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Government debt, European Institutions and fiscal rules: a synthetic control approach

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Abstract
Public debt and its development are key questions of public sector economics and fiscal policy. This paper uses the Synthetic Control Method to study how different large-scale steps of European integration and the establishment of the EU fiscal framework have affected government debt in EU Member States. The results point to a notable debt-restricting effect of EU membership and the introduction of the Stability and Growth Pact for a large majority of the studied country groupings as well as for individual countries. Outside of a few individual countries, the actual government debt levels are substantially lower than in the synthetic alternatives.

Keywords European union · Stability and growth pact · European fiscal framework · Fiscal rules · Government debt · International fiscal issues

JEL Classification E62 · H6 · H63 · H87

1 Introduction

Public debt and its development are key questions of public sector economics and fiscal policy. Traditionally studies have shown (for example, Reinhart & Rogoff, 2010; Panizza & Presbitero, 2014 as well as others) that a high amount of public debt will slow down economic growth once the debt-to-GDP ratio exceeds certain thresholds. On the other hand, Blanchard (2019) has suggested that, at least in a low interest rate environment, government debt can be expanded far more than was previously envisaged without stifling growth. Others, however, argue that governments

The views expressed in this paper are those of the authors and do not necessarily reflect those of the European Stability Mechanism (ESM).

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should not interpret negative interest-growth (*r-g*) environments as free lunches, given that a growing probability of a tail event could have major impacts on the safe rates and associated bond issuance (e.g. Lian et al., 2020; Rogoff, 2020), or on the negative effects of debt in a more general sense such as Boskin (2020), who states that in the long run, large debt ratios can lead to substantially higher taxes, lower future net incomes and intergenerational inequity.

The formation of government debt is a complicated process and it is challenging to differentiate between the effects of different large-scale reforms, other factors such as policy choices or technical aspects like stock-flow adjustments. This paper approaches the question by using the novel econometric approach of the Synthetic Control Method (SCM), originally presented by Abadie and Gardeazabal (2003), which can be used to study the effects of large-scale reforms by simulating counterfactuals using control samples where similar reforms were not introduced (or vice versa).

The aim of the paper is to study how different large-scale steps of European integration and the EU fiscal framework have affected public debt in EU Member States. A greater understanding in this regard would enable policymakers to design future policies to be more efficient in reaching their goals regarding levels of public debt. It should be noted that this paper concentrates on the level and dynamics of government debt. It takes no stance on, for example, the potential long-term growth effects from a short-term increase in government debt if invested in a growth-enhancing manner.

To the best of the authors' knowledge, this is the first attempt at explicitly analysing the impact of different EU-level fiscal rules to all EU countries using the methodological innovation of the SCM. In the previous literature, the most closely related studies are Koehler and König (2015), which studies the effect of the Stability and Growth Pact (SGP) on the euro area (EA) aggregate government debt and Strong (2023), which studies how fiscal rules have affected government debt in CFA zone countries. Beyond them applications of the SCM to questions of fiscal issues are somewhat rare with (Pfeil & Feld, 2016; Roesel, 2017) being the most notable exceptions, although they study smaller-scale fiscal rules.

The remainder of the paper is organised as follows: Sect. 2 summaries some of the literature and background on government debt and European institutions, Sect. 3 describes the SCM and the data used in the study, Sect. 4 presents the results of the empirical study, and Sect. 5 studies the robustness of the results. Section 6 concludes.

2 Government Debt and European Institutions

During the last 50 years, the role of the public sector and the conduct of fiscal policy have adjusted to better match the environment of a global economy. Advanced countries around the world have chosen to implement fiscal rules to control the dynamics of several public sector aspects such as government debt, budget balance, and public expenditure. In fact, Yared (2019) suggests that setting fiscal rules is one of the most promising policy choices to subdue the growth of government debt. The number of

countries which are applying some form of fiscal rules has risen rapidly in the past 30 years (Halac & Yared, 2018, 2019). Due to the increasing use of fiscal rules, an expanding amount of literature discusses different aspects such as their design, implementation, numerical compliance and effects.

Reuter (2015, 2019) notes that fiscal rules have a benchmarking effect for policy makers as well as the public and they drive fiscal policy towards numerical targets or limits, even in times of non-compliance. Reuter et al. (2022) further elaborate on this aspect, noting that actual compliance with numerical fiscal rules does not play a systematic role and the effects can be observed even if the rules are not complied with. Reuter (2015) also identifies determinants of compliance with various types of national numerical fiscal rules, finding significantly higher compliance with rules constraining stock (rather than flow) variables, rules set out in coalitional agreements, as well as rules covering larger parts of general government finances.

Another paper by Doray-Demers and Foucault (2017) notes that fiscal stress prevents fiscal reforms in the short term, and leads to stronger fiscal rules in the long term. The paper also suggests that countries facing financial difficulties after the sovereign debt crisis were coerced into adopting more stringent fiscal rules in order to obtain financial support. Badinger and Reuter (2017) identify significant effects of fiscal rules on the budget balance, government bond spreads as well as the volatility of output.

In the European context, the introduction of fiscal rules coincides with the advancement of European integration, which began a new phase with the formation of the EU in 1993 and the subsequent introduction of the SGP in 1997, which meant that member countries were subject to the EU-level fiscal framework and its rules along with any national level rules. In the formation of the EU, the establishment of the Maastricht convergence criteria, most specifically the government deficit and debt criteria, are the most probable actual elements affecting the behaviour of member countries and might act as an anchor for fiscal policy.[1] The design of fiscal rules in the EU is studied by Hallerberg et al. (2007) and Barbier-Gauchard et al. (2021) who conclude that fiscal rules significantly improve the financial performance of a country, but this is very dependent on the type of fiscal rule and structural factors. A similar stance is taken by Vinturis (2022), who concludes that there are notable regional differences in fiscal performance within Europe.

When it comes to compliance with the EU's numerical fiscal rules, Eyraud et al. (2017) note that since the introduction of the euro, a majority of member countries of the EA have failed to comply with at least two of the main four fiscal rules (Deficit, Debt, Medium-Term Objective, Fiscal effort). Hansen (2015) studies the reasons behind deviating from SGP rules and that the reasons are almost always based on economical need (for example, change in GDP growth, unemployment rate, etc.)

[1] The fiscal convergence criteria state that euro area Member States should have a budget deficit that must not exceed 3% of GDP, and a debt-to-GDP ratio that does not exceed 60% (or converges towards this level at a sufficient speed). Other convergence criteria focus on HICP inflation, exchange rate stability and long-term interest rates. Countries are expected to participate in the European Exchange Rate Mechanism (ERM II) for two years before joining the euro.

rather than relative political power, governing ideology or diffusion. The European Commission has the mandate to propose sanctions on countries, which are not complying with budgetary rules. These sanctions are then implemented by the European Council, but fines have rarely been issued. Sacher (2021) suggests that the Commission has taken a stance of "normative-strategic minimum enforcement" where it has refrained from applying the enforcement provisions to their full extent.

When it comes to the SGP, research is somewhat concentrated on political and qualitative aspects. For example, Terziev et al. (2018) summarise the history of the SGP and how the different adjustments since 1997 have affected the content of the agreement. They conclude that the pact was unable to contain the negative effects of the financial crisis, a view shared by Baerg and Hallerberg (2016), while also noting that the amendments made since the financial crisis have shifted the realm of the SGP more into aspects such as budgetary supervision and accountability.

3 The synthetic control method and data

Studying the impact of large-scale reforms is challenging as a counterfactual is needed to disentangle the actual effects from other developments which would have taken place without the reform. The SCM originally presented in Abadie and Gardeazabal (2003) and later developed further in Abadie et al. (2010) and Abadie et al. (2015) is a case study analysis approach designed to address this issue by simulating a counterfactual based on a comparison group. The number of empirical studies using the SCM is expanding and the method has been described by Athey and Imbens (2017, 9) as "arguably the most important innovation in the policy evaluation literature in the last 15 years".

A growing amount of literature is applying the SCM and some of it looks at the effects of European integration on different economic variables. A non-exhaustive list includes, for example, Koehler and König (2015) who study how the SGP has affected the formation of government debt in the Eurozone, Campos et al. (2019) who measure the economic growth effects of European integration, Bouvet (2021) who studies how the EMU has affected income equality, Cieślik and Turgut (2021), who study the growth effects of the EU's eastern enlargement, and Lehtimäki and Sondermann (2022) who use the SCM to analyse the growth impact of the European Single Market.

Some other closely related work with the SCM is done in Billmeier and Nannicini (2013) who study periods of trade liberalisation, Marrazzo and Terzi (2017) who study effects of structural reforms, Adhikari et al. (2018) who study reforms waves, and Stricker and Baruffini (2020) who address the effect of unemployment law reforms on unemployment rates.

This paper applies the SCM to study the development of government debt for different country groupings and individual countries, which have been subject to the EU's fiscal framework at some point. In applying the SCM, the approach of this paper follows the seminal work of Abadie and Gardeazabal (2003) and Abadie et al. (2010) on the SCM as well as the bias-corrected SCM in line with (Abadie &

L'hour, J., 2021; Ben-Michael et al., 2021; Abadie, 2021) as a large-scale robustness analysis. The following sections summary the different elements of the SCM used in this study.[2]

3.1 Unit(s) of interest

Abadie et al. (2015) note that the SCM can be used for each unit of interest separately, so the approach taken in this paper is to study different country groups as well as each individual country in the EU. This should give a broad picture of how the reform steps in European integration have affected the development of debt.

The empirical part begins by focusing on the GDP-weighted average of EU member states, followed by GDP-weighted averages of different country groups as well as all individual countries, which have been members of the EU during the studied time period, and therefore have (at least to some extent) been subject to its fiscal rules. Along with the changing composition of the EU and individual countries, the changing composition of the euro area, above-average economic performers, highly indebted countries and the most compliant as well as the least compliant countries are studied to provide a broad outlook of the large-scale reforms from many different points of view. For all country groupings and individual countries, a secondary reform of the introduction of the SGP is presented as it is a large-scale reform, which is expected to have a direct effect on the dynamics of government debt.

3.2 Comparison group

The SCM calculates the counterfactual (non-)treatment development by using the weighted average of the observations in the donor pool (Abadie et al., 2015). The method matches the characteristics of the treated unit with the synthetic control.

The donor pool used in the main part of this study consists of advanced countries with similar backgrounds in order to minimise potential biases related to the level of development. The donor pool of the main study consists of OECD countries which have not been members of the EU at any point of the sample.[3] This comparison group only consists of countries with similar levels of economic development which, based on Abadie et al. (2010), Kellogg et al. (2021) and Abadie and L'hour, J. (2021), reduce the potential of interpolation biases.

In Sect. 5 studying the robustness of the results, the comparison sample is extended to a group of 13 countries[4] outside the OECD and EU where data availability is sufficient to ensure that the results are not driven by the baseline choice of comparison countries.

[2] Appendix A presents the technical approach.

[3] 14 countries: Australia, Canada, Chile, Colombia, Iceland, Israel, Japan, South Korea, Mexico, New Zealand, Norway, Switzerland, Turkey, USA.

[4] This group consists of: Argentina, Costa Rica (which became an OECD country in 2021), India, Indonesia, Kenya, Malaysia, Nigeria, Paraguay, Singapore, South Africa, Sri Lanka, Thailand and Uruguay.

3.3 Control variables

In the choice of control variables, this paper combines several aspects identified in previous literature to cover different facets of the formation of government debt as well as to address country-specific institutional differences. Given that government debt has a high degree of hysteresis, the initial level is included as an anchoring control variable. The set of other control variables consists of:

1. Age Dependency Ratio
2. Banking Crisis dummy
3. Economic Freedom Index
4. Foreign Direct Investment
5. (log of) Government Expenditure
6. Inflation
7. Real Interest Rate
8. (log of) Population
9. (log of) Real GDP
10. the Share of Government Consumption
11. the Share of Gross Capital Formation
12. the Share of Household Consumption
13. Trade Openness
14. Unemployment

This set of variables captures a large share of the determinants and institutional aspects affecting the development of public debt identified in previous literature. While the set is rather comprehensive on macro-level aspects, it should also be noted that it is challenging to account for all country-specific factors. For example, national fiscal rules have been identified to have a significant effect on government debt when studied alongside the SGP (Kraemer & Lehtimäki, 2023). Therefore, it is prudent to expect some of the observed effects in Sect. 4 to be caused by other factors, at least for some individual countries.

The data used in the study is compiled from broadly used public databases (European Central Bank, Fraser Institute, International Monetary Fund, Penn World Table and World Bank) and consists of country-level data from all EU and non-EU OECD countries as well as a set of countries outside these groups where data availability is sufficient. A listing of all the data, transformations used and descriptive statistics can be found in Appendix B.

One of the potential pitfalls of the SCM is a chance of missing determinants causing a bias in the formation of the counterfactual, but as noted by Abadie et al. (2010) and later added to by Kellogg et al. (2021), a sufficiently long pre-treatment period with a comparison group consisting of observations with similar characteristics lowers this potential.

3.4 Sample

The sample used in the study consists of data from 1972 to 2019 which means a 21-year pre-treatment period from 1972 to the formation of EU in 1993 in the baseline scenario which is, based on Abadie et al. (2015), a relatively long period. The same goes for the introduction of the SGP where the pre-treatment period is 25 years. The choice of the sample period is driven by data availability and limiting the pandemic outside the sample as it was a substantial exogenous shock which is outside the focus of this paper and affected debt levels very heterogeneously in different countries.

The sample is shorter for several individual countries, which have, for example, become independent later than 1972 and joined the EU at different times. Therefore, the amount of pre-treatment and post-treatment years can vary between countries which should be taken into account when interpreting the results.

4 Results

This section presents the results of the study. First for different GDP-weighted country groups, then individual countries and finally discusses the robustness of the results. The study is started by defining the establishment of the EU in 1993 as the main reform, which is then followed by a subsequent reform of the introduction of the SGP in 1997. In the case of individual countries joining after the introduction of the SGP, the reforms are both presumed to have taken place in the year of joining the EU.

For all studied cases, the common practice of studying the root mean squared prediction errors (RMSPE), which describe the difference between the actual development and the synthetic counterpart, is followed. The post-treatment RMSPE and pre-treatment RMSPE as well as their ratio are presented along with the results. While not absolute, a higher ratio of post-treatment RMSPE to pre-treatment RMSPE can be generally interpreted as the studied reform having at least some effect on the development path.

Table 1 presents the predictor balance means, showing the difference between the treated (actual) and the synthetic (scenario where the EU was not formed) as well as covariate weights for the changing composition of the EU. The treated and synthetic are generally quite close to each other with trade openness and interest rate (both lower in the synthetic case) being the most notable differences. In the covariate weights, the initial government debt gets a high weight, as expected, as the initial level acts as an essential anchor for the level of government debt. Other covariates with relatively high weights are government consumption, unemployment, population and government expenditure.

Table 2 presents the weights given to each country in the comparison sample for the changing composition of the EU. The highest weight is assigned to the USA, followed by Korea, Australia and Israel. Canada also gets some weight. In this section, the covariate and country weights are only presented for the EU to conserve space,

Table 1 Predictor balance and covariate weights across countries and time, EU (changing composition)

	Treated	Synthetic	Covariate Weight
Age dependency Ratio	53.19	56.55	0.009
Banking crisis	0.00	0.04	0.059
Economic freedom Index	4.72	6.83	0.012
Foreign direct investment	0.74	0.73	0.001
Government expenditure (log)	26.39	25.93	0.109
Government debt (1972)	31.81	33.92	0.162
Inflation	2.32	2.09	0.068
Interest rate	10.10	4.49	0.010
Population (log)	17.79	17.67	0.119
Real GDP per capita (log)	10.14	9.73	0.014
Share of government consumption	0.17	0.16	0.170
Share of gross capital formation	0.27	0.28	0.025
Share of household consumption	0.60	0.58	0.024
Trade openness	48.44	38.54	0.066
Unemployment	6.58	6.11	0.155

Table 2 Donor country weights, EU (changing composition)

	Weight
Australia	0.169
Canada	0.051
Chile	0.000
Colombia	0.000
Iceland	0.000
Israel	0.131
Japan	0.000
Korea	0.273
Mexico	0.000
New Zealand	0.000
Norway	0.000
Switzerland	0.000
Turkey	0.000
USA	0.376

but the same data for weights for all studied country groups and individual countries can be found from Appendix D and E, and they are also summarised when discussing the robustness of the results.

Figure 1 presents the results for the European Union. The government debt levels for the synthetic counterpart are above the actual EU for the entire studied post-treatment period. When the introduction of the SGP is studied as the large-scale reform, the difference grows in a very similar pattern. The government debt level of

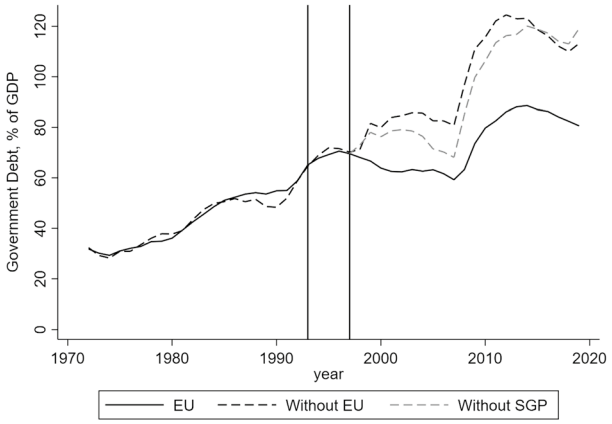

Fig. 1 The effects for the European Union (changing composition), level of general government debt (% of GDP)

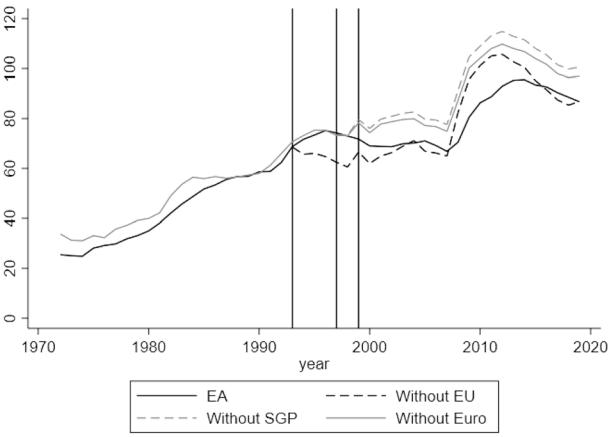

Fig. 2 The effects for the euro area (changing composition), level of general government debt (% of GDP)

the synthetic counterpart remains above the actual EU for the entire post-treatment period for both reforms.

The difference grows notably during the financial crisis. The government debt levels of the synthetic EU stay at a higher level after the crisis, whereas the actual levels have resumed a downward trend after the initial effect of the financial crisis.

Figure 2 presents the results for the euro area. In this case, to concentrate on the potential effect of the introduction of the euro, the year 1999 is set as the main reform, while EU formation and the introduction of the SGP are presented as secondary reforms. The difference between the actual and synthetic euro area is similar to the EU, but debt levels are somewhat higher for the actual GDP-weighted euro

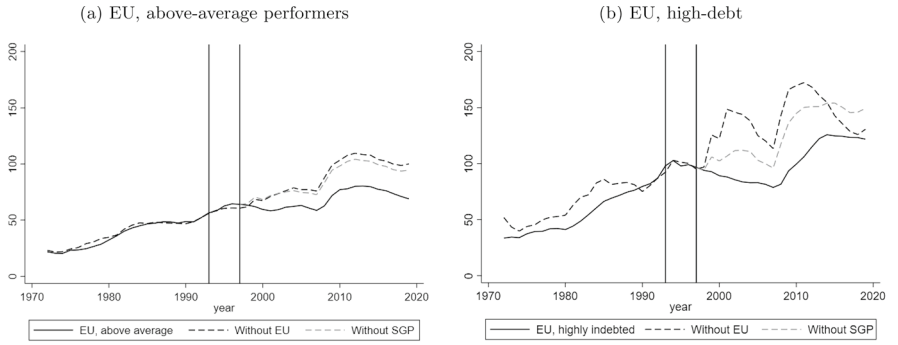

Fig. 3 Country Groupings, level of general government debt (% of GDP)

area as well as the synthetic euro area. The difference between the introduction of the euro and the SGP is very small which potentially indicates that the effect is not driven by the introduction of the common currency. It should also be noted that the separation of the actual and synthetic euro area begins in 1998, the year in which the preventive arm of the SGP came into effect.

Another potential way of grouping countries to broaden the scope of the study is to use the economic performace of countries identified by the European Commission (2020) which notes Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, Netherlands and Sweden as above-average economic performers and Cyprus, Greece, Italy, Portugal and Spain as high-debt countries.

The results, shown in Fig. 3, for above-average performers are quite similar than for the EU, although the peak of the debt is slightly higher after the financial crisis for the changing composition. For the synthetic high-debt countries, the debt levels would have kept increasing after the establishment of the EU and the implementation of the SGP and led to substantially higher levels during the financial crisis.

The actual debt levels are notably lower for both groups than for their synthetic counterparts. However, for the high-debt countries, the development of debt becomes almost stationary after the rise in levels caused by the global financial crisis, whereas the synthetic counterpart, while initially increasing to a notably higher level, begins lowering after the crisis. Overall, it appears that the studied reforms have substantially reduced the volatility of debt.

Another option is to study how government debt has formed in countries which have been the most or least compliant with fiscal rules. The European Fiscal Board compliance tracker (Larch et al., 2023) assesses numerical compliance with fiscal rules and identifies the most compliant and most non-compliant EU member countries. A group is created from the three (Sweden, Denmark and Luxembourg) and the five (previous + Bulgaria and Estonia) most compliant as well as the three (France, Italy and Portugal) and five (previous + Greece and Belgium) least compliant.[5] The data of the compliance tracker is summarised in appendix C.

[5] The UK is excluded due to leaving the EU as well as having special arrangements where the debt rule, amongst other factors of the SGP, did not apply to the country.

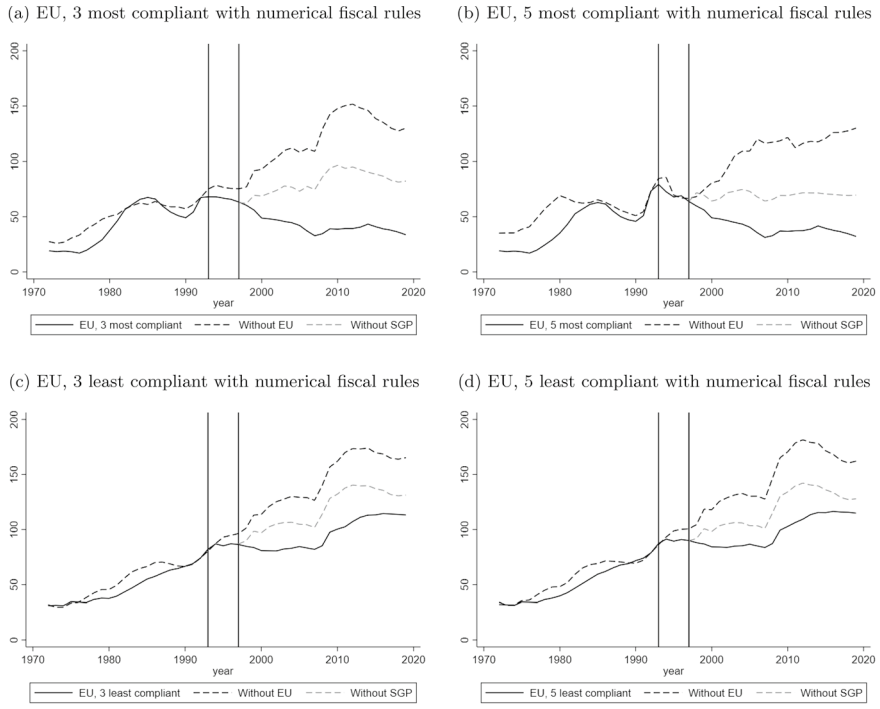

Fig. 4 Country Groupings, level of general government debt (% of GDP)

The effects for these groups are presented in Fig. 4. For the most compliant countries, the difference is already notable prior to the financial crisis, but grows substantially more during the crisis. For the least compliant countries, the debt level remained high and increased during the crisis. However, the levels for the synthetic counterparts are even higher. This points to a restricting effect of fiscal rules, even if they are poorly complied with, which is in line with the results of Reuter (2019) and Reuter et al. (2022).

Table 3 presents the cumulative difference between the actual and the synthetic counterparts for all country groups from the establishment of the EU or the introduction of common currency for EA as well as the pre-treatment and post-treatment RMSPEs as well as their ratios.

The results are listed up to the beginning of the financial crisis (2007) and the end of the sample (2019). The ratio between post-treatment and pre-treatment RMSPEs is quite high for all the studied groups and the pre-treatment RMSPEs are quite small, although for the group with the 5 most compliant somewhat larger.

For most cases, the synthetic counterparts have substantially higher levels of government debt for both presented time horizons. However, for the euro area and the highly indebted EU countries something notable can be observed towards the end

Table 3 Actual and synthetic government debt levels after formation of EU (or EA) (until 2007 and 2019) and descriptive statistics

	2007			2019			RMSPE		
	Actual	Synthetic	diff	Actual	Synthetic	Diff	Pre	Post	Ratio
European Union	59.3	80.8	21.5	80.6	113.2	32.6	0.040	0.441	11.029
Euro area	66.8	74.9	8.1	86.7	97.0	10.3	0.062	0.166	2.690
EU, above-average performers	58.5	75.8	17.3	68.8	100.0	31.2	0.042	0.395	9.297
EU, highly indebted	78.7	113.4	34.7	121.9	130.8	8.9	0.146	0.476	3.255
EU, 3 most compliant	32.7	109.2	76.5	33.6	130.3	96.8	0.149	1.158	7.766
EU, 5 most compliant	31.2	116.6	85.4	32.1	130.3	98.2	0.262	0.921	3.511
EU, 3 least compliant	82.0	126.5	44.5	113.3	165.3	52.0	0.104	0.634	6.089
EU, 5 least compliant	83.7	127.7	44.0	114.9	162.1	47.2	0.093	0.610	6.561

of the studied sample: in the synthetic counterpart (and therefore in the comparison countries), debt levels have fallen faster, which could be the result of a combination of factors such as lagging economic growth in the highly indebted countries of the euro area, relaxation of fiscal rules due to aid programmes or the absence of national monetary policy independence.

4.1 Individual country results, original members

In the second part of the empirical study, the model is run for all individual countries, which have been members of the EU at some point of the sample. The countries are arranged in groups by time of accession.

Figure 5 displays the SCM graphs and Table 4 the cumulative government debt for the first 12 countries which established the EU in 1993.

For France, Germany, Ireland, Italy and Netherlands, the observed debt level is constantly below their synthetic counterparts. The same goes for Belgium, but for this country, the SGP does not have an effect prior to the financial crisis as well as for Denmark, for which the pre-treatment fit is not as good as for many others.

Spain has a subtantially lower debt level until the financial crisis, but after the crisis the countries in its comparison group have lowered their debt, whereas the level in Spain has been quite stable. The same goes, to some extent, for Portugal.

For Greece, the synthetic counterpart is very similar up to the financial crisis, after which the Greek debt has stabilised, whereas the comparison country group has lowered debt levels faster.

For Luxembourg and the UK, the pre-treatment fits are poor. For the UK, the synthetic counterpart is below the actual after the financial crisis when the SGP is used as the studied reform. It should be noted that the country was exempt from many of the SGP's aspects, including the debt rule, through special arrangements.

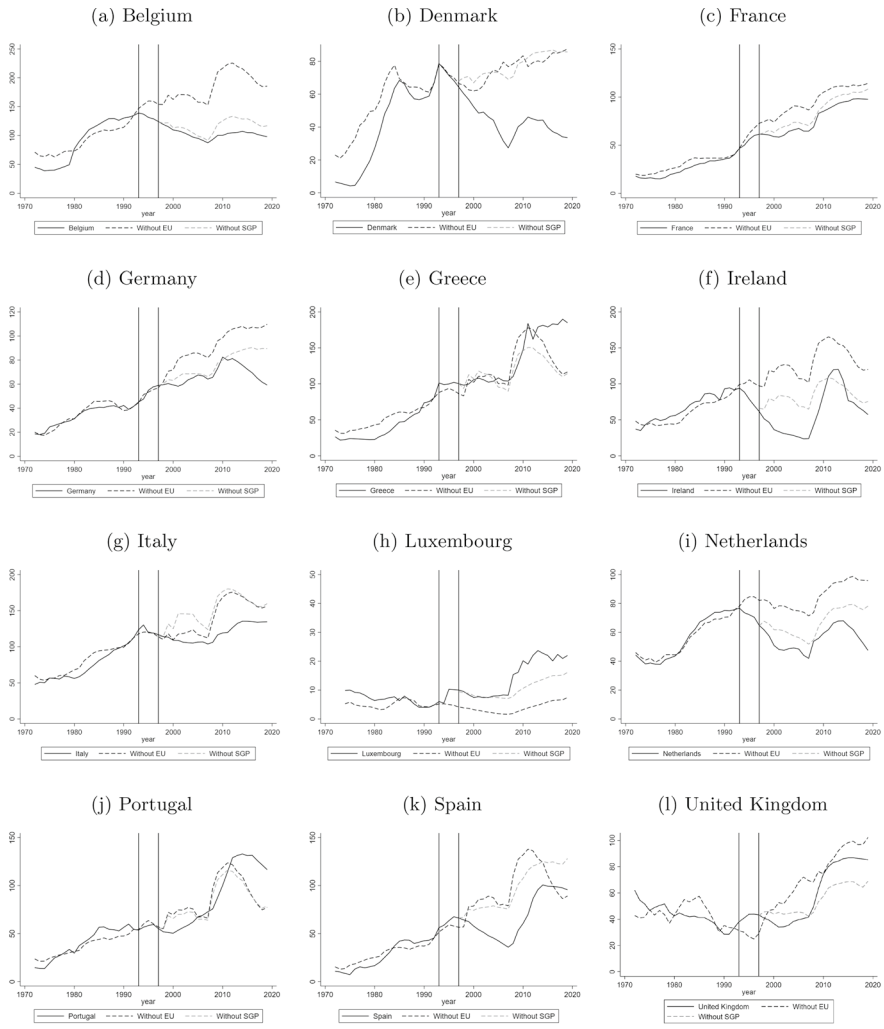

Fig. 5 Individual Country Results (original members)

4.2 Individual country results, cohort of 1995

Figure 6 displays the SCM graphs and Table 5 the cumulative government debt for the countries joining the EU in 1995.

For Austria and Finland, the synthetic counterparts are notably higher after the introduction of EU membership and the SGP and especially during the financial crisis their debt growth was low compared to the countries in the comparison group. In addition, Austria is a special case where the effect of the EU membership and the introduction of the SGP have had a very similar effect since 1997 and the two

Table 4 Actual and synthetic government debt levels after joining the EU (until 2007 and 2019) and descriptive statistics

	2007			2019			RMSPE		
	Actual	Synthetic	Diff	Actual	Synthetic	Diff	Pre	Post	Ratio
Belgium	87.3	152.8	65.4	98.1	185.6	87.5	0.138	0.601	4.343
Denmark	27.3	76.8	49.4	33.6	87.5	53.9	0.275	1.432	5.211
France	64.5	86.6	22.0	97.6	114.2	16.5	0.125	0.524	4.179
Germany	64.2	82.0	17.8	59.2	109.7	50.4	0.072	0.605	8.419
Greece	104.0	98.3	−5.7	184.9	116.6	−68.3	0.168	0.371	2.208
Ireland	23.9	101.8	77.9	57.3	119.9	62.6	0.102	0.747	7.327
Italy	103.9	112.0	8.1	134.6	156.2	21.7	0.081	0.230	2.835
Luxembourg	8.2	1.6	−6.6	22.0	7.4	−14.6	0.583	2.373	4.070
Netherlands	42.0	71.4	29.5	47.4	95.8	48.4	0.058	0.380	6.498
Portugal	72.7	66.0	−6.7	116.6	77.3	−39.3	0.129	0.419	3.243
Spain	35.8	78.8	43.0	95.5	89.2	−6.4	0.136	0.823	6.033
UK	41.5	69.4	27.8	85.2	102.3	17.0	0.277	0.491	1.771

Fig. 6 Individual Country Results (cohort of 1995)

Table 5 Actual and synthetic government debt levels after joining the EU (until 2007 and 2019) and descriptive statistics

	2007			2019			RMSPE		
	Actual	Synthetic	Diff	Actual	Synthetic	Diff	Pre	Post	Ratio
Austria	64.7	83.0	18.3	70.5	102.1	31.6	0.087	0.471	5.395
Finland	33.9	84.8	50.9	59.5	98.5	39.0	0.178	0.845	4.750
Sweden	39.0	68.5	29.5	34.9	63.8	28.9	0.173	0.287	1.658

synthetic counterparts resemble each other very closely. For Sweden the actual debt remains higher than the synthetic for the initial years after joining the EU, but this changes prior to the financial crisis and the country remains below the counterpart for the remainder of the sample.

Fig. 7 Individual Country Results (cohort of 2004)

4.3 Individual country results, cohort of 2004

Figure 7 displays the SCM graphs and Table 6 the cumulative government debt for the countries joining the EU in 2004.

The Czech Republic, Estonia, Hungary and Slovakia remain below their synthetic counterparts for a substantial part of the post-treatment sample, at least during the financial crisis. The same goes for Malta and, towards the end of the sample for Latvia, Lithuania and Poland, but the pre-treatment fit for these countries, outside of Latvia, are quite poor.

Table 6 Actual and synthetic government debt levels after joining the EU (until 2007 and 2019) and descriptive statistics

	2007			2019			RMSPE		
	Actual	Synthetic	Diff	Actual	Synthetic	Diff	Pre	Post	Ratio
Cyprus	53.2	51.7	−1.4	94.0	51.2	−42.9	0.108	0.493	4.565
Czech Republic	27.3	32.1	4.7	30.0	50.2	20.1	0.177	0.309	1.751
Estonia	3.8	4.1	0.3	8.6	28.3	19.8	0.132	0.457	3.457
Hungary	65.2	51.7	−13.5	65.5	108.8	43.3	0.265	0.350	1.320
Latvia	8.1	8.4	0.3	37.0	43.7	6.7	0.203	0.242	1.189
Lithuania	15.9	16.4	0.5	35.9	42.0	6.1	0.434	0.419	0.966
Malta	61.9	58.0	−4.0	40.6	79.0	38.4	0.522	0.290	0.556
Poland	44.5	43.5	−1.0	45.6	53.5	7.9	0.263	0.105	0.400
Slovakia	30.3	31.1	0.8	48.2	74.4	26.2	0.182	0.141	0.772
Slovenia	22.8	25.1	2.3	65.6	53.2	−12.3	0.225	0.401	1.785

For Cyprus and Slovenia, the recovery from the financial crisis has been slower than in their counterparts.

4.4 Individual country results, cohorts of 2007 and 2013

Figure 8 displays the SCM graphs and Table 7 the cumulative government debt for the countries joining the EU in 2007 and 2013. For Bulgaria and Romania, the actual government debt stays below their synthetic counterparts, but the pre-treatment fit is poor. Croatia has a higher government debt than its synthetic counterpart, but the divergence takes place notably before EU membership.

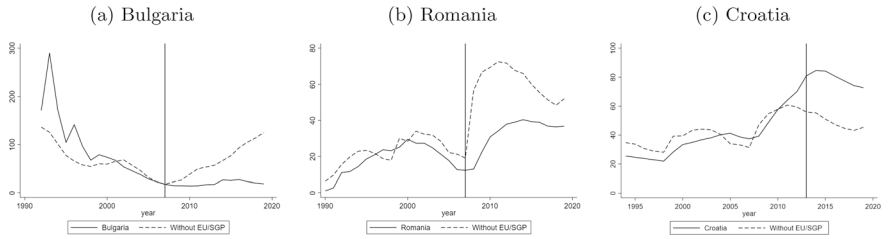

Fig. 8 Individual Country Results (cohort of 2007 and 2013)

Table 7 Actual and synthetic government debt levels after joining the EU (until 2019) and descriptive statistics

	2019			RMSPE		
	Actual	Synthetic	Diff	Pre	Post	Ratio
Bulgaria	18.4	125.1	106.7	2.350	2.565	1.092
Croatia	72.8	58.2	−14.6	0.374	0.314	0.838
Romania	36.8	52.1	15.2	0.491	0.618	1.260

5 Robustness of the results

Appendix D lists the weights of different covariates for all studied country groups and individual countries. There are no cases where the weight of a single covariate is over 0.500 with the highest being 0.486 (population for Luxembourg).

Klößner et al. (2018) note that many of the results of studies done with the SCM are driven by a single country in the comparison group, namely the USA. Country weights for all the studied country groups and individual countries are listed in Appendix E. In this study, the weight of the USA is generally very low and the country only gets a notable weight in case of the EU, the low debt country group and the UK. However, there are four cases where a single country in the comparison group gets a very significant weight. These are Luxembourg (where Iceland has a very high weight), Cyprus (Iceland), Estonia (Chile) and Bulgaria (Colombia). Therefore, the results for these countries should be interpreted with some caution.

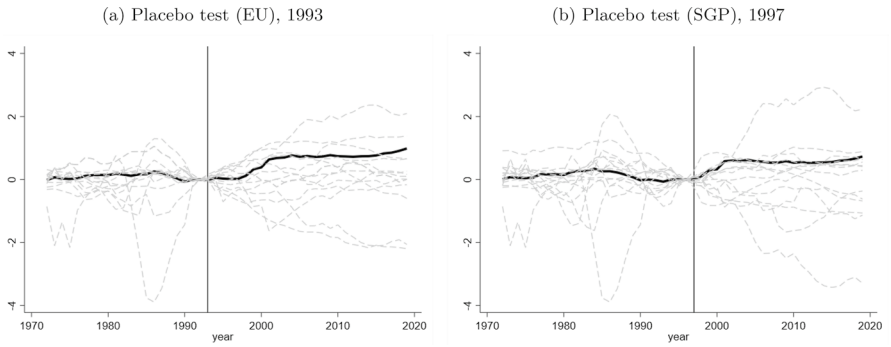

Fig. 9 In-space placebo tests

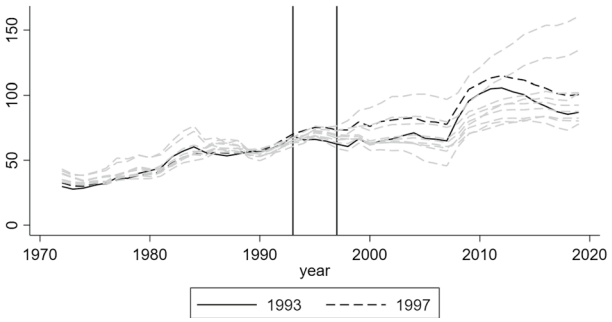

Fig. 10 In-time placebo test, EU

Next, the study turns to so-called in-space placebo tests where each country in the comparison sample is used as the "treated" country. The results of these placebo tests are presented in Fig. 9 with the time for reform set to 1993 and 1997.

The EU (black line) is very stable prior to the reforms and differs to some extent from most comparison countries for both the establishment of the EU and the implementation of the SGP. The most notable exception is Chile, which could potentially be due to the large-scale economic reforms which achieved a high level of economic growth and a substantial lowering of government debt levels, especially during the 1990 s.

The next robustness check is done in Fig. 10, which presents the so-called "in-time placebo test" where the reform is set to take place in different years. In the figure, the reform is set to take place in each year from 1990 to 2000. The black lines for the studied reforms are close to the middle of the potential synthetics towards the end of the sample. This can be interpreted as the process of integration being continuous and some anticipation effects exist, even if the formation of the EU and the introduction of the SGP were notable steps.

Finally, to ensure that the results are not driven by the choice of comparison group and the specific approach, a large-scale robustness check is done by extending the comparison sample to 13 additional countries where data availability is sufficient, making the total comparison sample consist of 27 countries. This extended sample also allows for the running of the bias-corrected or augmented SCM in line with Abadie and L'hour, J. (2021), Ben-Michael et al. (2021) and Abadie (2021). The results of these additional synthetic counterparts are presented in Appendix F along with the baseline results presented in Sect. 4 for each country grouping and individual country with separate figures for EU membership and the SGP where applicable.

The results from the extended sample and the bias-corrected SCM are qualitatively in line with the results of the baseline SCM in a substantial majority of country groupings and individual countries. The extended sample and bias-corrected SCM are generally very similar to each other. In a substantial share of the studied cases, the extended sample and bias-corrected SCM would imply a higher level of government debt when compared to the baseline SCM. However, as noted in Sect. 3, the inclusion of countries with differing levels of economic development increases the potential risk of interpolation biases, so restricting the comparison sample to OECD countries, as done in the baseline case, would be a more prudent and reliable option.

6 Conclusions

This paper studied how the formation of the European Union, the euro area and the establishment of the Stability and Growth Pact as well as the EU membership of individual member countries has affected the formation of government debt.

The effect of both the EU and the SGP is quite notable for most of the studied cases. Especially for the different country groups, the restricting effect is very notable and the synthetic options have higher levels of government debt in a large majority of studied cases for both large-scale reforms. Outside of some individual countries, the government debt levels are lower than in the synthetic alternatives. The results point to EU fiscal rules having had a broad restricting effect on government debt growth, though country-specific aspects of countries in the control group, and factors such as monetary policy arrangements, likely also play a role. For individual euro area countries, monetary policy is governed by an institution largely outside the reach of national governments, while for non-euro area countries the monetary authority might be less constrained in supporting fiscal policy decisions, which could imply that it might be possible to sustain a higher debt ratio without scarring financial markets.

In many cases, the difference between the actual and the synthetic alternative is larger if the comparison is done at the end of the sample in 2019. However, it should be noted that the global financial crisis was a large systemic shock, which caused significant, potentially heterogeneous, increases in government debt levels around the globe. The reliability of the SCM also diminishes as time passes since a reform and more white noise enters the development of the studied variables. Therefore, it might be prudent to concentrate on the results up to 2007. The global financial crisis also seems to have increased the discrepancy between the highly indebted countries and others. This could be a sign of the framework's limited capacity for producing proper fiscal responses or the potential pro-cyclicality of the fiscal rules which is discussed, for example, in Larch et al. (2021).

The results open up several avenues of future research: a more granular approach on country-level differences and their potential causes would be a potential way of better understanding the differences in government debt. A more detailed assessment of different numerical fiscal rules, their effects and how compliance affects their effectiveness could provide a better understanding of the associated mechanisms. For example, Kraemer and Lehtimäki (2023) find that national fiscal rules and EU fiscal rules both have a statistically significant effect on the formation of government debt and a potential future avenue would be to better account for the different national rules as well as the different reforms of the SGP.

Additionally, for some individual countries, the consolidation of government debt has been slower after the financial crisis than in the synthetic counterparts, which could be due to factors such as lagging economic growth, relaxation of fiscal rules due to programmes or the absence of national monetary policy independence. It is also very likely that the low interest rate environment of the 2010's implied very low

debt servicing costs and, subsequently, lower incentives for addressing debt levels. Several of these countries entered EU programmes or were under excessive deficit procedures during and after the financial crisis and the combination of consolidation and structural reforms might have been too demanding to reach sufficient levels of economic growth. A potential avenue of future research would be to look at these countries in more detail, as Newiak and Willems (2017) and Kuruc (2022) do in the case of IMF rescue packages.

Appendix

Technical details on the SCM approach

Based on Abadie and Gardeazabal (2003) and Abadie et al. (2010), the studied group $J+1$ includes an individual observation of interest $j=1$ where a treatment takes place in period T_i. The remaining set in the group $j=2,\ldots,J+1$ are not affected by the treatment and, therefore, form the control group which is used to simulate the counterfactual. Abadie et al. (2015) note that the SCM can be used for each unit of interest separately, so the approach taken in this paper is to study different country groups as well as each individual country in the EU. Most likely following medical literature, Abadie et al. (2010) express $j=1$, the individual country, area, etc., as the "treated unit" while the non-treated units form the "donor pool".

The sample $t=1,\ldots,T$ used in the study consists of data from 1972 to 2019. The amount of pre-treatment T_0 and post-treatment years T_1 (with $T_0+T_1=T$) can vary between countries due to different times of joining the EU.

The SCM calculates the counterfactual non-treatment development by using the units in the donor pool. Abadie et al. (2015) define it as a weighted average of observations in the donor pool, consisting of a $J\times 1$ vector of weights $W=(w_2,\ldots,w_{J+1})'$ with $0\leq w_j\leq 1$ of $j=2,\ldots,J+1$ and $w_2,\ldots,w_{J+1}=1$. The method then selects the value of W to match the characteristics of the treated unit with the synthetic control.

X_1 is a $(k\times 1)$ vector consisting of the pre-treatment control variable values of the treated unit which should match the ones of the comparison group, formed by X_0 which is the $k\times J$ matrix, as closely as possible. The selected synthetic control, W^*, should minimise the difference between the treated unit and the synthetic control (in essence, the minimum of vector X_1-X_0W).

By combining all these elements, the formal approach can be defined. $m=1,\ldots,k$, X_{1m} is the value of the m-th variable for the treated country and X_{0m} is a $1\times J$ vector of the values of the m-th variable for countries of the donor pool. Following Abadie and Gardeazabal (2003), W^* is chosen as the value of W that minimises:

$$W^*=\sum_{m=1}^{k}\upsilon_m(X_{1m}-X_{0m}W)^2, \tag{1}$$

where υ_m is the weight reflecting the importance the model assigns to m-th variable when defining the difference between X_1 and $X_0 W$. These weights are then used for the synthetic control estimator for the effect of the treatment which is the difference of post-treatment outcomes in the treated country and the effects observed in the donor pool countries:

$$Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt}, \tag{2}$$

where Y_{jt} is the observed effect in country j at time t and Y_1 a $(T_1 \times 1)$ vector of the post-treatment values of the treated country. Y_0 is therefore a $(T_1 \times J)$ matrix, with j being the post-treatment values of the effect for country $j + 1$.

Combining equations (1) and (2), it is possible to see that the matching variables in X_0 and X_1 serve as predictors of the post-treatment outcome.

Description, sources and descriptive statistics of the data

See Tables 8 and 9.

Table 8 Description of data and sources

Variable	Description	Source
Age dependency ratio	Age dependency ratio, % of working-age population	WB
Banking crisis	Crisis indicator	IMF (Laeven & Valencia, 2020)
Economic freedom Index	Headline indicator	Fraser Institute
Foreign direct investment	Foreign direct investment, net inflows (% of GDP)	WB
Government expenditure	General government final consumption expenditure (constant 2010 US$)	WB
Government debt	General government/public gross debt (% of GDP)	IMF
Inflation	GDP deflator (year-on-year change)	WB
Interest rate	Real interest rate, pct	ECB, IMF, WB
Population	Population (in millions)	WB
Real GDP per capita	GDP per capita (constant 2010 US$)	WB
Share of Government consumption	Share of government consumption at current PPPs	PWT
Share of gross capital formation	Share of gross capital formation at current PPPs	PWT
Share of household consumption	Share of household consumption at current PPPs	PWT
Trade openness	Trade (% of GDP)	WB
Unemployment	Unemployment, total (% of total labour force)	WB

Table 9 Descriptive statistics of EU, EA, EU countries and comparison countries

	EU, changing composition				EA, changing composition				EU countries				Comparison countries			
	Mean	Min	Max	Std dev	Mean	Min	Max	Std dev	Mean	Min	Max	Std dev	Mean	Min	Max	Std dev
Age dependency ratio	51.1	48.5	59.2	3.41	51.6	47.6	59.0	3.54	50.4	38.5	69.6	5.03	53.4	36.2	87.5	8.20
Banking crisis	0.11	0.0	1.0	0.31	0.11	0.0	1.0	0.31	0.11	0.0	1.0	0.32	0.07	0.0	1.0	0.26
Economic freedom Index	6.3	4.6	7.9	1.52	7.3	6.5	7.8	0.50	7.2	4.1	8.5	0.79	7.2	3.8	8.8	1.13
Foreign direct investment	2.5	0.1	9.5	2.41	2.5	−0.3	9.7	2.48	7.7	−58.3	449.1	30.16	2.1	−28.6	31.9	3.30
Government debt	59.6.8	29.3	88.6	17.90	63.6	24.9	95.6	21.00	55.3	1.7	189.9	33.00	55.3	3.9	284.0	42.88
Government expenditure	26.6	26.1	26.9	0.20	26.6	26.1	26.9	0.22	24.7	21.1	27.4	1.50	25.1	21.4	28.6	1.57
Inflation	1.9	0.7	3.3	0.67	1.8	0.6	3.5	0.69	2.3	−9.5	20.5	2.13	2.5	−4.7	30.3	2.93
Interest rate	6.0	0.1	15.0	4.32	5.7	0.0	15.0	4.35	5.2	−0.5	58.0	6.18	5.3	−0.3	183.2	13.81
Population	17.8	17.7	17.8	0.02	17.8	17.8	17.8	0.02	16.2	12.9	18.2	1.30	16.8	12.5	19.6	1.61
Real GDP	10.4	9.9	10.7	0.23	10.4	10.0	10.7	0.22	10.1	8.4	11.6	0.60	10.1	7.7	11.4	0.89
Government consumption	0.17	0.14	0.20	0.02	0.17	0.14	0.19	0.01	0.20	0.09	0.44	0.05	0.16	0.07	0.51	0.06
Gross capital formation	0.26	0.22	0.30	0.02	0.26	0.22	0.31	0.02	0.26	0.11	0.57	0.05	0.27	0.08	0.55	0.07
Household consumption	0.59	0.54	0.62	0.02	0.58	0.53	0.61	0.02	0.57	0.21	0.82	0.08	0.57	0.29	0.82	0.09
Trade openness	61.2	38.5	89.7	14.91	62.2	40.3	91.5	15.36	95.2	27.2	408.4	58.25	55.5	16.0	131.8	22.57
Unemployment	7.8	2.2	11.2	2.46	8.2	2.2	11.5	2.57	8.4	0.9	27.5	4.33	6.1	0.6	20.5	3.29

Description of the dataset

See Table 10.

Table 10 Historical numerical fiscal rule compliance (for 1993-2019)

	Deficit Rule	Debt Rule	Structural Balance rule	Expenditure Rule	Total
Initial EU members, 1993					
Belgium	16	11	4	4	35
Denmark	23	23	15	16	77
France	8	5	4	4	21
Germany	15	12	14	10	51
Greece	4	0	13	11	28
Ireland	15	18	15	16	64
Italy	15	1	5	3	24
Luxembourg	22	23	21	18	84
Netherlands	17	19	11	10	57
Portugal	5	6	9	8	28
Spain	12	12	7	5	36
UK	10	11	7	3	31
Cohort of 1995					
Austria	19	7	6	5	37
Finland	22	20	12	13	67
Sweden	22	23	19	19	83
Cohort of 2004					
Cyprus	10	11	15	8	44
Czech Republic	13	23	13	12	61
Estonia	22	23	12	11	68
Hungary	8	13	8	7	36
Latvia	17	23	7	7	54
Lithuania	14	23	12	11	60
Malta	13	13	10	7	43
Poland	7	23	8	7	45
Slovenia	14	18	5	3	40
Slovakia	11	22	5	9	47
Cohorts of 2007 and 2013					
Bulgaria	19	23	15	12	69
Romania	12	23	9	5	49
Croatia	10	17	7	8	42

Covariate weights

See Tables 11, 12.

Table 11 Covariate weights for country groups

	EU	EA	EU, ld	EU, hd	EU, 3 mc	EU, 5 mc	EU, 3 lc	EU, 5 lc
Age dependency ratio	0.009	0.262	0.053	0.033	0.006	0.004	0.000	0.000
Banking crisis	0.059	0.069	0.000	0.058	0.074	0.024	0.419	0.420
Economic freedom Index	0.012	0.229	0.000	0.266	0.011	0.000	0.000	0.000
Foreign direct investment	0.001	0.034	0.227	0.012	0.051	0.020	0.012	0.012
Government expenditure	0.109	0.000	0.004	0.010	0.071	0.025	0.004	0.004
Government debt (initial)	0.109	0.085	0.143	0.282	0.117	0.175	0.000	0.000
Inflation	0.068	0.000	0.041	0.021	0.094	0.045	0.159	0.159
Interest rate	0.010	0.006	0.081	0.027	0.001	0.018	0.001	0.001
Population	0.119	0.019	0.000	0.000	0.000	0.000	0.000	0.000
Real GDP per capita	0.014	0.096	0.027	0.046	0.147	0.020	0.018	0.018
Share of Government consumption	0.170	0.000	0.066	0.019	0.048	0.223	0.085	0.085
Share of gross capital formation	0.025	0.023	0.215	0.000	0.201	0.056	0.000	0.000
Share of household consumption	0.024	0.137	0.022	0.019	0.000	0.132	0.058	0.058
Trade openness	0.066	0.040	0.073	0.090	0.012	0.095	0.065	0.064
Unemployment	0.155	0.000	0.050	0.116	0.168	0.163	0.180	0.180

Table 12 Covariate weights for individual countries

	BE	DK	FR	DE	GR	IE	IT	LU	NL	PT	ES	UK	AT	FI	SE
Age dependency ratio	0.002	0.041	0.041	0.007	0.098	0.052	0.204	0.014	0.034	0.021	0.139	0.026	0.135	0.149	0.090
Banking crisis	0.034	0.013	0.013	0.082	0.000	0.049	0.073	0.000	0.169	0.057	0.000	0.000	0.003	0.020	0.010
Economic freedom Index	0.000	0.000	0.373	0.000	0.278	0.000	0.268	0.010	0.000	0.000	0.000	0.000	0.422	0.000	0.000
Foreign direct investment	0.000	0.041	0.050	0.038	0.006	0.008	0.004	-	0.003	0.025	0.000	0.181	0.013	0.062	0.017
Government expenditure	0.259	0.028	0.042	0.019	0.049	0.229	0.021	0.367	0.000	0.008	0.017	0.012	0.034	0.102	0.010
Government debt (initial)	0.015	0.161	0.016	0.275	0.135	0.024	0.103	0.000	0.084	0.341	0.000	0.433	0.012	0.184	0.149
Inflation	0.068	0.062	0.000	0.000	0.025	0.093	0.000	0.011	0.158	0.000	0.148	0.025	0.027	0.057	0.028
Interest rate	0.002	0.033	0.007	0.011	0.025	0.001	0.038	0.001	0.017	0.029	0.182	0.076	0.015	0.058	0.101
Population	0.387	0.000	0.000	0.000	0.000	0.337	0.000	0.486	0.000	0.000	0.000	0.000	0.044	0.181	0.000
Real GDP per capita	0.117	0.035	0.069	0.022	0.077	0.087	0.053	0.089	0.077	0.008	0.055	0.026	0.158	0.054	0.066
Share of government consumption	0.034	0.340	0.296	0.296	0.119	0.010	0.075	0.012	0.248	0.195	0.181	0.056	0.096	0.005	0.018
Share of gross capital formation	0.015	0.057	0.029	0.139	0.063	0.066	0.039	0.003	0.041	0.000	0.176	0.000	0.030	0.000	0.136
Share of household consumption	0.051	0.163	0.008	0.060	0.006	0.033	0.031	0.001	0.138	0.062	0.000	0.030	0.006	0.053	0.105
Trade openness	0.004	0.001	0.009	0.051	0.076	0.009	0.048	0.002	0.002	0.033	0.000	0.093	0.001	0.075	0.270
Unemployment	0.011	0.024	0.048	0.000	0.042	0.000	0.041	0.001	0.024	0.222	0.102	0.042	0.005	0.000	0.000
	CY	CZ	EE	HU	LV	LT	MT	PL	SK	SI	BG	RO	HR		
Age dependency ratio	0.009	0.000	0.049	0.037	0.093	0.093	0.121	0.008	0.103	0.003	0.001	0.101	0.009		
Banking crisis	0.010	0.210	0.160	0.000	0.044	0.021	0.029	0.013	0.212	0.003	0.005	0.138	0.001		
Economic freedom Index	0.112	0.104	0.000	0.000	0.399	0.345	0.000	0.021	0.000	0.001	0.000	0.000	0.027		
Foreign direct investment	0.002	0.021	0.054	0.000	0.007	0.001	0.020	0.218	0.017	0.002	0.006	0.281	0.001		
Government expenditure	0.377	0.031	0.038	0.095	0.039	0.057	0.012	0.023	0.014	0.422	0.416	0.001	0.431		
Government debt (initial)	0.001	0.384	0.471	0.000	0.029	0.096	0.000	0.227	0.307	0.003	0.008	0.248	0.028		
Inflation	0.017	0.084	0.060	0.000	0.109	0.065	0.371	0.062	0.106	0.002	0.008	0.005	0.003		
Interest rate	0.006	0.044	0.029	0.071	0.001	0.014	0.007	0.007	0.027	0.003	0.006	0.116	–		
Population	0.380	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.443	0.408	0.000	0.338		

Table 12 (continued)

	BE	DK	FR	DE	GR	IE	IT	LU	NL	PT	ES	UK	AT	FI	SE
Real GDP per capita	0.054	0.012	0.103	0.044	0.058	0.078	0.000	0.037	0.014	0.113	0.136	0.007	0.138		
Share of government consumption	0.006	0.033	0.001	0.067	0.003	0.006	0.073	0.109	0.002	0.001	0.002	0.002	0.000		
Share of gross capital formation	0.010	0.057	0.006	0.293	0.069	0.045	0.104	0.097	0.047	0.001	0.001	0.017	0.000		
Share of household consumption	0.007	0.004	0.006	0.131	0.031	0.041	0.129	0.000	0.080	0.002	0.001	0.003	0.002		
Trade openness	0.003	0.002	0.022	0.263	0.052	0.063	0.086	0.148	0.000	0.001	0.001	0.073	0.014		
Unemployment	0.007	0.014	0.001	0.000	0.065	0.074	0.050	0.030	0.072	0.001	0.001	0.008	0.007		

Donor country weights

See Table 13 and 14.

Table 13 Donor country weights for country groups

	AUS	CAN	CHI	COL	ISL	ISR	JAP	KOR	MEX	NZL	NOR	CHE	TUR	USA
Changing compositions														
European Union	0.169	0.051	0.000	0.000	0.000	0.131	0.000	0.273	0.000	0.000	0.000	0.000	0.000	0.376
Euro area	0.193	0.101	0.029	0.047	0.299	0.000	0.182	0.000	0.000	0.000	0.000	0.000	0.000	0.149
Groupings by debt level														
EU, low debt	0.000	0.000	0.000	0.000	0.000	0.000	0.039	0.012	0.028	0.000	0.458	0.000	0.047	0.416
EU, highly indebted	0.000	0.225	0.000	0.000	0.159	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.437	0.180
Groupings by compliance														
EU, 3 most compliant	0.171	0.000	0.000	0.000	0.178	0.144	0.277	0.000	0.000	0.010	0.221	0.000	0.000	0.000
EU, 5 most compliant	0.000	0.000	0.000	0.132	0.000	0.114	0.157	0.000	0.000	0.000	0.597	0.000	0.000	0.000
EU, 3 least compliant	0.000	0.572	0.000	0.146	0.127	0.002	0.153	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EU, 5 least compliant	0.000	0.616	0.000	0.098	0.167	0.006	0.112	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 14 Donor country weights for individual countries

	AUS	CAN	CHI	COL	ISL	ISR	JAP	KOR	MEX	NZL	NOR	CHE	TUR	USA
Initial EU members, 1993														
Belgium	0.000	0.415	0.000	0.000	0.000	0.029	0.072	0.000	0.000	0.382	0.000	0.102	0.000	0.000
Denmark	0.067	0.000	0.000	0.135	0.091	0.101	0.254	0.000	0.000	0.000	0.353	0.000	0.000	0.000
France	0.266	0.000	0.000	0.000	0.000	0.166	0.208	0.000	0.000	0.000	0.000	0.000	0.169	0.191
Germany	0.400	0.151	0.000	0.000	0.000	0.041	0.247	0.000	0.000	0.000	0.099	0.000	0.000	0.061
Greece	0.277	0.000	0.000	0.000	0.268	0.052	0.122	0.000	0.000	0.000	0.000	0.000	0.281	0.000
Ireland	0.000	0.362	0.067	0.125	0.373	0.000	0.000	0.000	0.033	0.000	0.000	0.039	0.000	0.000
Italy	0.398	0.269	0.000	0.000	0.000	0.112	0.000	0.000	0.000	0.000	0.000	0.000	0.222	0.000
Luxembourg	0.000	0.000	0.000	0.000	0.768	0.000	0.000	0.000	0.000	0.000	0.232	0.000	0.000	0.000
Netherlands	0.138	0.454	0.000	0.000	0.000	0.028	0.200	0.000	0.000	0.180	0.000	0.000	0.000	0.000
Portugal	0.000	0.000	0.000	0.000	0.555	0.000	0.000	0.000	0.032	0.021	0.000	0.000	0.287	0.105
Spain	0.392	0.000	0.089	0.000	0.000	0.027	0.068	0.000	0.000	0.000	0.000	0.000	0.281	0.142
UK	0.000	0.366	0.103	0.000	0.000	0.107	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.423
Cohort of 1995														
Austria	0.056	0.000	0.028	0.000	0.319	0.000	0.271	0.000	0.000	0.078	0.072	0.000	0.000	0.177
Finland	0.000	0.000	0.000	0.000	0.403	0.000	0.396	0.023	0.000	0.000	0.178	0.000	0.000	0.000
Sweden	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.151	0.000	0.228	0.476	0.000	0.000	0.146
Cohort of 2004														
Cyprus	0.000	0.000	0.035	0.099	0.774	0.000	0.000	0.000	0.000	0.000	0.000	0.092	0.000	0.000
Czech Republic	0.000	0.000	0.000	0.069	0.000	0.000	0.163	0.204	0.564	0.000	0.000	0.000	0.000	0.000
Estonia	0.000	0.000	0.990	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000
Hungary	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.495	0.505	0.000	0.000	0.000
Latvia	0.000	0.105	0.428	0.368	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.099	0.000
Lithuania	0.000	0.000	0.379	0.507	0.000	0.000	0.094	0.000	0.000	0.000	0.020	0.000	0.000	0.000

Table 14 (continued)

	AUS	CAN	CHI	COL	ISL	ISR	JAP	KOR	MEX	NZL	NOR	CHE	TUR	USA
Malta	0.000	0.574	0.000	0.034	0.000	0.000	0.000	0.000	0.000	0.204	0.188	0.000	0.000	0.000
Poland	0.000	0.163	0.021	0.373	0.000	0.185	0.000	0.000	0.000	0.257	0.000	0.000	0.000	0.000
Slovakia	0.000	0.000	0.000	0.565	0.000	0.000	0.293	0.000	0.000	0.000	0.142	0.000	0.000	0.000
Slovenia	0.000	0.000	0.235	0.109	0.553	0.000	0.000	0.102	0.000	0.000	0.000	0.000	0.000	0.000
Cohorts of 2007 and 2013														
Bulgaria	0.000	0.000	0.000	0.701	0.299	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Romania	0.402	0.000	0.000	0.000	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.147	0.000
Croatia	0.000	0.000	0.000	0.561	0.431	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000

Robustness

Country groupings

See Figs. 11, 12, 13, 14, 15, 16, 17 and 18

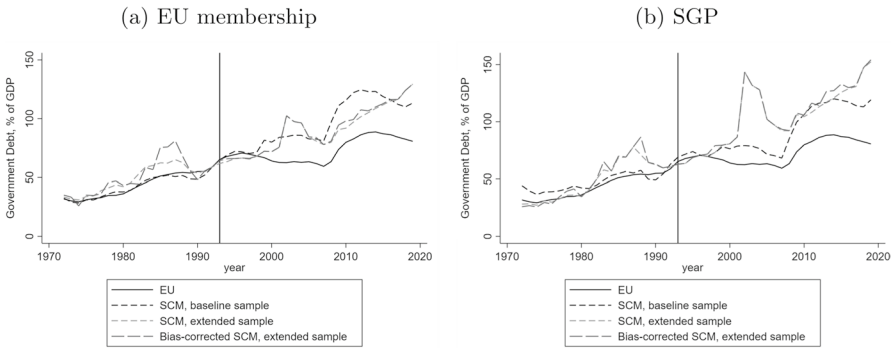

Fig. 11 EU, changing composition

Fig. 12 EA, changing composition

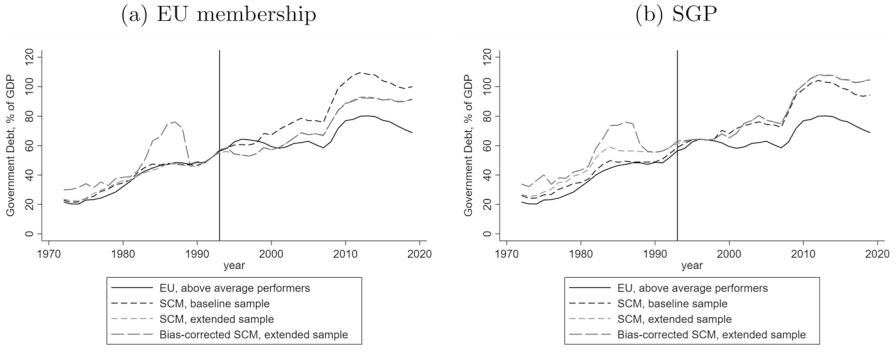

Fig. 13 EU, above-average performers

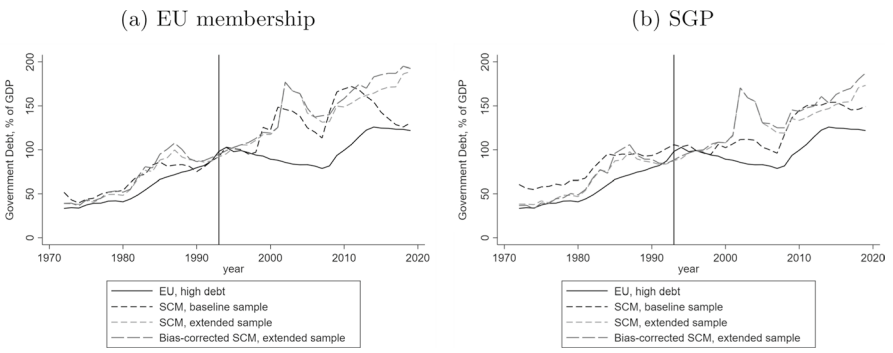

Fig. 14 EU, high debt

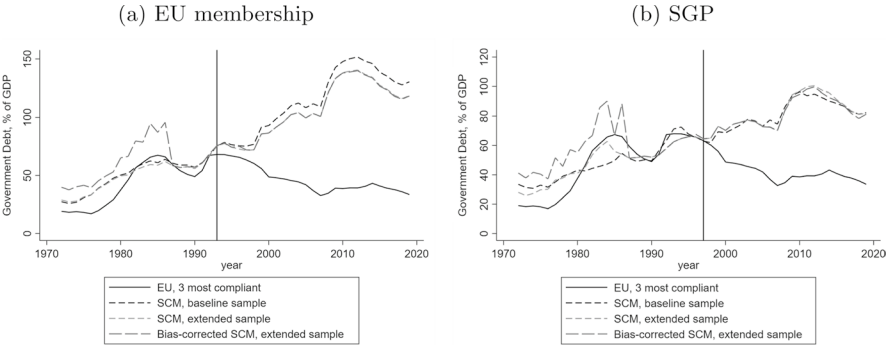

Fig. 15 EU, 3 most compliant with numerical fiscal rules

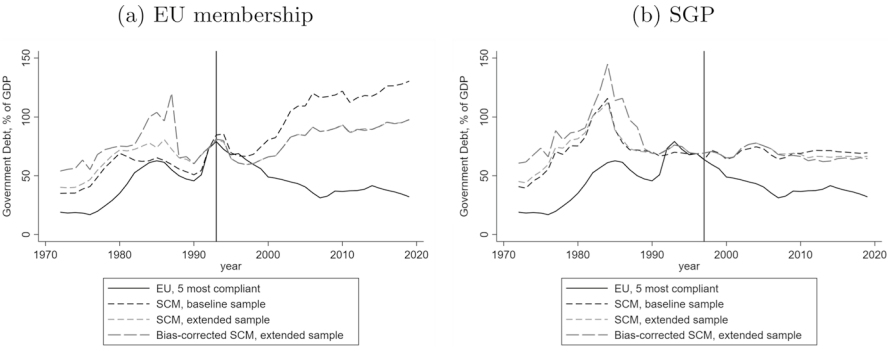

Fig. 16 EU, 5 most compliant with numerical fiscal rules

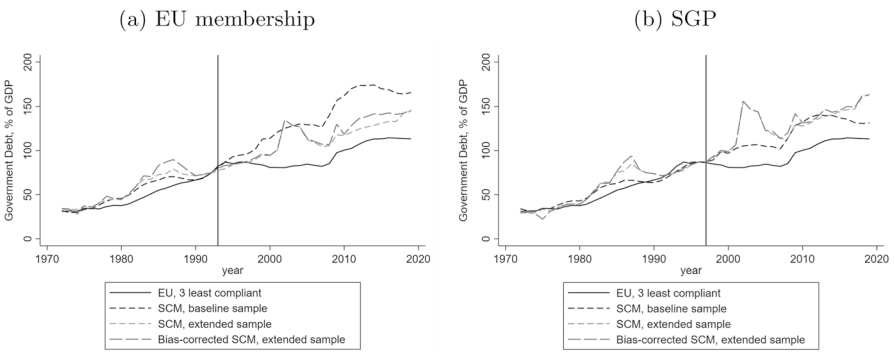

Fig. 17 EU, 3 least compliant with numerical fiscal rules

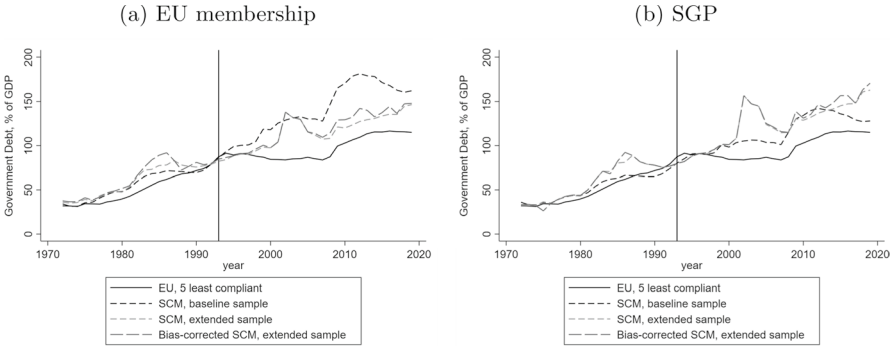

Fig. 18 EU, 5 least compliant with numerical fiscal rules

Initial EU members, 1993

See Figs. 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29 and 30.

Fig. 19 Belgium

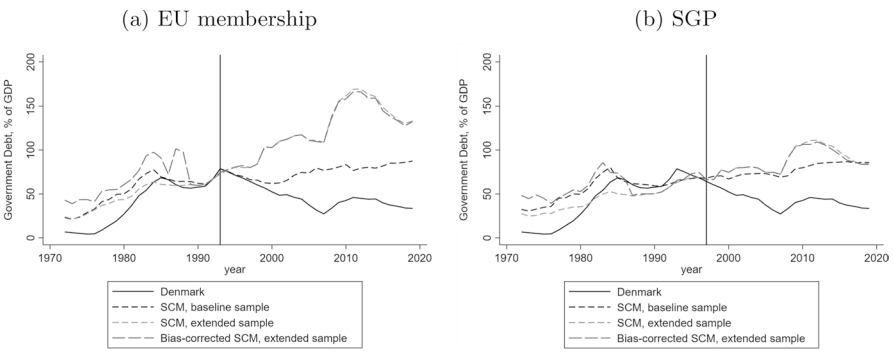

Fig. 20 Denmark

Fig. 21 France

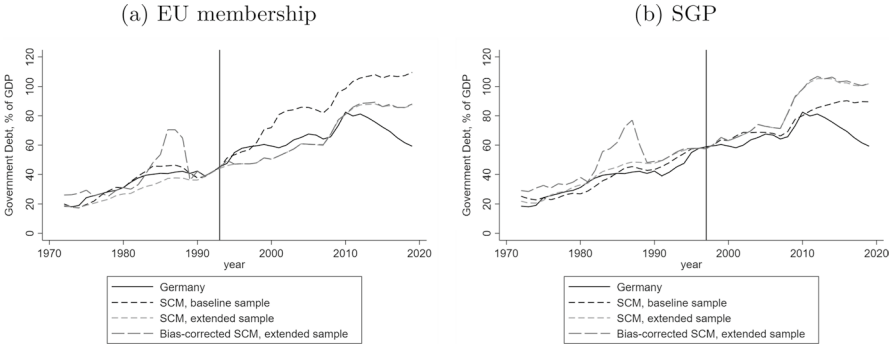

Fig. 22 Germany

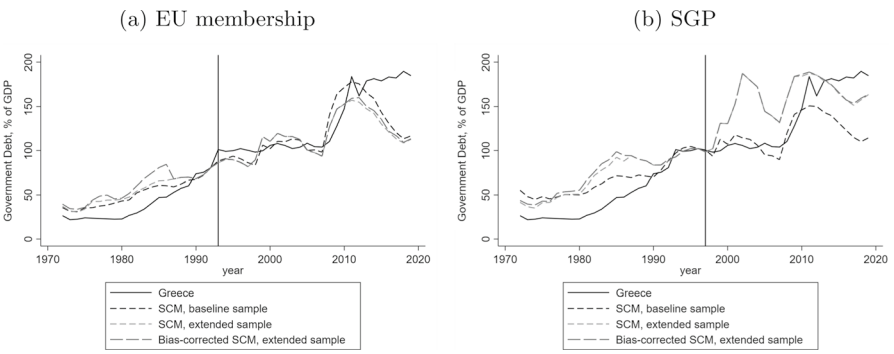

Fig. 23 Greece

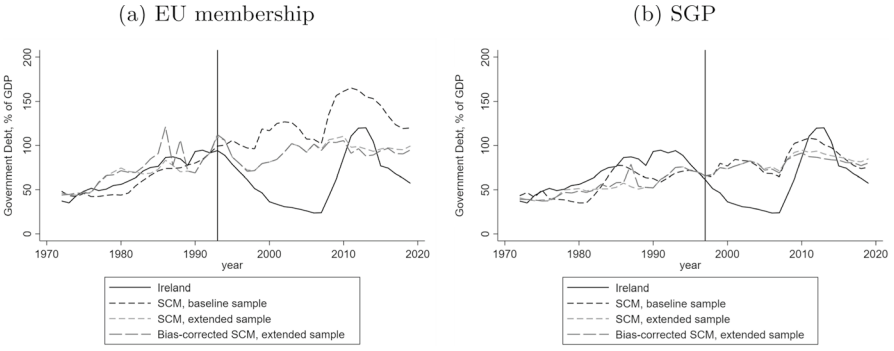

Fig. 24 Ireland

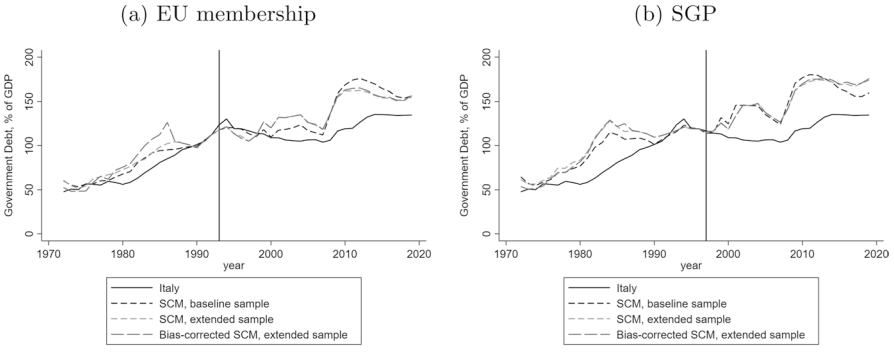

Fig. 25 Italy

Fig. 26 Luxembourg

Fig. 27 Netherlands

Fig. 28 Portugal

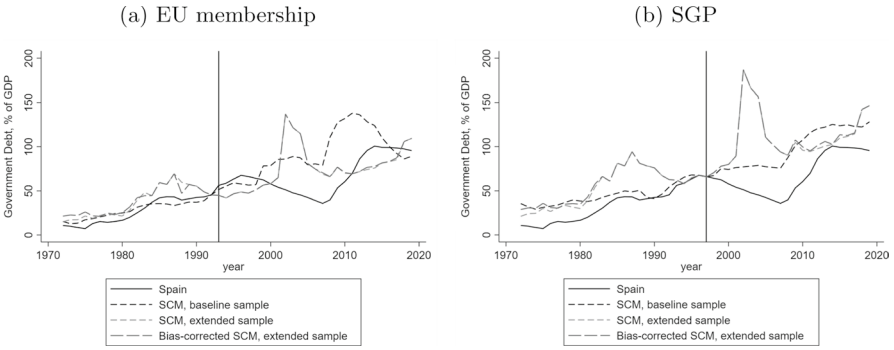

Fig. 29 Spain

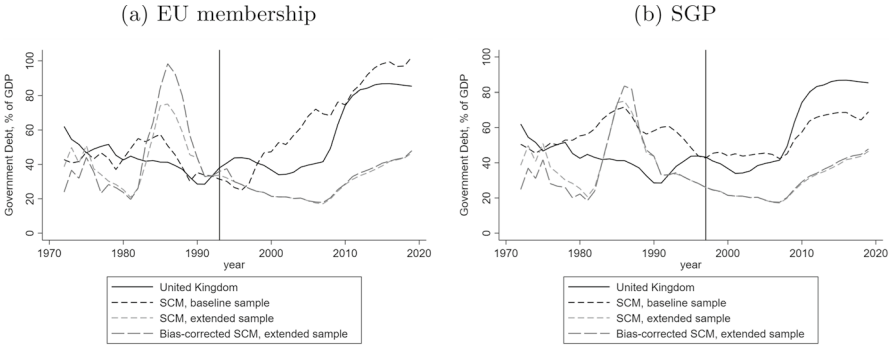

Fig. 30 UK

Cohort of 1995

See Figs. 31, 32 and 33.

Fig. 31 Austria

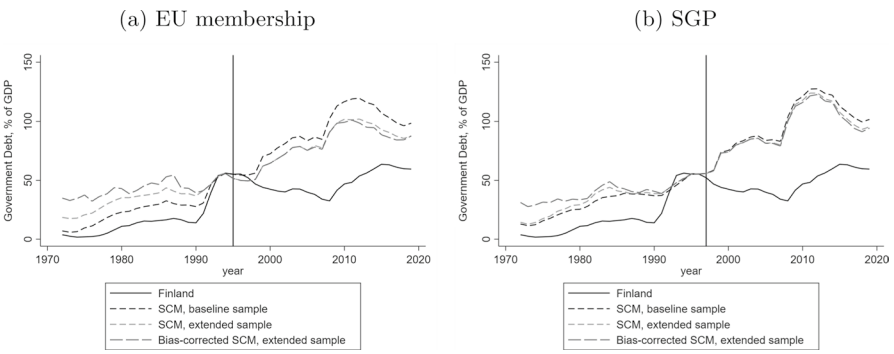

Fig. 32 Finland

Fig. 33 Sweden

Cohort of 2004

See Figs. 34, 35, 36, 37, 38, 39, 40, 41, 42 and, 43

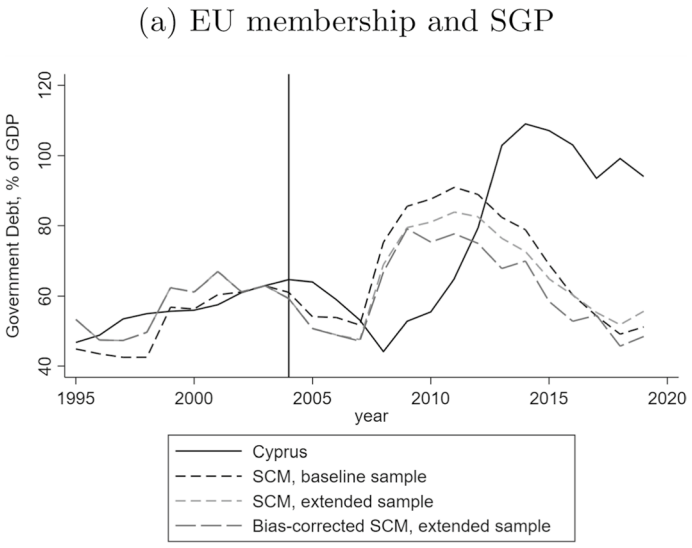

Fig. 34 Cyprus

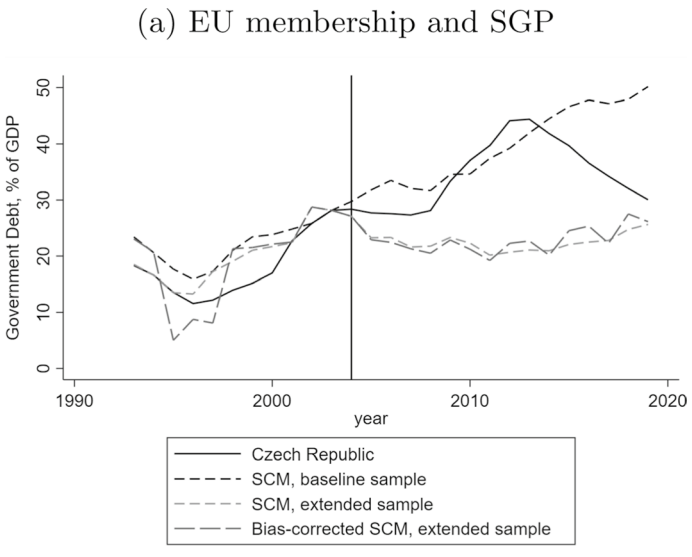

Fig. 35 Czech Republic

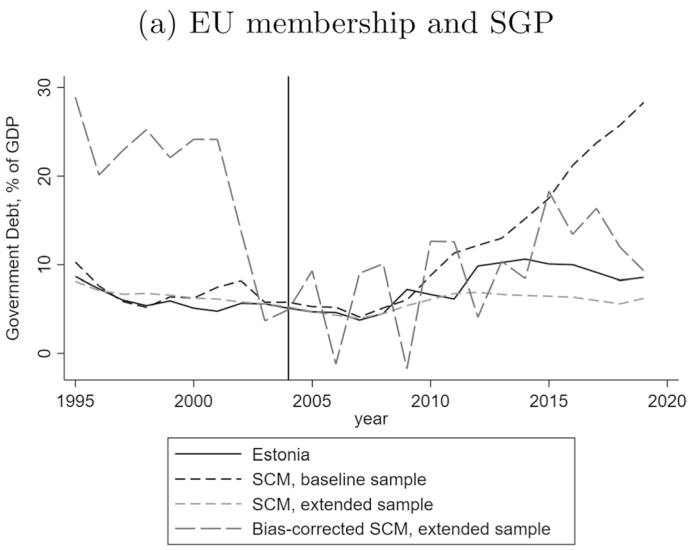

Fig. 36 Estonia

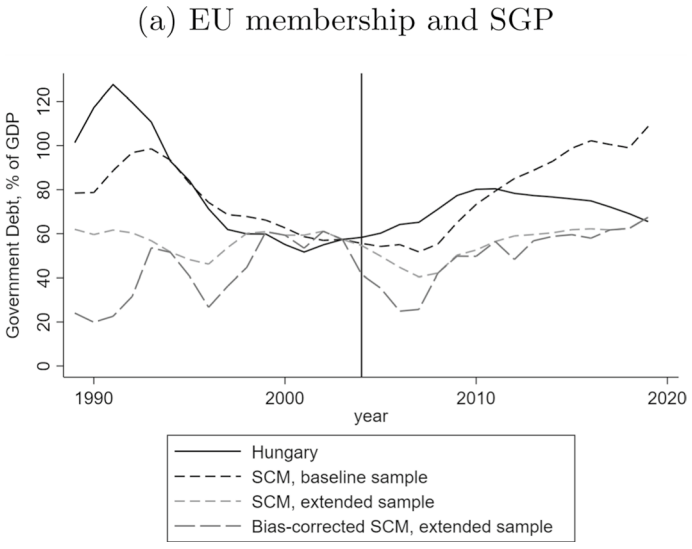

Fig. 37 Hungary

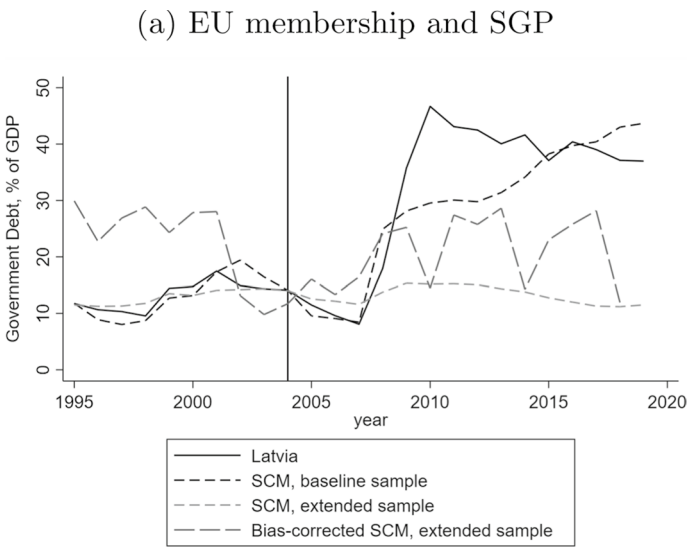

Fig. 38 Latvia

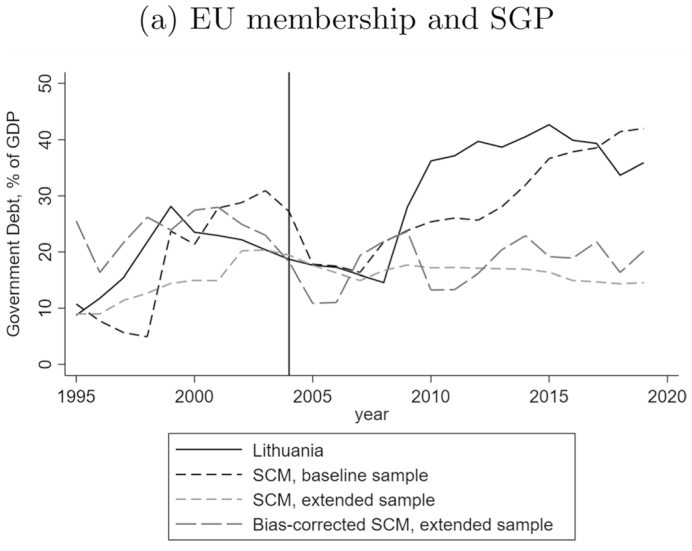

Fig. 39 Lithuania

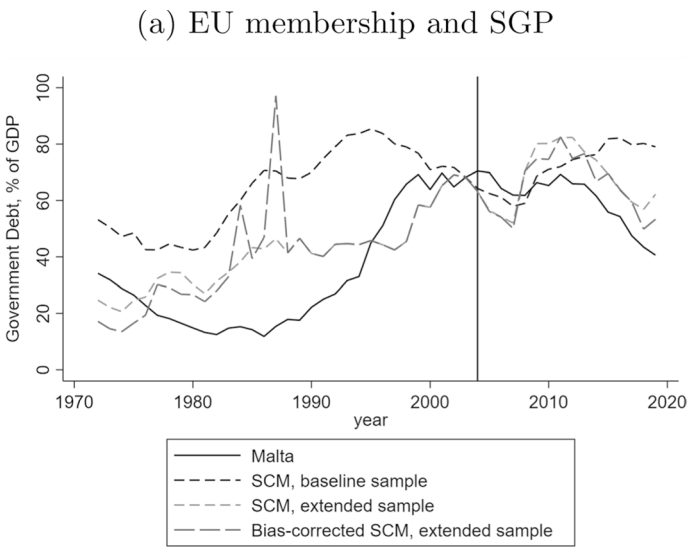

Fig. 40 Malta

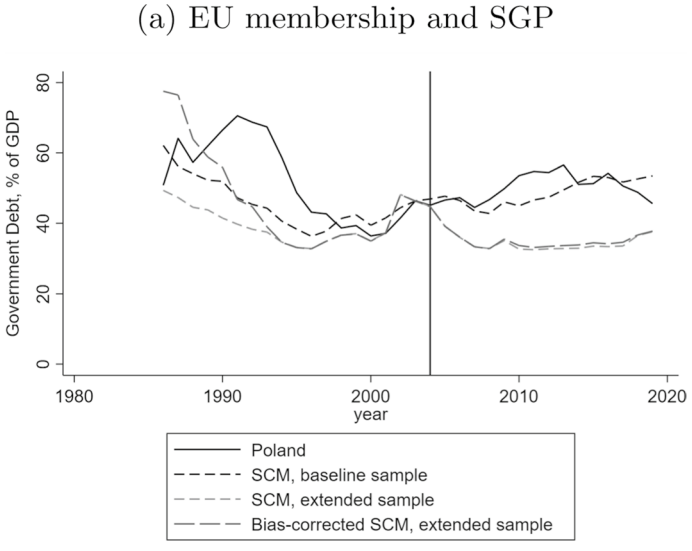

Fig. 41 Poland

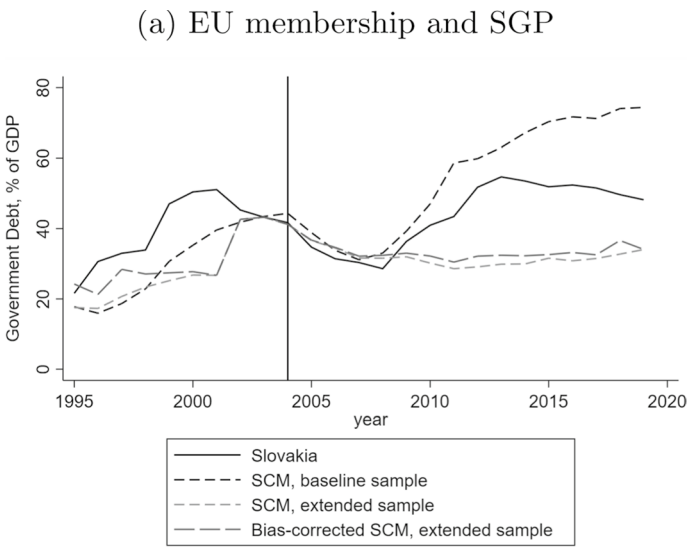

Fig. 42 Slovakia

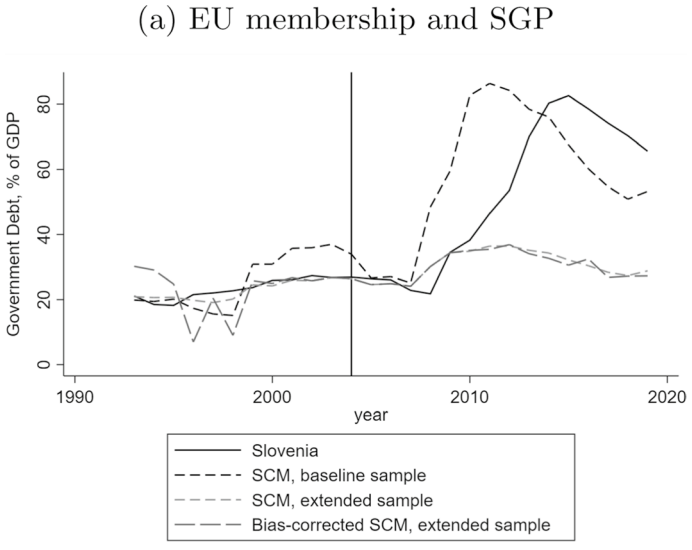

Fig. 43 Slovenia

Cohorts of 2007 and 2013

See Figs. 44, 45 and 46.

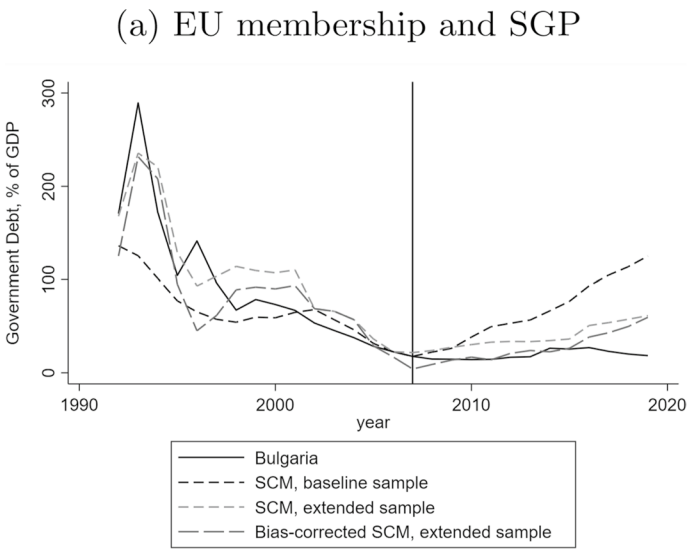

Fig. 44 Bulgaria

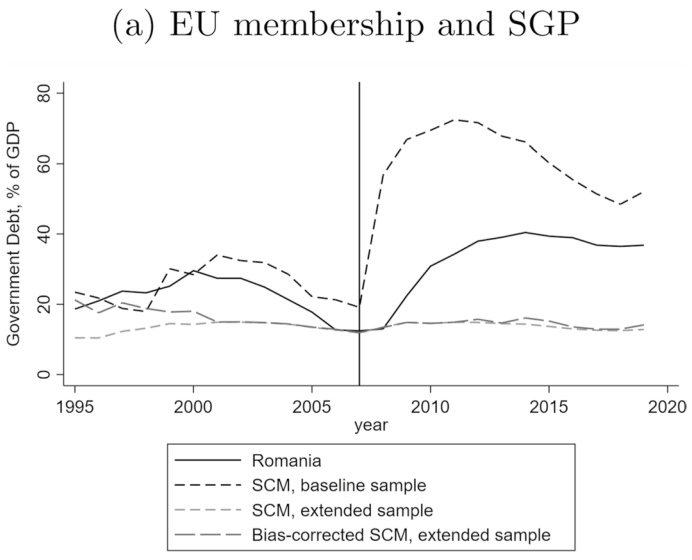

Fig. 45 Romania

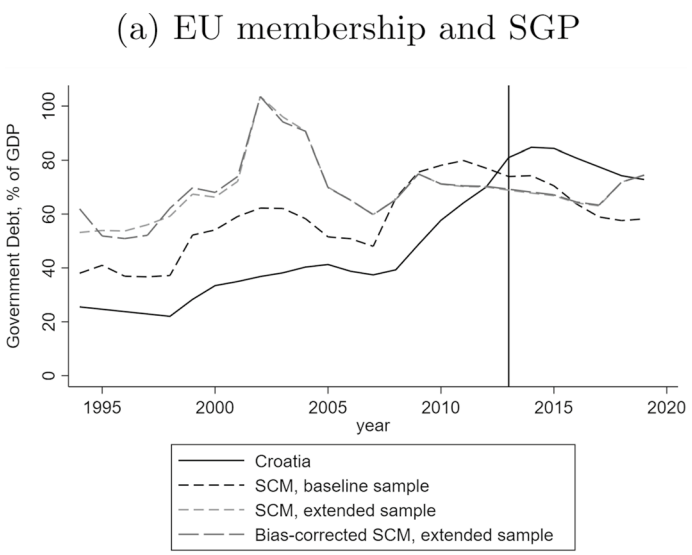

Fig. 46 Croatia

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Data Availability The data used in the study is compiled from broadly used public databases (European Central Bank, Fraser Institute, International Monetary Fund, Penn World Table and World Bank) and consists of country-level data from all EU and non-EU OECD countries. A listing of all the data, transformations used, descriptive statistics and sources can be found from Appendix B. The datasets generated and analysed are available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors have no competing interests to declare that are relevant to the content of this article. The authors received no financial support for the research, authorship and/or publication of this article.

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