Sustainability of public debt in Europe: the use of swaps

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SUSTAINABILITY OF PUBLIC DEBT IN EUROPE: THE USE OF SWAPS[*]

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Abstract

This study contributes to the literature on public debt sustainability and investigates whether European countries manage primary surplus also through interest rate swaps. Since the 1990s European countries have extensively employed Over The Counter (OTC) contracts such as swaps to smooth the financial costs of debt, shift part of debt forward, and exploit the lack of accounting transparency of these contracts. One of the primary goals of the EU fiscal framework is to ensure public debt sustainability. Several proposals have been considered to improve the current framework, yet none of them has addressed the issue of debt sustainability when countries use swaps. This is the first empirical investigation that confirms the use of swaps by European countries in the 2006-2018 period to improve the primary balance. According to panel data results, EU countries increased the primary surplus in the 2006-2018 period following a rising debt and took corrective action by actively managing their debt with swaps; this evidence is in line with the hypothesis of the strategic use of swaps by public administrations widely described in the theoretical literature on debt management. Policy implications and proposals to improve the current European fiscal framework are provided.

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Introduction

The economic literature on fiscal policy has traditionally focused on the development of an analytical framework to assess governments' "ability to pay" debt over time, i.e., debt sustainability (Fournier and Fall 2015). This study contributes to the literature on public debt sustainability applied to the case of the EU and investigates whether European countries increased primary surplus also through interest rate swaps over the 2006-2018 period.

Public debt sustainability is a primary objective of the current European fiscal framework and several proposals have been circulated among academics and policymakers on how to reform and improve the Stability and Growth Pact (SGP) (European Fiscal Board 2019). Indeed, with the introduction of the SGP and the debt crisis of 2011, public debt ratios in a number of high-debt EU Member States 'were not adequately reduced during good economic times' (European Fiscal Board 2019), similarly to other OECD countries (Beqirai et al. 2018).

According to the recent analysis of (European Fiscal Board 2019), between the adoption of the SGP in 1997 and the post-2007 financial crisis, the converging interest rates not reflecting the different economic fundamentals and sovereign risks between Member States contributed to raising fiscal imbalances and vulnerabilities, especially in high-debt countries.

The sustainability of public finances regained attention in the post-crisis period and with the adoption of the so-called six-pack reform (European Union 2011) the debt rule was then operationally defined with the purpose of clarifying the excessive deficit procedure (EDP) of the SGP. The provisions introduced in 2011 defined a quantitative condition for considering the debt ratio as '*sufficiently diminishing*' and approaching the reference value '*at a satisfactory pace*'.

However, at the date of the adoption of the new regulation, the compliance could not be assessed for some high-debt Member States because of the provision of a transitional period to allow those States subjects to an EDP to adapt their policies to the numerical target for debt reduction.

The fiscal consolidation required for complying with the budgetary rules, further strengthened by the reforms of the EU surveillance framework in 2011, induced many governments to implement austerity measures that did not reduce their outstanding debt, but had distortive effects on public spending and led to strategic reactions (Fastenrath et al. 2017). Such reactions included the smoothing of the financial costs of debt, the shifting of part of the debt forward, and exploiting the lack of accounting transparency of Over Counter (OTC) contracts, thus weakening the political responsibility associated with debt and debt-related liabilities (Lagna 2016). Debt-related instruments enjoyed substantially reduced accounting transparency and weak monitoring (Organization for Economic Cooperation and Development 2011).

According to the (Bank for International Settlements 2019), the trading of OTC derivatives products by nonfinancial operators includes sovereigns, local administrations, municipalities, and nonfinancial firms, and the notional value amounted to $449,000 million in June 2020. The most popular contract

for financial and nonfinancial customers is the interest rate swap that is employed to stabilize the costs of debt (i.e. interest) and to provide liquidity.

The governments issue fixed interest or exchange rate bonds and swap them with floating rate contracts (often with caps and floors) to lock in their maximum expense and gain from descending rates; this allows for better debt management and ameliorates the debt-to-GDP ratio. (Organization for Economic Cooperation and Development 2011) addressed the challenges related to debt management and reported on limitations for state and local governments, particularly on their use of complex contracts such as OTC derivatives. European countries have purchased swaps since the 1990s to window dress their deficit figures and access the European Monetary Union; this was possible because of inadequate accounting rules (Organization for Economic Cooperation and Development 2011).

Only after 2004 did Eurostat update the public sector accounting rules to consider debt-related instruments such as swaps and substantially revise the backward figures on debt and deficit (European Commission 2010); this revision contributed to the Greek crisis in 2011. The subsequent revision of the accounting rules for financial derivatives traded by sovereigns in 2014 added 0.5% extra costs to the Italian debt-to-GDP ratio while the debt of other countries did not increase so much (Bucci et al. 2020). Until 2014, swaps and other debt-related contracts were weakly supervised and monitored by European authorities, but not by intermediaries and financial markets, especially after the subprime crisis. The wide use of swaps is among the effects of the financialization of the state, that is, the "restructuring of state institutions and power in line with the growing influence of finance in today's world" (Lagna 2016) p.168. It also shows the financial industry's success in influencing policymakers to authorize municipalities to use derivatives and thereby to financialize their debt management (Trampusch and Fastenrath 2019).

However, to the best of our knowledge, no one has contributed to the understanding of the fiscal governance framework suitable for the primary objective of attaining a sustainable public debt when countries use swaps. Our aim is to fill this gap in the literature and answer the following research questions: have European countries improved their primary surplus using swaps? How can the EU fiscal framework be improved to consider the use of swap contracts? To answer these questions, we empirically estimate the debt sustainability condition in selected European countries in the 2006-2018 period and provide policy implications.

The paper is structured as follows: the first section reviews the literature on debt sustainability and the use of swaps by governments, the second section describes the analytical framework for assessing debt sustainability at the European level, the third presents the methodology, the fourth and fifth describe data and results, and the sixth provides policy implications and conclusions.

1. Literature review

1.1 Debt sustainability

The assessment of debt sustainability relied on two different approaches, reflecting the existing views on the broader issue of fiscal sustainability: the first was theoretical, while the second reflected the government's perspective (i.e. public debt management).

The standard theory of debt sustainability suggests that debt is sustainable if the solvency condition holds, i.e. public debt could be repaid at some point in the future. According to this approach, the assessment of debt sustainability crucially depends on the relation between debt and primary surplus over time and on the government intertemporal budget constraint, namely, the existing debt should be covered by the expected present value of the stream of future primary balances. Several approaches have been proposed in the literature at the empirical level. First, the assessment of fiscal sustainability was carried out testing the stationarity of the time series of public debt or deficit using a unit root or a co-integration test. In a seminal paper (Hamilton and Flavin 1986) proposed empirical tests to verify the fiscal sustainability, showing that the government intertemporal budget constraint of public debt was fulfilled if the time series of primary deficit and debt followed a stationary process, assuming constant interest rates. Applying this approach to U.S. data over the 1960-1984 period, they found that the debt was sustainable. Following the same approach based on testing the intertemporal budget constraint and the same dataset, (Trehan and Walsh 1991) confirmed the consistency of the U.S. budget with the intertemporal budget balance and derived the following sustainability condition: the headline deficit is stationary as long as interest rates are positive. However, the approach proposed in the literature based on testing the present budget constraint implied the estimation of the discount rate of expected future government budget surpluses (Hamilton and Flavin 1986). To simplify the analysis, (Bohn, 1995, 1998) modeled an alternative sustainability condition that did not require any assumption about interest or discount rates: to be able to repay their debt, governments should respond to increases in the debt-to-GDP ratio by increasing the primary surplus. Hence, if the primary surplus-GDP ratio is a positive function of the debt-to-GDP ratio, then the fiscal policy is sustainable. This implies that the corrective action automatically taken in response to higher debt permitted the time series of public debt not to diverge from the mean value, given that the reaction coefficient was large enough. (Greiner et al. 2007) applied this test to study the debt sustainability of selected Euro-area countries, with a focus on a high debt country whose deficit over GDP exceeded the 3% target set in the Maastricht Treaty, finding that fiscal policy was sustainable in the long run.

The fiscal reaction function approach proposed by (Bohn, 1995, 1998) was further explored to determine the debt limit above which the solvency is at risk. Once the reference threshold was determined, the difference between the debt level and its upper limit was used as a measure of fiscal space. (Ghosh et al. 2013) showed that, as the debt approaches its limit, the risk premium increases due to the higher probability of default, making the primary surplus insufficient to repay interest rate expenses and, in turn, negatively affecting the probability of default and increasing the possibility of a permanently

increasing debt/GDP ratio. This approach highlighted that the fiscal reaction functions modelled by (Bohn 1998) gave weak sustainability criteria and that, to avoid that the debt dynamics turns explosive, the debt coefficient in the fiscal reaction function must be sufficiently high.

Following these papers, the estimate of public debt sustainability thresholds and public debt limits, i.e. the theoretical level at which the government may lose access to markets, has received considerable attention in the Debt Sustainability Analysis (DSA); (Fournier and Fall 2015) estimated country-specific endogenous debt limits with the methodology of (Ghosh et al. 2013) for OECD countries in the 1985-2013 period, showing that low interest rates allowed debt limits to be particularly high for most of the OECD countries. (Berti et al. 2016) estimated country-specific fiscal reaction functions in selected EU countries in the 1950-2013 period and looked at the risks of *fiscal fatigue* related to a prolonged fiscal consolidation process. They showed a positive fiscal policy reaction to rising debt levels after 2009, which suggested a change in fiscal behavior in Germany, France, Italy, Austria, the UK, Portugal, and Spain, probably due to the EU public debt crisis. We want to contribute to this literature by considering whether swaps contribute to the primary surplus.

1.2 The use of swaps

Most of the finance literature on swaps focuses on their pricing efficiency and market liquidity; the pricing of swaps is sensible to the market's conditions. While bonds' and derivatives' prices should align due to the no-arbitrage condition, empirical evidence has found that in the EU sovereign bond markets they did not and country credit risk played a substantial role in this phenomenon (Fontana and Scheicher 2016). After the subprime crisis, high-debt countries such as Greece and Italy had limited access to the swap market because of their credit risk.

The possibility of postponing revenues and anticipating losses is highly controversial in the public finance literature (Giovannini 1997) because it allows for circumvention of debt limitations. The EU lacks a framework for sovereign debt restructuring (Guzman and Stiglitz 2016), but the 'limitlessly expanding finance augmented the financial risk in the economic system' (Mügge 2009) (p.515). Global financial regulation improved after the subprime crisis in terms of markets' infrastructure, liquidity and surveillance, but challenges remain for sovereign debtors because the new regulatory system failed to acknowledge the risk posed by derivatives traded by public entities at the central and local level (Oldani 2018). In the U.S. and the EU, governments are exempt from the central clearing of OTC contracts but they should report their trading to trade repositories "as a means of improving monitoring of the financial system and reducing systemic risk" (Macroeconomic Assessment Group on Derivatives 2013) (p. 17).

(Piga 2001) described the strategic use of swaps by France, Italy, and Greece to reduce their budget deficit before adopting the euro; swaps have been used to shift a part of the debt forward and access the euro (Zingales 2015). While Italy and France have not accumulated excessive risks, Greece has been unable to manage its liabilities (European Commission 2010). After 2010, Eurostat updated the accounting rules to provide information on debt related contracts such as swaps.

The confidentiality of derivatives contracts limited the access to data for researchers. The literature has not yet analyzed the costs and benefits of swaps related to government debts because of the lack of information; in fact, costs and benefits could be evaluated on the basis of proper financial information such as the counterpart(s), the duration, fees, the scenario used to price the swap, the so-called Greeks, the default event description and the implicit (interest or exchange) rates. These details are not publicly available.

The financialization of the state is not a recent phenomenon, but the literature has investigated its consequences only recently; longitudinal studies on 23 sovereign states' debt in the 1980-2010 period found that the financialization "is characterized by overarching commonalities accompanied by country-specific differences in both dimensions" (Fastenrath et al. 2017, p. 274). (Lagna 2016) reviewed the derivatives-based strategies of Italy in the 1993–1999 period, showing that Italian governments implemented *"statecraft strategies by exploiting the market-based methods and technologies of financial innovation"* (p. 178) and gained from financial speculation. Local public administrations mimicked the behavior of central states in Europe (Oldani 2019), as in the case of the Italian regions that extensively used swaps, but interest rates were lower than expected over the 2008-2017 period and swaps contributed to increasing the costs of the regions' debt (Oldani and Fantini 2020). We contribute to this growing area of research focusing on EU countries.

2. The analytical framework to assess debt sustainability

The Debt Sustainability Analysis (DSA) has been carried out to assess fiscal sustainability by (IMF 2013) and more recently at the EU level after the introduction of the enhanced surveillance framework.

The European Commission's approach aims at identifying fiscal sustainability risks at different time horizons (short, medium, and long-run), summarized in a heat map, on the basis of different analytical tools and indicators. A more detailed analysis is carried out (the enhanced DSA) only in case a country is found to be "vulnerable" under some specific conditions.

The assessment of the short-term risk of "fiscal stress" was introduced in the aftermath of the financial crisis. The assessment is based on the S0 indicator which is "an early-detection indicator, designed to highlight shorter-term (one-year horizon) fiscal sustainability challenges stemming from the fiscal as well as the financial and competitiveness sides of the economy" (Fiscal Sustainability Report, 2012). Instead, for the analysis of the medium-term fiscal sustainability, the European Commission relies on the joint interpretation of the medium-term fiscal sustainability indicator (S1) and the DSA (Fiscal Sustainability Report 2015).

The DSA is carried out by performing both deterministic and stochastic debt projections to analyze its dynamics over the following 10 years. It is based on a central scenario around which alternative scenarios and sensitivity tests on exogenous shocks are carried out. There is the "Fiscal reaction function scenario (FRF)", which tests the responsiveness of the primary balance for ensuring debt sustainability,

and a "Stability Growth Pact Scenario (SGP)", which estimates debt paths under the assumption of compliance with the structural balance adjustment provided by the SGP. The shocks considered are on the interest rate dynamics, nominal GDP growth, structural primary balance, and nominal exchange rates. Finally, to complete the medium-term risk assessment, additional aggravating/mitigating risk factors are also taken into account to detect additional vulnerabilities, e.g. those linked to the maturity of debt, to the share of debt denominated in foreign currency, or to the characteristics of debt holders.

The S1 indicator shows the additional fiscal adjustment effort required to improve the government structural primary balance over the following 15 years and reach the target of a 60% public debt-to-GDP ratio.

Finally, challenges over the long-run are identified through the joint use of the long-term fiscal sustainability indicator (S2) and the DSA. S2 shows the upfront fiscal adjustment (to the government structural primary balance) required to stabilize the debt-to-GDP ratio over an infinite time horizon.

Therefore, in both the medium and the long-run, if the DSA and fiscal risk indicators signal the presence of a high risk, Member States are required to correct such vulnerabilities. However, this does not directly imply that debt is considered unsustainable, because a broad assessment is made that takes into account additional elements, such as the structure of government debt financing; however, government liabilities and assets are not considered in the EDP.

The complex and comprehensive framework adopted to assess the sustainability of public debt at the EU level does not take into account the use of swaps. Our research purpose is to investigate whether swaps effectively contributed to debt sustainability in the 2006-2018 period in the European Union. In particular, given the multidimensional approach, the focus is on a time horizon that is most suitable to capture the possible effects of an active use of swaps, namely, the medium term (i.e. the assessment based on the joint interpretation of the S1 and DSA).

3. Methodology

According to the macroeconomic theory (Berti et al., 2016; Bohn, 1998; Ghosh et al. 2013) and the European treaties, the public debt sustainability condition is given by:

$$[T_t - G_t]/Y_t = \quad + \quad [B_t/Y_t] \qquad\qquad\qquad (1)$$

Where t refers to time, T are revenues and G are expenses of the state, Y is the GDP, B is the outstanding debt and , are parameters. If the primary surplus ($T_t - G_t$) to GDP (Y_t) increases linearly with a rising public debt-to-GDP ratio, the fiscal policy is sustainable for dynamically efficient economies (Bohn 1998; Greiner et al. 2007). After 1998, European treaties aimed at public debt stabilization for Member States, introducing a numerical target of 60% on the ratio between debt and GDP and a maximum deficit to GDP of 3%.

EU countries underwrote derivatives contracts, mostly interest rate and exchange rate swaps, to smooth the costs of debt and to hedge it, as reported by Eurostat in the Government Finance Statistics. Data on swaps underwritten by EU states are available only after 2006, but there is evidence in the literature of such trading activity also before that year (European Commission 2010, Piga 2001).

We investigate whether swaps effectively contributed to debt sustainability in the EU over the 2006-2018 period and verify the debt sustainability condition as follows:

$$S_{it} = \ b_{it-1} + \ ^{T}Z_{it-1} + \ _{it} \tag{2}$$

Where t refers to time, i refers to country, S is the primary surplus, b is the debt-to-GDP ratio, Z is a set of macroeconomic and financial variables and   is a normally distributed error term. The sustainability condition can be further specified as:

$$S_{it} = \ b_{it-1} + \ _{1}Ygap_{it-1} + \ _{2}Interest_{it-1} + \ _{3}Swap_{it-1} + \ _{it} \tag{3}$$

Where S_{it} is the primary surplus, b_{it-1} is the lagged debt-to-GDP ratio, $Ygap_{it-1}$ is the lagged output gap, $Interest_{it-1}$ is the lagged ratio between the interests paid by the government and GDP, and $Swap_{it-1}$ is the lagged settlement of swaps underwritten by the country. In this respect, we depart from the traditional approach for testing debt sustainability, which only considers macroeconomics variables (Bohn, 1998; Greiner et al. 2007), by including also financial ones. We expect that if the debt or output gaps grow, the primary surplus should increase as well, while the growth of interest expenses reduces the primary surplus. We expect that the use of swaps positively correlates with the primary surplus, since they are debt-related contracts.

4. Data and empirical results

Yearly data for the 2006-2018 period in European countries come from the Excessive Deficit Procedure (EDP) Eurostat database (Eurostat 2020). Data refer to GDP, gross total debt, interest expense, settlement of swaps, primary surplus and are measured in euro; debt, interest expense, and primary surplus are expressed as a ratio to GDP in the estimates. The output gap is in percentage. Countries that actively used swaps during the 2006-2018 period are Belgium, Croatia, the Czech Republic, Denmark, Estonia, Finland, Germany, Greece, Hungary, Ireland, Latvia, Italy, the Netherlands, Poland, Portugal, Slovenia, Spain, and Sweden. Other European countries (Austria, Bulgaria, Cyprus, France, Lithuania, Luxemburg, Malta and Romania) did not use swaps to hedge their debt or interests' payments.

During the 2006-2018 period there seemed to be a vicious debt swap cycle for 18 European swap user countries; the ratio of public debt to GDP did not decrease, and neither did the settlement of swaps (Fig.1). However, while debt over GDP increased because of macroeconomic and fiscal factors, the path of swaps depended on their pricing; it is very likely that countries used swaps to hedge against the

increase of interest rates, which did not take place over the period under observation. However, given the scarce information on contracts, a deeper analysis cannot be provided.

Fig.1 18 EU swap user countries, Yearly %
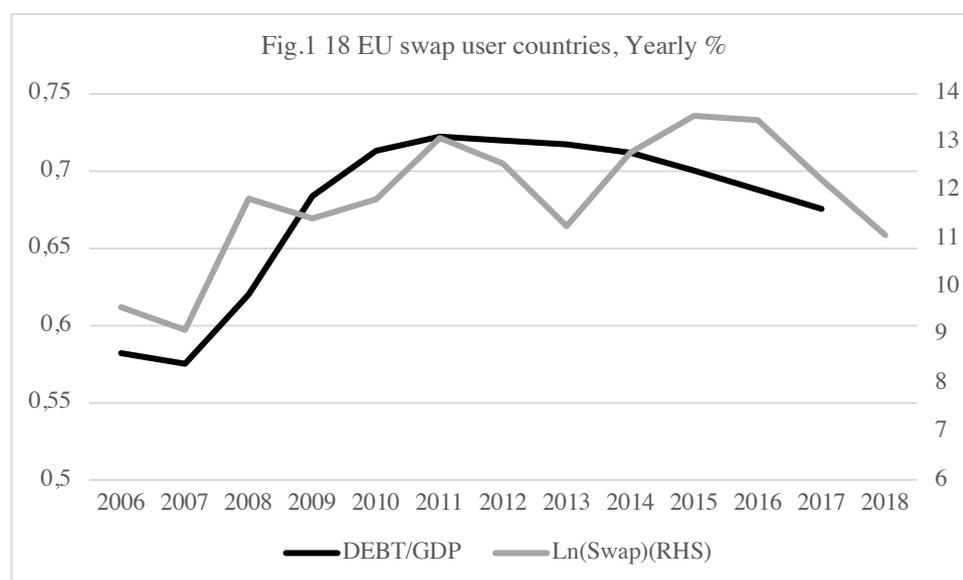
Source: Eurostat, EDP database.

Table 1: Descriptive statistics for 18 European swap user countries, 2006-18 Yearly

Descriptive statistics

	Obs.	mean	St. Dev
Primary Surplus /GDP	234	-0.47	3.63
Interests/GDP	234	2.3	1.37
Debt/GDP	234	67	0.38
Output Gap	234	-0.82	4.01
Swap	220	12,435.6	89,772.41

Source: Eurostat, EDP database.

The 18 European swap user countries largely differ in size and descriptive statistics; the debt-to-GDP ratio has an average value of 67% during the 2006-2018 period. Virtuous countries show a debt-to-GDP ratio lower than 40%, while Greece exceeds 180%. Interest expense over GDP has an average value of 2.3% during the period under observation, and the primary surplus has an average value of 0.47%, since larger countries run budget deficits. The output gap showed a negative average value (-0.82%) as a result of the prolonged recession. The settlement of swaps has an average value of 12.5 billion euro with a high standard deviation provided that some countries used them for negligible amounts.

Table 1 reports the descriptive statistics of the 18 countries that used swaps in the 2006-2018 period. The settlement of swaps is normalized by taking the natural logarithm to avoid scale problems in the

different econometric estimates. Macroeconomic data are often non-stationary, especially public finance ones (Hamilton and Flavin 1986); Levin-Lin-Chu unit root tests confirmed that the time series of debt, interests, swap, and output gap are co-integrated of first order (I(1)).

The well-established literature defines the econometric techniques to estimate the debt sustainability condition (Bohn 1998; Gosh 2013; Greiner et al. 2007); the empirical strategy starts with the panel data estimates on first difference of AR(1) variables. The second step is to estimate the debt sustainability condition with the AR(1) error term; the third uses the dynamic GMM Arellano Bond technique. The debt sustainability condition is also estimated for countries that did not use swaps as a robustness check.

4.1 Panel data estimates on first difference

Equation (3) has been estimated with the pooled OLS and the random effect model with and without swaps, and the results are reported in Table 2; the first difference of I(1) variables reduces the endogeneity among independent variables (Bohn 1998). By using the first difference the signs of their coefficients change with respect to the expected ones. Fixed effect models can be inconsistent with non-stationary variables.

The pooled OLS estimates (column 1 of Table 2) of equation (3) on 18 European countries for the 13-year period (2006-2018) fit the data; the results are in line with the literature (Bohn 1998; Greiner et al. 2007), according to which the (first difference of) lagged debt over GDP strongly and negatively correlates with the primary surplus over GDP; the (first difference of) interest expense over GDP positively correlates with the primary surplus, while the (first difference of) output gap negatively correlates. Signs and magnitudes of the coefficients of the pooled OLS and the random effect model (columns 1 and 3 of Table 2) do not differ.

The pooled OLS estimates (column 2 of Table 2) of equation (3) on 18 European countries for the 13-year period (2006-2018) including swaps fit the data; the results are in line with the literature according to which the (first difference of) lagged debt over GDP strongly and negatively correlates with the primary surplus over GDP. The (first difference of) interest expense over GDP positively correlates with the primary surplus, while the (first difference of) output gap negatively correlates with the primary surplus (Bohn, 1998; Greiner et al. 2007). The random effect model results, in terms of signs and magnitude (column 4 of Table 2), do not differ from the pooled OLS ones. Post-estimation tests rejected the null hypothesis that the coefficients were zero.

Over the period under observation (2006-2018), the debt-to-GDP ratio and the primary surplus to GDP grew, confirming that the fiscal policy is sustainable for EU countries. Results show that the (first difference of) settlement of swaps positively and significantly contributed to the primary surplus; a 1% increase in swaps, *ceteris paribus,* leads to an increase in the primary surplus over GDP from 15% to 21% (of 1%); a 1% increase in the (first difference of) swaps positively contributed to the primary surplus by 0.15-0.21%.

Table 2 – Eq.(3) 18 European swap user countries, 2006-2018 Yearly

Dep. Variable: Primary Surplus /GDP	POOLED OLS		RANDOM EFFECT	
D(Interest/GDP)	0.73	0.97	0.92	1.1
S.E.	(0.65)	(0.72)	(0.61)	(0.68)
D(Debt/GDP(-1))	-40.52***	-41.63***	-39.46***	-40.95***
S.E.	(3.91)	(4.2)	(3.7)	(4.07)
D(Output Gap)	-0.05	-0.10	-0.03	-0.07
S.E.	(0.07)	(0.81)	(0.06)	(0.07)
D(Ln(Swap))		0.21***		0.15*
S.E.		(0.07)		(0.09)
Constant	0.18	-1.32**	0.17	-0.91
S.E.	(0.20)	(0.54)	(0.29)	(0.72)
n. obs.	216	181	216	181
Prob > F (>Chi²)	0.000	0.000	0.000	0.000

Legenda: *, **, *** reports significance at 10%, 5% and 1% respectively
Indep. variables are taken at first difference

4.2 Panel data estimates with AR(1) error term

Following (Gosh et. al 2013) the debt sustainability condition with AR(1) error term has been estimated, and the results are reported in Table 3. Over the period under observation (2006-2018), the debt-to-GDP ratio and the primary surplus to GDP grew, confirming that the fiscal policy is sustainable for EU countries. The lagged interest expense over GDP negatively impacted on primary surplus over GDP, as expected, while the lagged output gap positively and significantly correlated with the primary surplus over GDP. An increase of 1% of debt in *t-1* leads to an increase in the primary surplus to 5.4% in *t*. A 1% increase of (lagged settlement of) swaps, *ceteris paribus*, leads to an increase of the primary surplus over GDP of 0.25%.

Table 3 - 18 European swap user countries, 2006-2018 Yearly

Dep. Variable: Primary Surplus /GDP

Interest/GDP(-1)		-0.68	-1.01**
	S.E.	(0.43)	(0.46)
Debt/GDP(-1)		4.440**	5.46***
	S.E.	(1.72)	(1.89)
Output Gap(-1)		0.21***	0.21**
	S.E.	(0.07)	(0.09)
Ln(Swap)(-1)			0.25*
	S.E.		(0.13)
Constant		-1.49*	-3.51***
	S.E.	(0.80)	(1.12)
n. obs.		216	167
Prob > F (>Chi²)		0.025	0.005

Legenda: *, **, *** reports significance at 10%, 5% and 1% respectively

Estimates with AR(1) error term

4.3 Linear dynamic panel data estimates

The previous estimation techniques partially addressed the endogeneity problems arising among independent variables; some recent contributions in the literature used the Instrumental Variable technique (Theofilakou and Stournaras 2012), but it provided weak results when N and T are small, as in this case. The GMM linear dynamic estimator is a valid and sound alternative (Blundell and Bond 1998); it takes the first difference of the regression equation to eliminate individual effects. Table 4 reports the linear dynamic panel data results, where the instrumental variables are the lagged primary surplus, the interest expense over GDP (2 lags) being a market-driven variable rather than a policy one.

Table 4 - 18 European swap user countries, 2006-2018 Yearly

Dep. Variable: Primary Surplus /GDP		Linear Dynamic Panel Data	
IV Primary Surplus/GDP(-1)		0.53***	0.45***
	S.E.	(0.56)	(0.06)
IV Interest/GDP(-1)		-1.41**	-1.151**
	S.E.	0.61	(0.66)
IV Interest/GDP(-2)		0.46	0.33
	S.E.	(0.62)	(0.66)
Debt/GDP(-1)		5.91***	5.3***
	S.E.	(1.19)	(1.44)
Output Gap(-1)		0.07	0.06
	S.E.	(0.06)	(0.08)

Ln(Swap)(-1)			0.54***
	S.E.		(0.16)
Constant		-1.99**	-4.96***
	S.E.	(0.80)	(1.25)
n. obs.		216	167
n. instruments		141	138
Prob > F (>Chi²)		0.000	0.000

Legenda: *, **, *** reports significance at 10%, 5% and 1% respectively

IV Instrumental Variables

The results confirm that lagged debt, lagged interest expense and lagged swaps significantly correlated with the primary surplus over GDP. A greater use of swap contracts, *ceteris paribus*, led to a statistically significant increase of the primary surplus over GDP. Post-estimation Sargan J- test confirms that the overidentifying restrictions are valid in both specifications, confirming that additional instruments are valid.

The small number of observations impedes further investigations and imposes caution in interpreting the results; however, the empirical findings presented using different econometric techniques are coherent with those reported in the existing literature (Gosh et. al 2013; Greiner et al. 2007) and show that swaps positively correlated with the primary surplus. Since the growth of debt is counterbalanced with the primary surplus' increase, the results confirmed that financial engineering has been useful and helped the public debts' stabilization over the 2006-2018 period. In particular, some EU countries used swaps to ameliorate their deficit/surplus figures, in compliance with existing fiscal rules that did not limit the use of debt-related contracts; these empirical results are new in the literature. The results, however, cannot shed light on the effective costs and benefits of swaps used by EU countries in the absence of proper financial information on swap contracts.

5. Non-swap user countries

To check for the model's robustness, equation (3) has been estimated for 8 European countries that during the 2006-2018 period did not use swaps to manage their debts: Austria, Bulgaria, Cyprus, France, Lithuania, Luxemburg, Malta and Romania. According to the descriptive statistics reported in Table 5, the average debt-to-GDP ratio of European countries that do not use swaps was 51% during the 2006-2018 period, which was lower than that of swap user countries (67%). Interest expense over GDP had an average value of 1.8% during the period under observation and the primary surplus had an average value of -0.22%; both values were lower than those referring to swap users. The output gap had an average value of -0.41%, smaller than swap user countries (-0.82%). The Levin-Lin-Chu unit root test confirmed that interest over GDP was non-stationary (I(1)), while the primary surplus, output gap, and debt over GDP were stationary.

Table 5 - Descriptive statistics, 8 European countries non-swap users, 2006 - 2018 yearly

	Obs.	Mean	St. Dev
Primary Surplus /GDP	104	-0.22	2.69
Interest/GDP	104	1.79	0.99
Debt/GDP	104	51	0.29
Output Gap	104	-0.41	3.43

Source: Eurostat, EDP database.

Table 6 - Eq.(3) results, 8 European non-swap user countries, 2006-2018 yearly

Dep. Variable: Primary Surplus /GDP	Fixed effect	Random effect
INDEP. VARIABLES		
d(Interest/GDP)	-2.22**	-0.19**
	(0.98)	(0.07)
Debt/GDP(-1)	8.97***	5.2**
	(2.62)	(2.17)
Output Gap(-1)	0.28***	0.19**
	(0.09)	(0.08)
Constant	-4.81***	-2.49**
	(1.29)	(1.18)
n. obs.	96	96
Prob > F (>Chi²)	0.000	0.026

Legenda: *, **, *** reports significance at 10%, 5% and 1% respectively
(1) Hausman test rejects the inconsistency of Random effect model.

Table 6 reports the estimates of eq. (3) on non-swap user countries over the 2006-2018 period; the fixed and random effect coefficients were quite similar, yet the Hausman test rejects the consistency of the random effect model. For these non-swap user countries, the fixed effect model results show that the (first difference of) interest expense over GDP negatively and significantly impacted on the primary surplus over GDP, while the lagged output gap is positively and significantly correlated with the primary surplus over GDP. The primary surplus increased in response to the growth of lagged debt, confirming that the sustainability condition holds for non-swap user countries. Table 7 illustrates the results of the fixed effect model with AR(1) error term; Table 8 shows the GMM dynamic panel data results, according to which an increase of debt is counterbalanced with a greater primary surplus. Coefficients are similar in the three models and confirm that the sustainability condition holds for non-swap user countries over the 2006-2018 period.

Table 7 - 8 European non-swap user countries, 2006-2018 Yearly
Fixed effect with AR(1) error term

Dep. Variable: Primary Surplus /GDP

Interest/GDP(-1)		-1.14
	S.E.	(0.87)
Debt/GDP(-1)		15.95***
	S.E.	(3.72)
Output Gap(-1)		0.15*
	S.E.	(0.09)
Constant		-6.82***
	S.E.	(1.1)
n. obs.		88
Prob > F (>Chi²)		0.000

Legenda: *, **, *** reports significance
at 10%, 5% and 1% respectively

Table 8 - 8 European non user countries, 2006-2018 Yearly
Linear Dynamic Panel Data

Dep. Variable: Primary Surplus /GDP

IV Primary Surplus/GDP(-1)		0.29***
	S.E.	(0.07)
IV Interest/GDP		0.48**
	S.E.	0.78
IV Interest/GDP(-1)		-0.42
	S.E.	(0.82)
Debt/GDP(-1)		6.45***
	S.E.	(1.31)
Output Gap(-1)		0.38***
	S.E.	(0.06)
Constant		-3.34**
	S.E.	(0.72)
n. obs.		96
n. instruments		96
Prob > F (>Chi²)		0.000

Legenda: *, **, *** reports significance at
10%, 5% and 1% respectively

IV Instrumental Variables

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6. Policy Implications of the use of swaps

The very limited information on swap contracts impedes the perspective evaluation of risks for countries actively using them; empirical results confirm that swaps are debt management instruments that positively contributed to the primary surplus over the period under observation (2006-2018), but there is no guarantee on future yields and costs. The current EU fiscal sustainability framework does not consider, in the analysis of fiscal risk in the medium term, the potential risks and costs of swaps relative to the level of indebtedness.

The economic and financial implications of the use of swaps should be analyzed in the proper time horizon, in accordance with the Fiscal Sustainability Risk approach adopted by the European Commission. Indeed, it is in the medium term that the use of the swap could have a major impact on the overall assessment of fiscal risk, which is based on the simultaneous interpretation of the DSA and S1. The sensitivity test on interest rate dynamics could be further improved by considering the use of swap contracts; even in the absence of interest rate shocks, the net settlement of swaps can increase the cost of debt.

According to the latest assessment (European Commission 2020), which considers data up to 2019, under the baseline non-fiscal policy change scenario (the starting point of the risk assessment) in highly indebted countries, public debt is projected to increase (e.g. in Italy) or marginally decrease (e.g. in Spain and France), while the Commission assesses the fiscal assumptions in other countries with substantial improvement in debt figures as being too ambitious (e.g. in Portugal and Cyprus). Interestingly, with the only exception of Italy, the compliance with the medium-term objective of structural deficit in countries classified at high risk (i.e. Belgium, Spain, France, Portugal, Romania and the United Kingdom) would bring the debt above safety levels by 2030 (i.e. below the upper threshold for a high risk of 90%). Since most of these countries (Belgium, Portugal, Spain) use swap contracts, what we suggest is a further refinement of the assessment.

First, the European Commission should improve the disclosure of information on debt related contracts; second, it should consider the costs and benefits of swaps in the qualitative assessment. The debt sustainability analysis should be enriched so as to include information on the probabilistic effects of swaps in the stochastic scenario or by considering the use of swaps as an additional element of the judgmental approach, in consideration of the exposure and costs of swaps and the relative potential risks on debt sustainability. This requires the provision of detailed accounting and contractual information of such contracts, in particular the counterpart(s), the duration, fees, the scenario used to price the swap, the so-called Greeks, the default event description, the implicit (interest or exchange) rates and the existence of any conflict of interest with financial intermediaries.

Also, in view of a possible review of economic governance in the EU and considering that the strengthening of fiscal constraints has not contributed to public debt reduction in the recent past, it would be advisable to improve the rules related to accountancy and transparency in the analysis of fiscal

and financial sustainability and consider the use of swaps among the qualitative objectives of public debt.

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