output gap. Instruments include the lagged output gap, the second lag of the debt ratio, and the first and second lag of output growth gap ($\frac{\overline{Y}_t}{\overline{Y}_{t-1}} - \frac{Y_t}{Y_{t-1}}$). For the new EU member states in our sample, Bulgaria, Cyprus, Czechia, Estonia, Croatia, Hungary, Lithuania, Malta, Polen, Romania, Slovakia, and Slovenia, data are only available from 1995 onwards.

A3.2. Deriving the debt limit

The debt limit as defined by Ghosh et al. (2013), is derived from:

$$\mu + f(\overline{d}) = (r - g)\overline{d},$$

where μ summarises the determinants of the primary balance that are independent of the debt level (that is, the level of the intercept and controls in Z_i). The debt limit is then given by the fixed point $\overline{d}$, which is the highest level of debt at which the primary surplus is exactly sufficient to cover the growth-adjusted interest service of an extra unit of debt.

A3.3 Fiscal Reaction Regression Results

Table A3. Fiscal Reaction Function Baseline Estimates

	1990 - 2007				2008 - 2024			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	EU West	EU East	EU West, UK, US		EU West	EU East	EU West, UK, US	
Lagged debt ratio	0.0363***	0.00850	0.0455***		0.0245***	0.0276***	0.0218***	
	(0.00867)	(0.0144)	(0.00972)		(0.00381)	(0.00829)	(0.00368)	
Austria				0.0856***				0.0537
				(0.0215)				(0.0464)
Belgium				0.0448***				-0.00565
				(0.00970)				(0.0451)
Germany				0.109***				0.0744*
				(0.0392)				(0.0449)
Denmark				0.0514***				0.0553**
				(0.0148)				(0.0269)
Spain				0.0768**				0.0318**
				(0.0306)				(0.0139)
Finland				0.0907***				0.0102
				(0.0250)				(0.0122)
France				0.0450				-0.0467
				(0.0341)				(0.0678)
Greece				0.0432***				0.0270***
				(0.0161)				(0.00553)
Ireland				0.0545***				0.0186*
				(0.0104)				(0.0104)
Italy				0.0573***				0.0157
				(0.0208)				(0.0104)
Netherlands				0.0699***				0.0289
				(0.0215)				(0.0411)
Portugal				0.0882***				0.0417***
				(0.0326)				(0.0112)
Sweden				0.132***				0.138**
				(0.0181)				(0.0682)
United Kingdom				0.106*				0.0501***
				(0.0621)				(0.0151)
USA				0.0955***				0.0174
				(0.0301)				(0.0130)
Lagged primary balance	0.609***	0.485***	0.617***	0.657***	0.783***	0.578***	0.759***	0.733***
	(0.0349)	(0.0509)	(0.0384)	(0.0518)	(0.0513)	(0.0817)	(0.0571)	(0.0683)
Output gap	0.326***	0.146**	0.349***	0.380***	0.122**	0.127**	0.108**	0.114**
	(0.0872)	(0.0577)	(0.0844)	(0.0702)	(0.0522)	(0.0535)	(0.0528)	(0.0551)
Irregular expenditures	-0.865***	-0.302	-0.833***	-0.827**	-1.233***	-1.536***	-1.213***	-1.172***
	(0.265)	(0.192)	(0.260)	(0.331)	(0.0677)	(0.280)	(0.0660)	(0.0467)
Trade	0.0205	0.00257	0.0227	0.0238**	0.0121*	0.00999**	0.0258***	0.0267***
	(0.0125)	(0.00989)	(0.0147)	(0.0115)	(0.00651)	(0.00446)	(0.00894)	(0.00949)
Inflation	0.147**	0.00367*	0.169***	0.211***	-0.0999	-0.0707	-0.180*	-0.112
	(0.0657)	(0.00199)	(0.0627)	(0.0665)	(0.0946)	(0.0583)	(0.0960)	(0.0958)
Political stability	0.157**	-0.0377	0.175**	0.120	-0.472***	-0.435**	-0.460***	-0.494***
	(0.0787)	(0.114)	(0.0792)	(0.0845)	(0.162)	(0.191)	(0.161)	(0.170)
Constant	-5.212***	-0.724	-6.050***	-7.574***	0.395	0.435	-0.248	-0.758
	(1.438)	(1.650)	(1.509)	(1.840)	(1.211)	(1.596)	(1.127)	(1.734)
Country fixed effects	x	x	x	x	x	x	x	x
Observations	221	102	255	255	208	192	240	240

Source: Authors' calculations based on IMF World Economic Outlook, European Commission AMECO, Bureau of Economic Analysis, and ICRG. *Note*: Arellano-Bond GMM estimates of EU, UK, and the U.S. fiscal reaction functions. EU13 encompasses Austria, Belgium, Germany, Denmark, Spain, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal, and Sweden. EU East encompasses the new member states Bulgaria, Cyprus, Czechia, Estonia, Croatia, Hungary, Lithuania, Latvia, Malta, Poland, Romania, Slovakia, and Slovenia. Country names denote country-specific slope estimates. Instruments for output gap are the lagged output gap, second lag of the debt ratio, and first and second lag of output growth gap (following Plödt and Reicher 2015, Checherita-Westphal and Žďárek 2017). Irregular expenditures are public annual changes in public expenditures that lie outside 90% of the country's sample. Inflation is a 3-year rolling average of the CPI. Trade describes the sum of exports and imports as share of GDP. Political stability is the ICRG Political Risk Index. Significantly negative cubic lagged debt terms indicate fiscal fatigue following Ghosh et al. (2013). Robust standard errors clustered at country level in parentheses (* p<0.10, ** p<0.05, *** p<0.05)

Table A4. Additional estimates for Western EU

	1990 - 2007				2008 - 2024				2008 - 2019	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Lagged debt ratio	0.240***	0.0240***	0.0363***	0.0458***	-0.106	0.0110**	0.0150***	0.0261***	0.0374***	0.151***
	(0.0870)	(0.00867)	(0.00867)	(0.0134)	(0.0850)	(0.00503)	(0.00344)	(0.00617)	-0.00535	(0.0489)
Lagged debt ratio^2	-0.00270**				0.00130*					-0.00129**
	(0.00113)				(0.000752)					(0.000509)
Lagged debt ratio^3	0.0000105**				-0.00000385*					0.00000419***
	(0.00000455)				(0.00000197)					(0.00000161)
Lagged PB	0.632***	0.679***	0.609***	0.617***	0.770***	0.851***	0.821***	0.824***	0.793***	0.800***
	(0.0464)	(0.0443)	(0.0349)	(0.0397)	(0.0555)	(0.0580)	(0.0462)	(0.0771)	-0.0469	(0.0578)
Output gap	0.309***	0.332***	0.326***	0.305***	0.133**	0.0217*	0.0390*	-0.00266	0.176***	0.178**
	(0.0817)	(0.103)	(0.0872)	(0.106)	(0.0545)	(0.0117)	(0.0220)	(0.0594)	-0.0665	(0.0736)
Irregular expenditure	-0.800***	-0.775***	-0.865***	-0.894***	-1.221***	-1.061***	-1.104***	-1.383***	-1.166***	-1.155***
	(0.294)	(0.216)	(0.265)	(0.332)	(0.0573)	(0.0697)	(0.0714)	(0.0593)	-0.068	(0.0818)
Inflation	0.0172**	0.0164*	0.0205	0.0217**	0.0140*	-0.0119	0.00513	0.0501***	0.0146*	0.0131*
	(0.00809)	(0.00965)	(0.0125)	(0.00922)	(0.00799)	(0.0140)	(0.00721)	(0.0185)	-0.00826	(0.00761)
Trade	0.133**	0.183***	0.147**	0.118	-0.140	-0.254	-0.132	-0.124	0.147**	0.144***
	(0.0609)	(0.0370)	(0.0657)	(0.0901)	(0.0957)	(0.212)	(0.0848)	(0.0769)	-0.0612	(0.0540)
Political stability	0.124	-0.106	0.157**	0.140*	-0.481***	0.188*	-0.0500	-0.377***	0.0933	0.0588
	(0.0925)	(0.0994)	(0.0787)	(0.0823)	(0.174)	(0.101)	(0.102)	(0.140)	-0.0772	(0.0815)
Constant	-9.170***	-1.250	-5.212***	-5.704***	4.141	-0.783	-0.733	-3.285*	-4.687***	-7.176***
	(2.881)	(1.067)	(1.438)	(1.862)	(3.724)	(1.311)	(1.063)	(1.897)	-1.277	(1.566)
Estimator	IV-GMM	IV-GMM	IV-GMM	IV-FE	IV-GMM	IV-GMM	IV-GMM	IV-FE	IV-GMM	IV-GMM
Country fixed effects	x	x	x	x	x	x	x	x	x	x
Time fixed effects		x			x					
Crisis Dummies			x			x				
Observations	221	221	221	221	208	208	208	208	377	377

Source: Authors' calculations based on IMF World Economic Outlook, European Commission AMECO, Bureau of Economic Analysis, and ICRG.

Note: Arellano-Bond GMM and FEIV estimates of Austria, Belgium, Germany, Denmark, Spain, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal, and Sweden. Instruments for output gap are the lagged output gap, second lag of the debt ratio, and first and second lag of output growth gap (following Plödt and Reicher 2015, Checherita-Westphal and Žďárek 2017). Irregular expenditures are public annual changes in public expenditures that lie outside 90% of the country's sample. Inflation is a 3-year rolling average of the CPI. Trade describes the sum of exports and imports as share of GDP. Political stability is the ICRG Political Risk Index. Significantly negative cubic lagged debt terms indicate fiscal fatigue following Ghosh et al. (2013). Robust standard errors clustered at country level in parentheses (* p<0.10, ** p<0.05, *** p<0.05)

Table A5. Additional estimates for Eastern EU

	1990 - 2007				2008 - 2024				2008 - 2019	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Lagged debt ratio	-0.0362	0.00191	0.00850	-0.0259	-0.0183	0.0316***	0.0178**	0.0442***	0.0333***	0.00562
	(0.0828)	(0.0171)	(0.0144)	(0.0180)	(0.0566)	(0.00715)	(0.00809)	(0.0127)	(0.00922)	(0.0471)
Lagged debt ratio^2	0.00155				0.000416					0.000660
	(0.00177)				(0.00106)					(0.000918)
Lagged debt ratio^3	-0.0000138				-0.000000358					-0.00000419
	(0.0000109)				(0.00000565)					(0.00000525)
Lagged PB	0.536***	0.493***	0.485***	0.521***	0.577***	0.538***	0.632***	0.619***	0.513***	0.514***
	(0.0599)	(0.0631)	(0.0509)	(0.0827)	(0.0818)	(0.0345)	(0.0500)	(0.0684)	(0.0534)	(0.0546)
Output gap	0.151***	-0.00105	0.146**	-0.00363	0.139**	0.153***	0.0580	-0.0353	0.164***	0.164***
	(0.0576)	(0.0680)	(0.0577)	(0.0587)	(0.0556)	(0.0505)	(0.0431)	(0.0811)	(0.0402)	(0.0403)
Irregular expenditure	-0.721***	-0.399**	-0.302	-1.027*	-1.518***	-1.113***	-1.247***	-1.688***	-0.785***	-0.813***
	(0.261)	(0.200)	(0.192)	(0.575)	(0.285)	(0.144)	(0.188)	(0.256)	(0.305)	(0.274)
Inflation	0.00000918	-0.00621	0.00257	0.0370**	0.0113***	0.00775	0.00667*	0.0136	0.0109*	0.00948
	(0.0108)	(0.00783)	(0.00989)	(0.0164)	(0.00426)	(0.00526)	(0.00341)	(0.00998)	(0.00589)	(0.00630)
Trade	0.00523***	0.00397	0.00367*	0.00677***	-0.0662	0.208**	-0.104*	-0.121**	0.00419***	0.00390**
	(0.00181)	(0.00326)	(0.00199)	(0.00242)	(0.0595)	(0.0849)	(0.0532)	(0.0485)	(0.00151)	(0.00159)
Political stability	-0.0548	0.253***	-0.0377	-0.0136	-0.443**	-0.330*	-0.387***	-0.275**	-0.0739	-0.0827
	(0.117)	(0.0800)	(0.114)	(0.216)	(0.177)	(0.175)	(0.149)	(0.112)	(0.132)	(0.141)
Constant	-0.120	-2.755**	-0.724	-2.559	1.442	-2.463	1.312	-1.838**	-2.345	-1.878
	(2.413)	(1.149)	(1.650)	(3.093)	(1.569)	(2.268)	(1.404)	(0.774)	(1.660)	(1.729)
Estimator	IV-GMM	IV-GMM	IV-GMM	IV-FE	IV-GMM	IV-GMM	IV-GMM	IV-FE	IV-GMM	IV-GMM
Country fixed effects	x	x	x	x	x	x	x	x	x	x
Time fixed effects		x			x					
Crisis Dummies			x			x				
Observations	102	102	102	102	192	192	192	192	246	246

Source: Authors' calculations based on IMF World Economic Outlook, European Commission AMECO, Bureau of Economic Analysis, and ICRG.
Note: Arellano-Bond GMM and FEIV estimates of Bulgaria, Cyprus, Czechia, Estonia, Croatia, Hungary, Lithuania, Latvia, Malta, Poland, Romania, Slovakia, and Slovenia. Instruments for output gap are the lagged output gap, second lag of the debt ratio, and first and second lag of output growth gap (following Plödt and Reicher 2015, Checherita-Westphal and Žďárek 2017). Irregular expenditures are public annual changes in public expenditures that lie outside 90% of the country's sample. Inflation is a 3-year rolling average of the CPI. Trade describes the sum of exports and imports as share of GDP. Political stability is the ICRG Political Risk Index. Significantly negative cubic lagged debt terms indicate fiscal fatigue following Ghosh et al. (2013). Robust standard errors clustered at country level in parentheses (* p<0.10, ** p<0.05, *** p<0.05)

Table A6. Additional estimates for Western EU, UK, and US

	1990 - 2007				2008 - 2024				2008 - 2019	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Lagged debt ratio	0.250**	0.0271***	0.0455***	0.0514***	-0.123	0.00888**	0.0126***	0.0271***	0.0370***	0.163***
	(0.0985)	(0.00834)	(0.00972)	(0.0146)	(0.0886)	(0.00360)	(0.00319)	(0.00547)	(0.00508)	(0.0485)
Lagged debt ratio^2	-0.00257*				0.00148*					-0.00142***
	(0.00132)				(0.000761)					(0.000515)
Lagged debt ratio^3	0.00000933*				-0.00000447**					0.00000464***
	(0.00000548)				(0.00000191)					(0.00000165)
Lagged PB	0.652***	0.704***	0.617***	0.633***	0.746***	0.842***	0.795***	0.798***	0.803***	0.808***
	(0.0456)	(0.0446)	(0.0384)	(0.0435)	(0.0582)	(0.0671)	(0.0530)	(0.0800)	(0.0409)	(0.0489)
Output gap	0.322***	0.327***	0.349***	0.326***	0.120**	0.000567	0.0225	-0.00759	0.186***	0.190***
	(0.0818)	(0.0883)	(0.0844)	(0.0956)	(0.0536)	(0.0160)	(0.0229)	(0.0524)	(0.0669)	(0.0734)
Irregular expenditure	-0.775***	-0.813***	-0.833***	-0.895***	-1.191***	-1.042***	-1.070***	-1.357***	-1.195***	-1.181***
	(0.288)	(0.221)	(0.260)	(0.331)	(0.0570)	(0.0697)	(0.0631)	(0.0456)	(0.0673)	(0.0723)
Inflation	0.0174*	0.0179*	0.0227	0.0217**	0.0279***	0.00458	0.0186**	0.0520***	0.0170*	0.0154*
	(0.0102)	(0.0107)	(0.0147)	(0.0102)	(0.0102)	(0.0108)	(0.00912)	(0.0163)	(0.00907)	(0.00846)
Trade	0.157***	0.203***	0.169***	0.118	-0.226**	-0.369*	-0.202**	-0.172**	0.148**	0.150***
	(0.0569)	(0.0516)	(0.0627)	(0.0881)	(0.0933)	(0.193)	(0.0846)	(0.0674)	(0.0613)	(0.0539)
Political stability	0.131	-0.0398	0.175**	0.123	-0.444**	0.163	-0.0605	-0.339**	0.0926	0.0616
	(0.0840)	(0.0933)	(0.0792)	(0.0753)	(0.178)	(0.107)	(0.0914)	(0.136)	(0.0745)	(0.0781)
Constant	-10.02***	-3.894***	-6.050***	-5.802***	3.672	-1.597*	-1.335	-3.444*	-4.752***	-7.599***
	(2.942)	(0.812)	(1.509)	(1.862)	(3.984)	(0.928)	(0.863)	(1.934)	(1.262)	(1.498)
Estimator	IV-GMM	IV-GMM	IV-GMM	IV-FE	IV-GMM	IV-GMM	IV-GMM	IV-FE	IV-GMM	IV-GMM
Country fixed effects	x	x	x	x	x	x	x	x	x	x
Time fixed effects		x			x					
Crisis Dummies			x			x				
Observations	255	255	255	255	240	240	240	240	435	435

Source: Authors' calculations based on IMF World Economic Outlook, European Commission AMECO, Bureau of Economic Analysis, and ICRG.
Note: Arellano-Bond GMM and FEIV estimates of Bulgaria, Cyprus, Czechia, Estonia, Croatia, Hungary, Lithuania, Latvia, Malta, Poland, Romania, Slovakia, and Slovenia. Instruments for output gap are the lagged output gap, second lag of the debt ratio, and first and second lag of output growth gap (following Plödt and Reicher 2015, Checherita-Westphal and Žďárek 2017). Irregular expenditures are public annual changes in public expenditures that lie outside 90% of the country's sample. Inflation is a 3-year rolling average of the CPI. Trade describes the sum of exports and imports as share of GDP. Political stability is the ICRG Political Risk Index. Significantly negative cubic lagged debt terms indicate fiscal fatigue following Ghosh et al. (2013). Robust standard errors clustered at country level in parentheses (* p<0.10, ** p<0.05, *** p<0.05)