Table 1

log t convergence test results and convergence clubs classification

(a) Government debt convergence results					
log(t)	All countries				
γ	-0.253*				
t-stat	-22.13				
Club classification					
log(t)	Club 1 [19]	Club 2 [9]			
γ	-0.00900	0.560			
t-stat	-0.686	6.100			
(b) Government revenues convergence results					
log(t)	All countries				
γ	-0.729*				
t-stat	-33.34				
Club classification					
log(t)	Club 1 [19]	Club 2 [5]	Club 3 [2]	Club 4 [2]	
γ	0.00700	0.792	0.114	-3.378*	
t-stat	0.527	22.75	0.395	-2.779	
(c) Government expenditures convergence results					
log(t)	All countries				
γ	-1.075*				
t-stat	-10.68				
Club classification					
log(t)	Club 1 [5]	Club 2 [11]	Club 3 [6]	Club 4 [3]	Club 5 [2]
γ	0.284	0.264	0.113	0.851	-0.125
t-stat	1.016	16.05	8.963	9.936	-0.154
Final classification					
log(t)	Club 1 [5]	Club 2 [11]	Club 3 [9]	Club 4 [2]	
γ	0.284	0.264	0.169	-0.125	
t-stat	1.016	16.05	14.93	-0.154	

Note: The table presents γ *coefficient from log* t *regression together with t-statistics.*
** Marks a rejection of convergence at 5% level. Numbers in brackets are number of countries in the club. Club classification is a result of the initial clustering algorithm. Final classification is a result after club merging. Final classification is presented only when club merging is significant. Countries that form different clubs are presented in figure 3.*

However, we find strong evidence of club convergence. Convergence clubs are implicitly included in discussions about the EU core and periphery as well as in the idea of *two-speed* recovery in Europe popularized by Blanchard (2010). We use the clustering algorithm of Phillips and Sul (2007, 2009) to determine convergence clubs endogenously. Results are presented in table 1 under Club classification section. Countries that form convergence clubs are shown in figure 3.

Table 1a presents results for government debt. We find two convergence clubs, one containing 19 and the other 9 countries. The γ coefficient is statistically zero in the first, and positive, but less than 2 in the second club, which indicates conditional convergence of clubs. Similarly, for government revenues, three conver-

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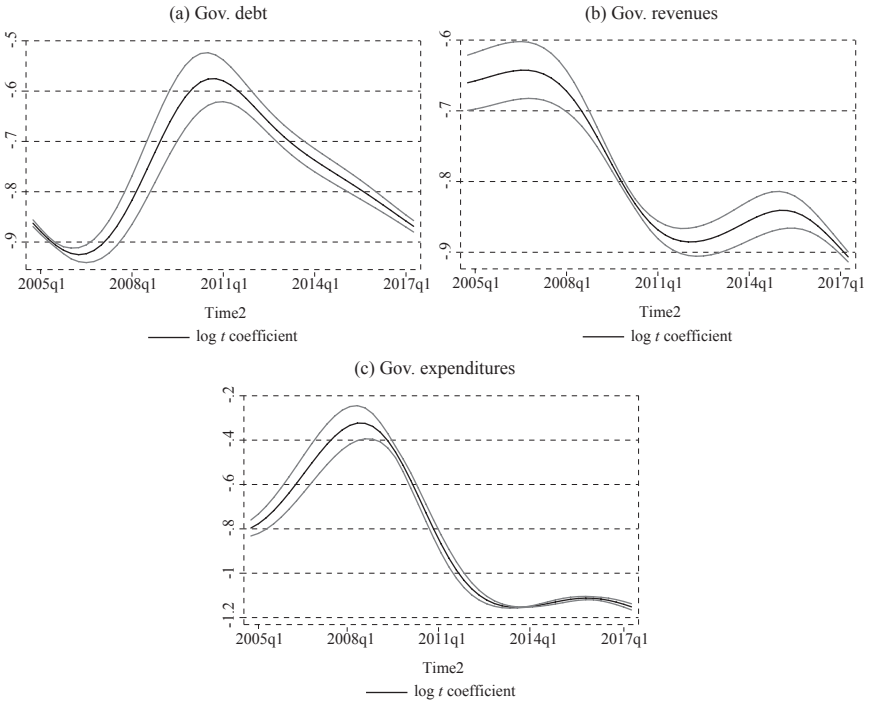
gence clubs emerged and club sizes are 19, 5, and 3 (table 1b). Ireland and Romania form a divergence group, since they do not converge to any club. For government expenditures, club classification finds five clubs in total, plus Ireland as a divergent group. However, clubs 3 and 4 can be merged together according to log *t* test, so the final classification shows four convergence clubs plus Ireland (table 1c). Club sizes are 5, 11, 9, and 2 for Clubs 1, 2, 3, and 4 respectively. In each case $0 \leq \gamma < 2$ indicating conditional convergence.

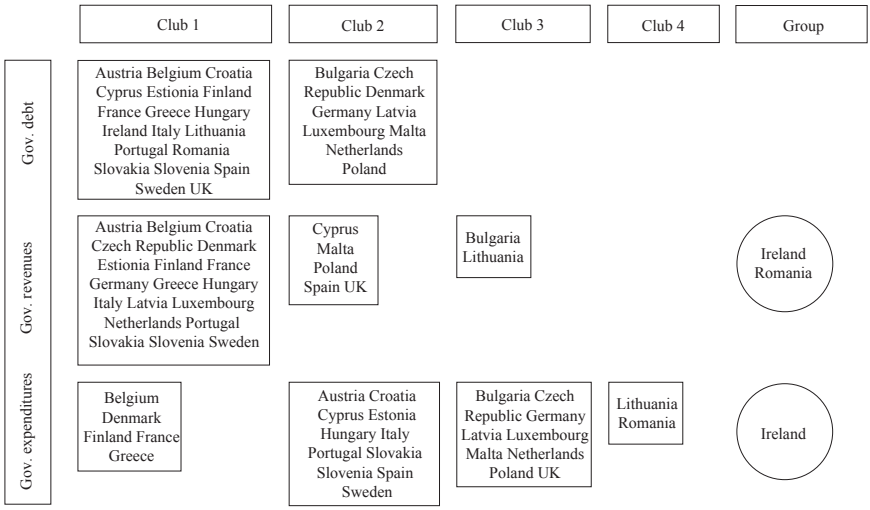
Figure 2

Rolling window estimation of log t regression



Identified clubs are heterogeneous in a sense that countries within a club do not share common geographical, political, or development similarities. In figure 3 we show countries that form different clubs. The first row of figure 3 shows clubs from 1 to 4 and divergent groups. The first column indicates fiscal variables: government debt, revenues, and expenditures. Convergence clubs are in squares, while divergent groups are in circles. For example, government debt Club 1 includes Croatia, Cyprus, Estonia, Hungary, Lithuania, Romania, Slovakia, and Slovenia, which are new member states, mostly small countries, and most of them experienced the transition from centrally planned to market economy. However, Austria, Belgium, Finland, France, Greece, Ireland, Italy, Portugal, Spain, Sweden, and the UK are also members of the same club (government debt Club 1). Similar diversity can be found within other clubs.

FIGURE 3
Convergence clubs



Note: Convergence clubs are in squares, non-convergent groups are in circles.

We find a substantial degree of homogeneity in government debt, revenues, and expenditures clubs. For example, government debt Club 1 and government revenues Club 1 share 12 of 19 countries (figure 3). All eleven countries in government expenditures Club 2 are also in government debt Club 1. There is a major overlap between government debt Club 2 and government expenditures Club 3. Other similarities can also be observed in figure 3. Therefore, clubs are heterogeneous within countries, but homogenous in fiscal variables.

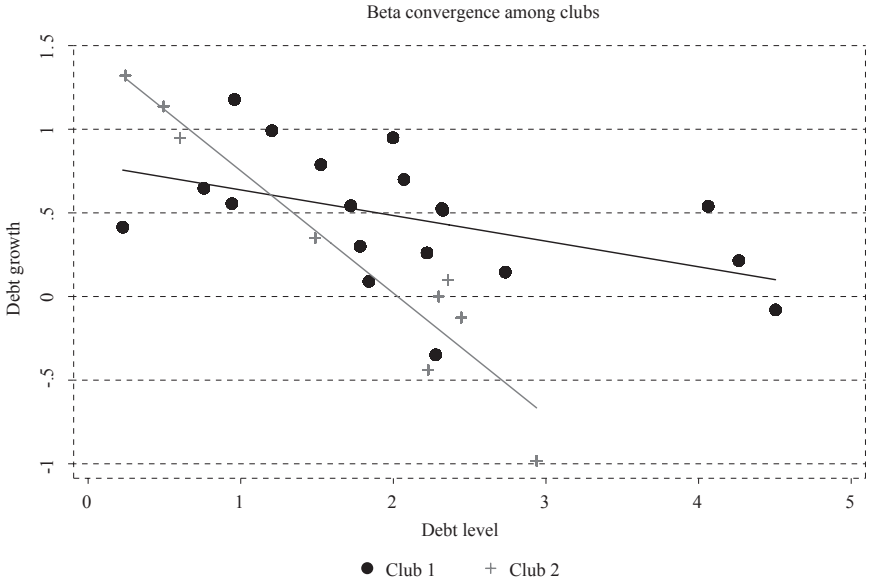
Endogenously identified clubs indeed show evidence of convergence, but this is not the case for *ad-hoc* exogenous clubs. First, we group countries into EU-15 and EU-13 and apply the log *t* regression to government debt, revenues, and expenditures data. The results reject convergence in all cases except for government debt in EU-13, where the γ coefficient is statistically equal to zero (0.042 with a *t*-statistic of 1.34). Next, we group countries into EU core and periphery[8] and use the log *t* test. Convergence is strongly rejected in both groups for all three fiscal variables. It seems that countries converge to some criteria other than simply geographical, political, or development similarities, or indeed multiple similarities.[9] These results could be compared with Kočenda, Kutan and Yigit (2008) who analyze fiscal convergence in the ten EU countries that joined EU in 2004. They do not find a systematic difference among all EU countries, EU core, and EU periphery when analyzing fiscal convergence. Delgado (2006) uses cluster analysis to group EU countries thus avoiding *ad-hoc* exogenous clubs, but the paper does not tackle the issue of fiscal club convergence.

[8] EU core countries are Austria, Belgium, Denmark, Finland, France, Germany, Luxembourg, Netherlands, Sweden, and UK. Other 18 countries form EU periphery.
[9] Analysis of factors and criteria to which countries converge is beyond the scope of this paper.

The log *t* regression improves upon the standard β-convergence tests, but results are compatible with such tests. In figure 4 we show a simple scatter plot of government debt level and a growth rate, which is a version of an unconditional β-convergence test. For government debt Clubs 1 and 2, we estimate the equation of the form $\log(d_{Ti}/d_{1i})=\alpha+\beta d_{1i}+\varepsilon_i$, where the dependent variable is the debt growth rate between the last and the first period, and the independent variable is a debt level in the first period. Club 1 is depicted with black circles, and Club 2 with grey pluses. As shown in the figure 4, regression lines for each club are negatively sloped indicating convergence within clubs according to the standard β-convergence test.

Figure 4

β-convergence in clubs



3.2 UNIT ROOT TESTS OF FISCAL CONVERGENCE

Table 2 presents results of fiscal convergence using unit root tests for the sample of 28 EU countries and within clubs identified by the clustering algorithm. For the government debt data, we analyze convergence to the average for the full sample of the EU 28, then for the 19 countries of convergence club 1, and then for the 9 countries of club 2 (table 2a). A similar analysis is done for government revenues and expenditure in table 2b and 2c, respectively. For each club, we compute a separate adjusted average. Unit root rejection rates at 10% significance level are presented for ADF, Lee and Strazicich (2003), and Enders and Lee (2012) test. Rejection of the unit root hypothesis is considered evidence of convergence.

Table 2

Club convergence using unit root tests

2a: Percent of countries converging to the average gov. debt (%)

	ADF	Lee & Strazicich	Enders & Lee
EU [28]	3.57	3.57	7.14
Club 1 [19]	0.00	5.26	5.26
Club 2 [9]	22.22	0.00	0.00

2b: Percent of countries converging to the average gov. revenues (%)

	ADF	Lee & Strazicich	Enders & Lee
EU [28]	35.71	85.71	46.43
Club 1 [19]	42.11	94.74	57.89
Club 2 [5]	40.00	100.00	40.00
Club 3 [2]	0.00	100.00	100.00

2c: Percent of countries converging to the average gov. expenditures (%)

	ADF	Lee & Strazicich	Enders & Lee
EU [28]	39.29	78.57	46.43
Club 1 [5]	40.00	100.00	40.00
Club 2 [11]	54.55	90.91	81.81
Club 3 [9]	33.33	77.78	55.56
Club 4 [2]	100.00	100.00	100.00

Notes: Rejection rates of unit root hypothesis at 10% level of significance are reported in the table. Number of countries in a club is in brackets. The rejection rate is calculated as (# of rejections/ # of countries within a club)×100.

We find neither absolute nor club convergence in government debt data because the difference of government debt against the average is stationary for just a few countries. For the full sample of EU 28, unit root rejection rates are only 3.5% in the case of ADF and the Lee and Strazicich test, and 7% for the Enders and Lee test. Rejection rates within two clubs are not much different, thus not supporting club convergence of government debt.

In the case of government revenues and expenditures, we do not find evidence of absolute convergence, but club convergence is supported. Almost half of countries in the EU 28 sample converge to the average. ADF test has low power in the presence of structural breaks, but the unit root is rejected in 35% to 40% of countries for both series. The Enders and Lee test has more power and rejects the unit root in 46% of countries. Finally, the Lee and Strazicich test with sharp structural breaks shows the biggest rejection rates of 78% and 85%. For both government revenues and expenditures, rejection rates within clubs are higher than in the full sample of EU 28, indicating stronger convergence within clubs. This is especially true for Lee and Strazicich (2003) test where rejection rates are mostly over 90% within clubs indicating strong club convergence. Enders and Lee (2012) test has rejection rates within clubs well over 50%, except in government revenues club 2 and government expenditures club 1. ADF test gives somewhat mixed results but does not reject the club convergence hypothesis. This confirms that convergence clubs using the Phillips and Sul (2007, 2008) clustering algorithm are robust,

except for government debt. As a comparison, De Bandt and Mongelli (2000) use cointegration techniques to analyze fiscal convergence in the Eurozone. Their findings support fiscal convergence in the Eurozone over the 1970-1998 period. Unit root tests which allow for nonlinearities have recently been a more popular way of analyzing convergence (see Raguž Krištić, Rogić Dumančić and Arčabić (2018) and references therein).

3.3 FISCAL (UN)SUSTAINABILITY

Next, we analyze if fiscal policy is sustainable in the European Union and within convergence clubs found in the previous section. In this respect, we use the policy response function from equation (9) which relates primary government surplus with public debt and the output gap. If surplus increases as a response to an increase in public debt, fiscal policy is considered sustainable, as discussed in the methodology section.

We analyze fiscal sustainability using seven different models (subsamples). Model 1 is the benchmark model, which includes 28 EU countries. Models 2 and 3 include subsamples of countries from government debt convergence clubs identified in the previous section. The first club consists of 19, and the second of 9 countries.[10] Next, we consider fiscal policy sustainability within exogenous clubs of EU-15 and EU-13 countries with Models 4 and 5. Finally, Models 6 and 7 use subsamples with government debt $\geq$ 90% (Model 6) and debt $<$ 90% of GDP (Model 7). This subsample analysis is motivated by the influential paper of Reinhart and Rogoff (2010) who argue that a public debt higher than 90% of GDP depresses economic growth. Maastricht criteria also require government debt below 60% of GDP. However, EU countries fought with the Great Recession and the sovereign debt crisis, which substantially increased the level of public debt in some countries. Our data show that 15 out of 28 EU countries had a government debt higher than 60% of GDP in 2017:Q2. Therefore, such subsample analysis is interesting from both an academic and a policy perspective. The 90% level of public debt can be considered as arbitrary, especially since Arčabić et al. (2018) show there is no single level of public debt associated with the decrease of GDP growth. However, in this paper, we are only interested in fiscal sustainability.

Fiscal policy is found to be unsustainable in the EU. We present the results of system GMM-CCE and FE estimators in tables 3 and 4, respectively. Different models are numbered in the first row of each table, and independent variables are in the first column. In table 3, the estimated coefficient β_1 next to the government debt is negative or insignificant. In other words, the government does not increase primary surplus as a response of higher government debt, and fiscal policy is not sustainable. We find weak evidence of fiscal sustainability for the EU-13 group countries and for the subsample with debt $\geq$ 90%. For these two models (Models

[10] We consider government debt convergence clubs only, but clubs are fairly homogeneous between fiscal variables, as discussed. In addition, some government revenues and expenditures convergence clubs include only a few countries, which is impractical for panel data analysis.

5 and 6), point estimates are positive with both system GMM-CCE and FE estimator. However, coefficients are insignificant for system GMM-CCE estimator, and point estimates are small in magnitude in both cases (tables 3 and 4).

Fiscal policy is countercyclical in the EU and in all subsamples considered. Balassone, Francese and Zotteri (2010), and Cassou, Shadmani and Vázquez (2017) use β_2 coefficient next to the output gap to analyze cyclicality of fiscal policy. As presented in tables 3 and 4, the coefficient next to output gap is positive and statistically significant in all models.[11] Positive output gaps are related to an increase in primary surplus, which can be interpreted as a countercyclical fiscal policy. This indicates that fiscal policy in the European Union tries to smooth business cycles.

Fiscal policy is fairly persistent because the coefficient ρ next to the lagged surplus is positive, statistically significant, and roughly 0.5.

[11] Only Model 6 in table 4 has a positive, but insignificant output gap.

Table 3

Results of fiscal sustainability analysis using system GMM-CCE model

Models	Model 1 Benchmark	Model 2 Club 1	Model 3 Club 2	Model 4 EU-15	Model 5 EU-13	Model 6 Debt ≥ 90%	Model 7 Debt < 90%
Variables	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus
Surplus (lagged) (ρ)	0.502***	0.415***	0.390***	0.547***	0.308**	0.573**	0.526***
	(0.08)	(0.09)	(0.10)	(0.06)	(0.11)	(0.21)	(0.10)
Debt (β_1)	-0.018	-0.009	-0.043	-0.029	0.040	0.036	-0.057*
	(0.01)	(0.01)	(0.12)	(0.02)	(0.03)	(0.08)	(0.03)
Output Gap (β_2)	0.286***	0.413***	0.435***	0.394***	0.388**	0.297**	0.305***
	(0.05)	(0.07)	(0.13)	(0.04)	(0.15)	(0.09)	(0.07)
Constant	0.776	0.122	2.030	1.879	-2.351*	-4.298	2.459*
	(0.76)	(1.06)	(5.63)	(1.23)	(1.15)	(8.69)	(1.44)
Observations	1,708	1,159	549	915	793	281	1,427
Number of countries	28	19	9	15	13	9	26
F-test	0	3.40e-06	0.00139	0	2.43e-05	0.00352	0
# of instruments	23	14	11	14	11	11	20
Hansen test	0.222	0.100	0.371	0.175	0.102	0.506	0.166

*Note: Standard errors in parentheses, ***, **, and * mark statistical significance at 1%, 5%, and 10% level. Model 1 is the benchmark model. Models 2 and 3 include countries from endogenous debt convergence clubs 1 and 2, respectively. Models 4 and 5 include EU-15 and EU-13 countries, and models 6 and 7 include subsamples with government debt ≥ 90% and debt < 90% of GDP, respectively.*

Table 4

Results of fiscal sustainability analysis using FE model

Models:	**Model 1 Benchmark**	**Model 2 Club 1**	**Model 3 Club 2**	**Model 4 EU-15**	**Model 5 EU-13**	**Model 6 Debt ≥ 90%**	**Model 7 Debt < 90%**
Variables	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus
Surplus (lagged) (ρ)	0.512***	0.515***	0.491***	0.637***	0.336***	0.248**	0.611***
	(0.06)	(0.07)	(0.12)	(0.04)	(0.07)	(0.10)	(0.09)
Debt (β_1)	0.006	0.004	0.025	0.003	0.029**	0.031**	-0.009
	(0.01)	(0.01)	(0.02)	(0.00)	(0.01)	(0.01)	(0.01)
Output Gap (β_2)	0.176***	0.172***	0.209**	0.226***	0.197***	0.213	0.133***
	(0.04)	(0.04)	(0.09)	(0.03)	(0.05)	(0.12)	(0.04)
Constant	-0.614*	-0.713	-0.998	-0.327	-1.831***	-3.951**	0.168
	(0.36)	(0.42)	(0.71)	(0.35)	(0.40)	(1.48)	(0.63)
Observations	1,708	1,159	549	915	793	281	1,427
R-squared	0.304	0.298	0.335	0.457	0.173	0.123	0.384
Number of countries	28	19	9	15	13	9	26

*Note: Standard errors in parentheses, ***, **, and * mark statistical significance at 1%, 5%, and 10% level. Model 1 is the benchmark model. Models 2 and 3 include countries from endogenous debt convergence clubs 1 and 2, respectively. Models 4 and 5 include EU-15 and EU-13 countries, and models 6 and 7 include subsamples with government debt ≥ 90% and debt < 90% of GDP, respectively.*

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4 CONCLUSION

The Great Recession and the sovereign debt crisis in the Eurozone have shaken fiscal policies in the EU. Many European countries have breached public debt and deficit goals set by the Stability and Growth Pact. Therefore, the issue of fiscal policy convergence and sustainability is very important for the EU.

This paper analyzes fiscal policy convergence and tests for fiscal sustainability in 28 EU countries using data on government debt, revenues, and expenditures. We show absolute divergence in fiscal policies, which was further increased by the Great Recession and the sovereign debt crisis. However, we find strong evidence of club convergence. Club convergence is important to consider because the EU does not have a single fiscal policy and member state policies are heterogeneous. In general, convergence clubs are implicitly included in discussions on the EU core and periphery, and in the *two-speed* recovery idea which argues that different groups (or clubs) of European countries are characterized by faster and slower recoveries from the recession. We find two government debt convergence clubs, three government revenue clubs, and four government expenditure clubs. Endogenously identified clubs do not have simple geographical, political, or development similarities. They are heterogeneous within countries, but homogenous between fiscal variables. Exogenous grouping of EU countries into EU-15 and EU-13 or into EU core and periphery does not show evidence of fiscal convergence. Convergence clubs are related to multiple equilibriums within the EU, which makes a single fiscal policy difficult to achieve. More precise fiscal rules could be considered by policymakers together with corrective measures such as the Excessive Deficit Procedure. Fiscal rules instead of discretionary decision making might be a step toward similar fiscal policies and fiscal convergence in the EU.

Fiscal policy in the EU is found to be unsustainable, but countercyclical. We use a policy response function for the sustainability analysis where primary surplus is a function of government debt and the output gap. We show that surplus does not respond to an increase in government debt, which cannot be interpreted as sustainable. However, primary government surplus increases in expansions and decreases in recession, thus being countercyclical and aimed at smoothing business cycles. In this respect, the fiscal goals for public debt and deficit set by the Stability and Growth Pact may not be enough to ensure fiscal sustainability. More precise fiscal rules together with corrective measures would be helpful for both fiscal sustainability and convergence.

Disclosure statement

No potential conflict of interest was reported by the author.

APPENDIX

DATA CONSTRUCTION AND SOURCES

For the convergence analysis, we use data on general government debt, revenues, and expenditures. Variables are in millions of euro, current prices. We divide all by nominal GDP to express fiscal variables in real terms and in a percent of GDP. The main data source is Eurostat and the International Financial Statistics database from the International Monetary Fund. All data span the period from 2000:q1 to 2017:q2, but some data have been reconstructed. For Germany, Estonia, Ireland, and Luxemburg we interpolate annual data for 2000 and 2001 since quarterly data start from 2002:q1. For Austria, we interpolate annual data for 2000 since quarterly data start from 2001:q1. For Croatia, we reconstruct monthly data on central government expenditure and revenue based on the old methodology. The data are provided by Croatian National Bank (CNB) and we use central government data as a proxy for the general government. Nominal GDP is taken from the Eurostat database except for Croatia, Malta, and Poland for which we take the data from IFS. Public debt data are entirely taken from the Eurostat database. Public debt is usually expressed as a percent of GDP on annual bases. Therefore, public debt is divided by a sum of GDP in a current and previous three quarters, or $d_t = (\$d_t / \sum_{i=0}^{3} \$y_{t-i}) \times 100$, where d_t is public debt in a percent of GDP, $\$d_t$, and $\$y_t$ are nominal debt and GDP in millions of euro. We use this approach for the sustainability analysis when the sample starts in 2002:q1. For the convergence analysis where the sample starts in 2000:q1, we divide public debt only by current quarter GDP to maximize number of observations, or $d_t = (\$d_t / \$y_t) \times 100$. For the sustainability analysis, we also use primary surplus and real GDP data from Eurostat. All the data span the period from 2002:q1 to 2017:q2 (balanced panel). Below we plot time series of government revenues and expenditures (figure A1), and primary surplus and government debt (figure A2) in a percent of GDP. Table A1 contains basic descriptive statistics.

FIGURE A1

Government revenues and expenditures as a percent of GDP

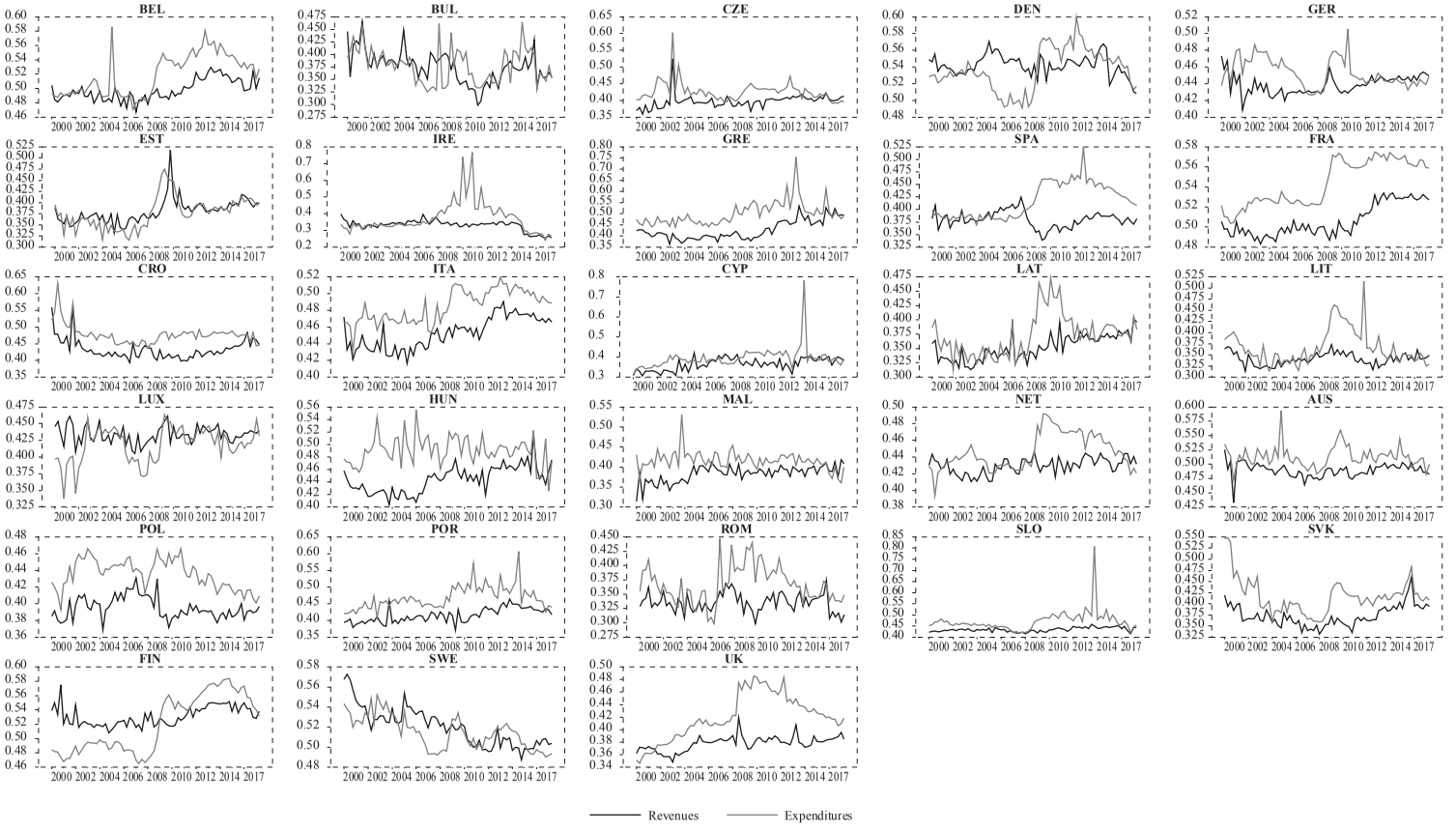

FIGURE A2

Primary surplus and government debt as a percent of GDP

TABLE A1

Descriptive statistics

Country	Revenues		Expenditures		Debt		Surplus	
	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
Belgium	0.498	0.014	0.519	0.029	102.371	6.191	1.489	2.662
Bulgaria	0.375	0.032	0.378	0.035	25.430	12.762	0.809	3.995
Czech R.	0.397	0.021	0.427	0.030	34.493	6.377	-1.570	2.538
Denmark	0.542	0.012	0.537	0.025	41.284	6.727	2.350	2.937
Germany	0.439	0.011	0.453	0.017	69.791	6.443	0.853	1.749
Estonia	0.380	0.027	0.376	0.035	6.770	2.386	0.605	2.605
Ireland	0.331	0.031	0.374	0.095	63.992	35.900	-3.019	8.925
Greece	0.427	0.042	0.501	0.052	135.084	31.814	-2.996	4.643
Spain	0.380	0.016	0.417	0.035	64.440	24.433	-1.729	4.398
France	0.506	0.016	0.544	0.023	78.400	13.788	-1.601	1.526
Croatia	0.433	0.030	0.478	0.030	56.491	19.248	-1.880	2.281
Italy	0.453	0.019	0.485	0.019	115.085	12.457	1.345	1.277
Cyprus	0.365	0.030	0.395	0.055	73.230	21.307	-0.192	5.510
Latvia	0.352	0.022	0.374	0.036	26.770	14.433	-1.088	3.003
Lithuania	0.341	0.013	0.367	0.039	28.502	10.293	-1.275	3.675
Luxembourg	0.434	0.013	0.418	0.026	14.941	7.215	1.360	1.821
Hungary	0.444	0.021	0.490	0.023	69.585	8.796	-0.745	3.255
Malta	0.384	0.020	0.416	0.023	66.048	4.001	0.266	2.870
Netherlands	0.429	0.009	0.446	0.021	56.298	8.245	-0.165	2.086
Austria	0.489	0.012	0.513	0.019	76.310	6.738	0.363	1.796
Poland	0.395	0.013	0.435	0.018	48.860	5.134	-1.724	1.608
Portugal	0.415	0.021	0.469	0.035	92.343	30.325	-1.906	3.499
Romania	0.335	0.016	0.367	0.033	25.756	10.096	-1.550	3.267
Slovenia	0.434	0.010	0.472	0.048	44.276	22.349	-1.759	4.888
Slovakia	0.373	0.024	0.417	0.039	43.263	8.989	-1.969	2.157
Finland	0.531	0.013	0.520	0.040	46.337	10.241	1.891	3.288
Sweden	0.520	0.019	0.515	0.016	42.539	4.814	1.568	1.730
UK	0.378	0.012	0.420	0.036	60.967	22.826	-2.558	2.478

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