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Working Paper 02/21

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Stock-flow adjustments and interest costs in public debt dynamics

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Abstract

Standard analyses of debt sustainability are based on the conventional notion of interest costs. We propose an alternative measure — dubbed shadow interest costs — that accounts for the effects of stock-flow adjustments on the stock of debt. The two measures differ because of the relevance of active debt management: Shadow costs are far larger, more volatile, persistent, and sensitive to changes in macroeconomic conditions. As a result, while reported costs for high-debt countries are largely shielded from changes in market interest rates and debt levels, shadow costs are not. These last allow far more realistic assessments of debt sustainability than their conventional counterparts.

JEL classification: E62, H53, H63, I38

Keywords: Stock-flow adjustments, public debt, primary deficit.

1 Introduction

Most analyses of public debt sustainability maintain that governments' debt-management is a useful tool to handle the dynamics of debt.[1] We provide evidence that debt-management plays an important role for debt sustainability, because not only it directly affects interest costs, but also influences debt levels through the so-called stock-flow adjustments.

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[1] For instance, Missale (2001) emphasizes the idea that the EU's Stability and Growth Pact makes deficit stabilization paramount, and this last can be achieved by effective debt management capable of minimizing the debt servicing costs.

More specifically, figures on general government debt levels track changes in cash accounting, while, by contrast, both deficits and primary deficits are obtained from accrual-based accounting. Stocks and flows are therefore not mutually consistent, and governments' accounts are typically reconciled by creating an artificial item, the so-called stock-flow adjustments. These last are generated by a number of different factors, such as: Net acquisitions of financial assets; transactions in liabilities that are excluded from standard government debt definitions, like derivatives; valuation effects caused by debt issuance above or below the nominal value, or redemption of debt above or below parity; appreciation or depreciation of foreign-currency debt.[2] All of the driving forces behind such adjustments are produced by active debt-management. We provide evidence that the macroeconomic factors that drive debt-management operations also shape the path of public sector debts, at least as much as the determinants behind interest costs, such as market interest rates.

We start by measuring the stock-flow adjustments as a ratio with respect to debt, rather than output, to make them directly comparable across countries and to reported interest costs. Our first aim is to analyse the size and stochastic properties of such adjustments, to test the implicit assumption that they are random processes centered around zero, and revert quickly toward such mean. We find that the average size of stock-flow adjustments dwarfs that of interest costs, are not purely random, and their dynamic is completely different when splitting the sample between high- and low-debt countries, suggesting that debt levels place constraints on debt-management operations rather than simply influencing interest costs.

We then calculate the shadow interest cost i_t^* that generates the actual (observed) variations in the stock of debt, for given primary balance flows, and compare it to the interest cost i_t calculated out of the official figures for interest paid. Throughout the paper, we refer to this last as the "reported" interest cost. We find that the two series feature very different stochastic properties. The shadow cost reverts to substantially higher means than the reported interest cost, and it is way more volatile.[3]

[2]Net acquisitions of financial assets are always sizable and the main drivers normally involve transactions in shares, following privatizations or bail-outs of private-sector firms, and changes in the deposit position with the central bank. Valuation effects are largely the results of the issuance of short-term treasuries such as zero-coupon bonds. Changes in the value of foreign-currency debt are normally relevant for developing countries, while transactions in derivatives are relevant in developed ones.

[3]Shadow interest costs are specified as the ratio between stock-flow adjustments plus interest paid in the current year divided by the value of debt of the previous year. Instead, reported interest cost are calculated as interest paid in the current year divided by the value of debt of the previous year.

We finally carry out a comparative analysis between the shadow and reported interest costs, finding that the two never move in lock-step, with the former being far more sensitive to fluctuations in the macro economy than the latter. Thus, shadow interest costs allow a more realistic assessment of debt sustainability than their conventional counterparts.

Our results suggest that shadow costs do not peak during recessions, and that high-debt countries exercise discipline in debt management, although their space to implement counter-cyclical fiscal policies may be far more limited than usually assumed. For instance, innovations in market interest rates have a rather limited influence of interest costs, while they have a strong *negative* impact on shadow interest costs in high-debt countries. This counter-intuitive result suggests that debt-management policies are very efficient curbing interest costs, but that, on the other hand, benefits from persistently low market interest rates are far smaller than usually thought.

The remainder of the paper is organised as follows: Section 2 discusses the relevant literature on stock-flow adjustments. Section 3 introduces the data, and sets out a number of preliminary estimation exercises. Section 4 report our empirical analyses. Section 5 discusses the results, while Section 6 concludes.

2 Literature review

A first strand of the literature has highlighted the size and relevance of stock-flow adjustments. Campos et al. (2006) have been among the first to shed light on the nexus between the dynamics of public debts, deficits, and stock-flow adjustments. Using data for 117 countries partitioned into advanced, emerging and low-income over the period 1985-2003 they find that stock-flow adjustments account for substantial shares of public debt growth, and that important determinants of such adjustments are inflation and foreign exchange devaluations. Such determinants — dubbed balance-sheet effects — exert a strong impact on both low and medium-income economies that issue substantial shares of public debt in foreign currencies, whereas the importance of the same determinants fades away for high-income countries.[4] More recently, Abbas et al. (2011) analyze the size and impact of stock-flow adjustments, showing that they are as important as budget deficits in explaining fluctuations over time of public debts. In

[4]More in general, Dell'Erba et al. (2013) show that the share of debt denominated in foreign currencies is an important aspect of debt sustainability.

a similar vein, Weber (2012) analyses a panel of 163 countries over the period 1980 – 2010 finding that stock-flow reconciliations reflect country-specific factors that can be only partially explained by balance sheet effects and realizations of contingent liabilities. More specifically, stock-flow adjustments in emerging and low-income countries depend on inflation and (foreign exchange) valuation effects, whereas for the cohort of advanced economies the main determinant consists of one-off disbursements related to financial crises. The same study then provides *prima-facie* evidence that higher levels of fiscal transparency are associated with lower stock-flow reconciliations. Seiferling (2013) analyzes the valuation and volume changes in assets (both financial and non-financial) together with liabilities of general governments, finding that stock-flow residuals are smaller than previously assumed, and not correlated with fiscal transparency.

A second strand of research has focused on the institutional and political factors behind stock-flow adjustments. Beetsma et al. (2009) use real-time data for the EU economies over the period 2001-2010 to better identify the process of formation of stock-flow adjustments throughout the planning and implementation stages of fiscal aggregates. They provide evidence that in the planning stage the one-year ahead stock-flows account for as much as 50% of those eventually implemented, are positively linked with GDP forecast and current stock-flows, and negatively related to the current levels of debt. Von Hagen and Wolff (2006) investigate whether stock-flow adjustments represent accounting stratagems operated by governments to dodge EU balanced-budget rules, finding evidence that stock-flow adjustments are used to manipulate deficits. In a similar fashion, Afonso and Jalles (2020) test similar hypotheses, but for an extended panel of 65 economies over the period 1985 -2014 that allows the use of a wider set of fiscal rules. Their empirical results, by contrast, indicate that fiscal rules do not induce governments to make a systematic use of stock-flow adjustments to manipulate budget deficits.

Seiferling (2013) provides a detailed analysis of the size of stock-flow adjustments that reaches different results from the previous research. By making use of the IMF's Government Finance Statistics Manual, the author produces a more granular reporting of stocks and flows, finding that, in most cases, stock-transaction residuals can be fully explained by changes in the volume and valuation of financial assets. Hence, when properly defined, stock-flow residuals are smaller than previously assumed and are not correlated with fiscal transparency. In this alternative view, therefore, the adjustments are produced by the opacity of public finance accounting, and not correlated to any macroeconomic variable.

Finally, Jaramillo et al. (2017b) focus on 179 episodes of large spikes in public debts in 90 countries, finding that these last had been driven by peaks in stock-flow adjustments. Their empirical results indicate that such spikes in public debt are associated to peaks of financial markets' distress, especially in stock markets and for advanced economies. Jaramillo et al. (2017a) investigate how the dynamics of stock-flow adjustments affect the path of public debts, finding that countries plagued with substantial accumulation of stock-flows adjustments also feature a greater probability of experiencing non-declining debt trajectories in the aftermath of public debt spikes.

To summarize, the literature suggests that stock-flow adjustments are always a relevant factor in explaining debt dynamics. However, when analyzing the driving forces behind the formation of the adjustments, the results are quite mixed and inconclusive. In our work, we shed light on these dynamics, by gauging the potential different drivers using a common framework, based on state-of-the-art econometric techniques.

3 Dataset and preliminary evidence

3.1 Dataset

We gather series for the levels of public debt, balance and primary balance, revenue, expenditure, and interest paid for the service of public debt over the period 1980 - 2019 for thirty-three economies from the World Economic Outlook (WEO) database. The data on public debt and primary balance are at book values, with the latter defined as revenues minus expenditures (other than interest costs). The output gap is defined as GDP growth minus its long-run trend.[5]

We then use the OECD database to supplement our primary dataset with series for the financial assets held by governments, the market value of net financial liabilities, inflation, output gap, and yield spread.[6] Government's financial assets include shares,

[5]The cohort of countries under scrutiny consists of Australia, Austria, Belgium, Canada, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, UK, and US. We ditch from the above list Hong-Kong, San Marino and Puerto Rico because data prior to 2005 are not available, and Macao, Singapore and Taiwan because data on primary balance and/or public debt are not available.

[6]The yield spread is specified as the difference between long and short term yields on government bonds.

other securities, loans, deposits and other account receivables.[7] These data series therefore track changes in government's portfolios of financial assets, which become relevant following the bail outs of private sector firms, as in the case of retail banks during financial crises, or conversely, after privatization of public sector firms.

We then gather series for the liabilities at market value that we match with their counterparts at book values from WEO to compute a market-to-book spread defined as the difference between the market and the book value of general government liabilities. One can think of this spread as a proxy for the duration of the stocks of public debt. In fact, it widens or shrinks because of fluctuations of market interest rates, in proportion to the average duration of the existing stock of debt.

Since our dataset is a combination of WEO and OECD series, in the next paragraph we carry out two different checks to make sure that there is consistency between the two sources. First, we gather SFAs from the AMECO database and compare them with those previously obtained from the WEO counterpart.[8] We then gather series for net interest payments from the OECD database and map them against their WEO counterparts. Such two series might, in fact, differ as the former are calculated as a difference between general balance and primary balance, whereas the latter are calculated by including any items other than interest revenues and costs.[9]

3.2 Preliminary evidence

We initially specify the reported interest cost i_t as interest paid in year t divided by the nominal value of debt of the year $(t-1)$, i.e. $i_t = \frac{IC_t}{D_{t-1}}$ where IC_t is the interest paid in year t. We then calculate the stock-flow adjustments following two different procedures that provide the same identical results, but can be understood differently. The former

[7]In the year 2009 the average composition in the euro area was the following: Shares 37.5 %, currency and deposits 19.2 %, loans 13.3 %, securities other than equity 10.3 %, other receivables 18.6 %. The residual included derivatives and insurance technical reserves. Source: ECB Monthly Bulletin, June 2010. The above composition remains pretty much unchanged in following years, as shown by Mink and Rodríguez Vives (2004). In recent years, Eurostat has started publishing detailed data on the composition of the stocks of financial assets. For example, for the year 2018 the average changes in the composition was the following: Shares 25.8 %, currency and deposits 55.9 %, loans -6.8%, securities other than equity -6.5%, other receivables 39.9 %. See EUROSTAT (2020).

[8]The AMECO database — unlike the WEO data we use — gathers series for a smaller cohort of countries comprising of European economies plus Japan and the US.

[9]This analysis is based on the full sample of 33 countries. In Section 3.4 we drop from the full sample ISL, CYP, MLT and KOR, as they do not feature data on net liabilities. In the panel analysis of Section 5 we drop ISR, CHE, CZE, LVA and LTU as such economies do not feature data on output gap.

is our newly developed procedure, the latter is the standard procedure used in the literature. In our procedure, we calculate the shadow interest cost i_t^* that generates the actual variations in the stock of debt that we observe, for given primary balance flows. Defining PS_t the primary surplus at time t, assuming stock-flow consistency we would have $D_t = D_{t-1} - PS_t + IC_t$ and therefore the interest cost ratio $i_t = \frac{IC_t}{D_{t-1}}$ would be $i_t = (D_t - D_{t-1} + PS_t)/D_{t-1}$. In the absence of stock-flow consistency, caused by the different accounting principles with which debt and primary surplus are compiled, the equality is not guaranteed as a share of the actual debt accumulation is not caused by the primary balance or the actual observed interest cost i_t. We therefore calculate the shadow interest cost $i_t^* = \frac{D_t - D_{t-1} + PS_t}{D_{t-1}} \neq i_t$.

The spread $i_t^* - i_t$ provides a measure of the stock-flow adjustments defined as a ratio to nominal debt. Thus, to obtain the standard measure of stock-flow adjustments — defined as $SFA_t = D_t - D_{t-1} + PS_t - IC_t$ — the spread must be multiplied by the value of debt:[10]

$$SFA_t = \Big[\frac{D_{t+1} - D_t + PS_{t+1}}{D_t} - \frac{IC_{t+1}}{D_t}\Big] D_t = (i_{t+1}^* - i_{t+1}) D_t. \tag{1}$$

We start with a preliminary analysis to check whether the stock-flow adjustments calculated out of the WEO data match with their counterparts from AMECO. We compare the two series by computing their correlation, as well as tests for equality of means and standard deviations. Table 9 in the Appendix reports the results for three panels of countries that we denote with EU6, EU21 and OTH, as well as for three individual economies such as the US, JP and the UK.[11] Empirical results suggest that the series are highly correlated, featuring same mean and standard deviation, especially for the European economies. Overall, the broad-brush picture we obtain is that both the WEO- and AMECO-based adjustments series share very similar stochastic properties.[12]

We then carry out a similar empirical exercise by comparing the series for interest paid obtained from WEO data with their counterparts from the OECD database.

[10]Defining D_t as the value of the debt-to-output ratio in time t, PS_t the primary surplus-to-output ratio in time t, and $g_t = \frac{Y_t - Y_{t-1}}{Y_{t-1}}$ the growth rate of nominal output, the shadow rate can be obtained as $i_t^* = (1+g_t)\frac{D_t}{D_{t-1}} - (1+g_t)\frac{PS_t}{D_{t-1}} - 1$.

[11]EU6 comprises of BEL, ITA, LUX, NED, GER and FR. EU21 comprises of the EU6 cohort plus AUT, CZE, CYP, DAN, EST, FIN, GBR, GRE, ISL, IRL, LVA, LTU, MAL, NED, NOR, POR, ESP, SWE, CHE, SVK, SLV. OTH comprises of AUS, CAN, ISR, KOR, US, and NZL.

[12]The only two instances where the WEO and AMECO series differs in levels — yet sharing very similar time dynamics — occur for the US and UK.

Also in this case, the gap between the two series is negligible for the vast majority of countries, with the only exception of the US and UK where the gap is more marked. We compare the two interest series by computing their correlation, as well as tests for equality of means and standard deviations for same three cohorts of countries previously defined. The empirical results of Table 9 suggest that the two series feature high correlation, same standard deviations yet different means. The two series feature slight differences in levels, whereas their time dynamics remains very similar. Also for this second comaprison exercise, empirical results show that both the WEO- and OECD-based series share similar stochastic properties.

3.3 Reported and shadow interest costs

Notwithstanding the substantial literature that has analyzed the stock-flow adjustments, economic policy analyses invariably assume that they are irrelevant for debt dynamics. We now provide evidence on the size of the adjustments and on their stochastic properties, and we do so by comparing shadow and reported interest costs. Do the two series share the same stochastic process? Do they revert to the same mean, so that positive and negative stock-flow adjustments offset each other over time?

Figure 1 displays the reported and shadow costs for the different cohorts previously considered. The diagrams highlight that the shadow cost is always and everywhere not only higher, but also far more volatile than the reported interest cost.

The first two columns of Table 1 display the average values of the reported and shadow interest costs series, while the third shows the result of tests for equality of means between the two series, for the full sample. The following columns report the same statistics for the 1986-2006 and 2007-2019 sub-periods. The difference between the series is striking in all of the cohorts of countries under scrutiny. The difference is so large that reported interest costs appear largely irrelevant to debt dynamics. Even more surprisingly, the same pattern can be observed in the two sub-samples, so that bank bail outs following the financial crisis are not the main drivers of stock-flow adjustments. Only in the case of Japan and the US in the second sub-samples, the two series feature the same mean, while in all other cases the differences are very substantial. We then finally test for the null that the correlation among the shadow and reported interest costs is equal to zero. Also in this case, we soundly reject the null at the 1% level for all the cohorts under scrutiny. Except for the cases where such tests are applied to individual countries, we find strong negative correlations. Overall, these results provide convincing evidence that the shadow and reported interest costs follow two different stochastic trends.[13]

Table 1: Preliminary statistics of reported (i_t) vs shadow (i_t^*) interest costs.

	Full sample				1986-2006			2007-2019		
	$\bar{i_t}$	$\bar{i_t^*}$	$Eq.^a$	$\rho(i_t^*; i_t)^b$	$\bar{i_t}$	$\bar{i_t^*}$	$Eq.^a$	$\bar{i_t}$	$\bar{i_t^*}$	$Eq.^a$
EU6	3.132	8.109	-4.977	-0.529	4.173	8.928	-4.755	1.691	6.975	-5.283
			(0.000)	(0.000)			(0.000)			(0.016)
EU21	3.190	7.842	-4.652	-0.299	4.134	9.505	-5.371	2.095	5.912	-3.816
			(0.000)	(0.000)			(0.000)			(0.000)
US	2.650	3.657	-1.007	0.569	3.510	6.711	-3.200	2.319	2.482	-0.163
			(0.218)	(0.000)			(0.243)			(0.772)
JP	1.299	4.444	-3.144	0.838	1.780	6.494	-4.713	0.338	0.343	-0.005
			(0.000)	(0.000)			(0.000)			(0.986)
UK	4.161	4.761	-0.599	0.342	4.923	4.991	-0.068	2.636	4.300	-1.663
			(0.272)	(0.000)			(0.917)			(0.102)
OTH	2.400	9.664	-7.263	-0.175	3.373	11.47	-8.100	1.058	7.168	-6.110
			(0.000)	(0.000)			(0.000)			(0.000)

Notes: Annual data for 33 countries over the period 1989-2019 (N=33, T=31). The cohorts of countries are defined as follows: EU6 = BEL, ITA, LUX, NED, GER and FR. EU21= EU6 plus AUT, CZE, CYP, DAN, EST, FIN, GRE, ISL, IRL, LVA, LTU, MAL, NED, POR, ESP, SWE, CHE, SVK, SLV. OTH= AUS, CAN, ISR, KOR, NOR, NZL and SWE. [a]Eq.= Paired t-test for the null of equality of means between i_t and i_t^*. [b]Test for the null of correlation equal to zero. P-values displayed in parentheses.

We further investigate if the reported and shadow interest costs are integrated stochastic processes. We do so by making use of the statistics proposed by Choi (2001), Im et al. (2003), and Levin et al. (2002) applied to the cohorts of countries previously defined. Table 8 in the Appendix shows that such statistics soundly reject the null of unit-root for the two series, across the usual cohorts of countries, providing compelling evidence of stationarity. We then gauge the stationarity of the spread ($i_t^* - i_t$), and again unit-root tests consistently reject the null at the 1% level.

3.4 Cross-country and time series patterns of the stock-flow adjustments

We now study the relationship linking stock-flow adjustments to debt levels, and provide evidence that this relationship is strong, but also highly non-linear so that the adjustments of high and low-debt countries are very different. We analyse the rela-

[13]We also carried out both the Rank and Levene tests for the null of equality of medians and standard deviations, respectively. Empirical results show that the two interest costs feature different medians and SDs, with this pattern of results being consistent across the different cohorts under scrutiny. These last results are not reported, but available from the authors upon request.

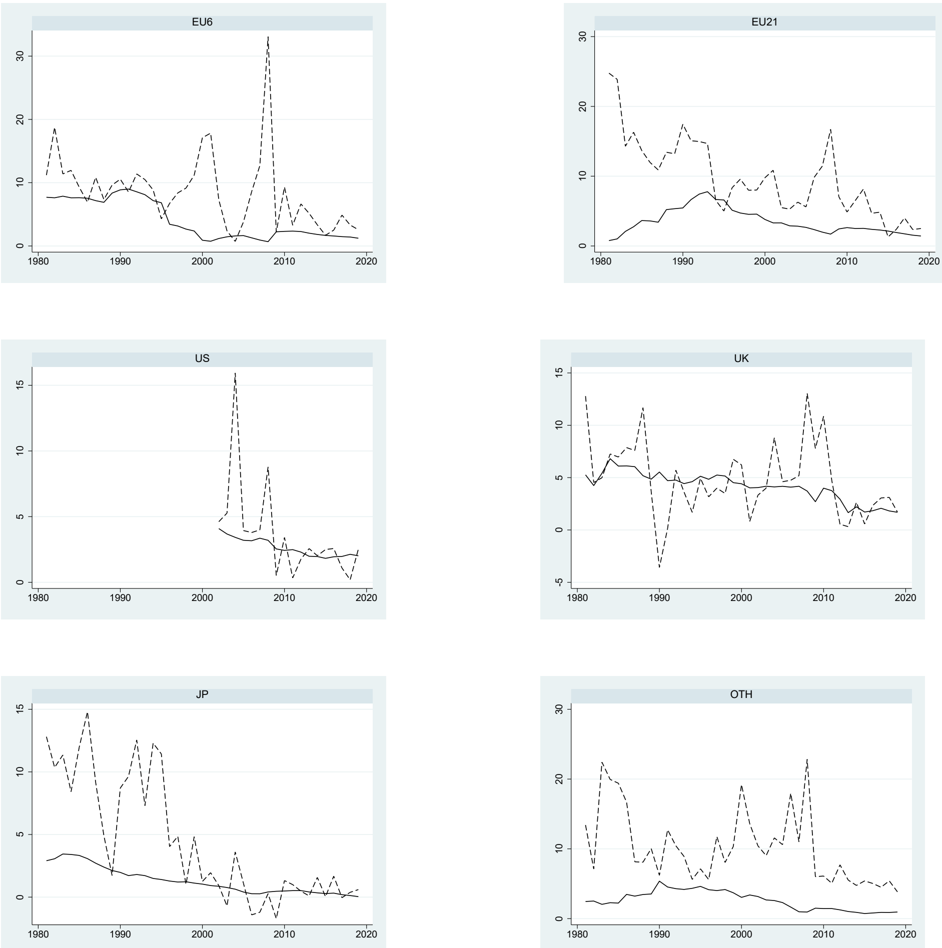

Figure 1: Annual reported interest cost i_t (solid line) and shadow interest cost i_t^* (dashed line) series for the EU6, EU21 and OTH cohorts of countries, a well as for the US, the UK, and Japan.

tionship by using the standard book-value measure of debt, but also the net liability value measured at market prices, in the light of the evidence from Seiferling (2013) that changes in the asset position of governments are a major drivers of the adjustments. It turns out that the relationship is far stronger with net liabilities.[14]

We proceed in two steps: in the first we calculate the time-series mean and standard deviations of the stock-flow adjustments (as always expressed as a percentage of debt levels) for each country; in the second, we make cross country regressions. Finally, we analyze the time-series properties of the adjustments in each individual country, to gauge their levels of mean reversion.

We perform a first round of regressions to shed light on the relationship between stock-flow adjustments and the assets-liabilities positions of the countries previously considered. More specifically, we focus on two asset-liabilities measures defined as the average values computed over time of the net liabilities at market value ($NETLIAB_{j,t}$), as well as the liabilities at book-value ($LIAB_{BK,j,t}$).[15] We then run the following regressions:

$$MOM_j(SFA) = a + b \times \overline{NETLIAB}_j + \epsilon_j \tag{2}$$

$$MOM_j(SFA) = a + b \times \overline{LIAB}_{BK,j} + \epsilon_j \tag{3}$$

$$MOM_j(SFA) = a + b \times \overline{NETLIAB}_j + c \times \overline{LIAB}_{BK,j} + \epsilon_j \tag{4}$$

where the dependent variable $MOM_j(SFA)$ consists of either the time average means $\overline{SFA}_j$, or the respective standard deviations $SD_j(SFA)$, of the stock-flow adjustments (SFA) for $j = 1, .., 29$.

The empirical results set out in Table 2 suggest that both the average size and volatility of stock-flow adjustments are strictly linked to the level of indebtedness of countries. There is, in fact, in both cases a strongly negative relationship, suggesting that both the size and volatility of the adjustments are much larger for countries that feature low levels of debt. As importantly, the relationship is far stronger with the

[14]We make similar analyses with the market value of the asset or liability position separately, but the relationship with the net position is far stronger. We ditch from our dataset ISL, CYP, MLT and KOR as OECD data for the assets and liabilities positions are not available.

[15]The former variable is taken from the OECD database, whereas the latter is the gross debt at book value taken from WEO.

net liabilities than with the book value of debt, as the former variables keep their sign and statistical significance whereas the significance of $\overline{LIAB}_{BK}$ tends to fade away when both variables are jointly added to the regressions. Moreover, the adj R^2 is also substantially greater for the univariate regression featuring $\overline{NETLIAB}$.

Table 2: Empirical estimates of Eqs.(2)-(4) with $\overline{SFA}$ and $SD(SFA)$ as dependent variable.

	$\overline{SFA}$			$SD(SFA)$		
$\overline{NETLIAB}$	-0.144***	-	-0.186***	-0.16***	-	-0.144***
	(0.037)	(-)	(0.031)	(0.032)	(-)	(0.02)
$\overline{LIAB}_{BK}$	-	-0.097***	0.081**	-	-0.158***	-0.031
	(-)	(0.049)	(0.040)	(-)	(0.052)	(0.045)
$\bar{R}^2$	0.441	0.076	0.470	0.473	0.228	0.460

Notes: Dataset consists of 29 cross-country obs. Dependent variables are $\overline{SFA}$ and $SD(SFA)$. The former is specified as $\overline{SFA}_j = (1/T)\sum_{t=1}^{T} SFA_{j,t}$, whereas the latter is $SD_j(SFA) = \sqrt{(1/T)\sum_{t=1}^{T}(SFA_{j,t} - \overline{SFA}_j)^2}$. $\overline{NETLIAB}$ is average values over time of net liabilities at market value, whereas $\overline{LIAB}_{BK}$ is average values over time of liabilities at book-value. All of the above variables calculated using annual series over the sample period 1986-2019.

We now analyze if the relationship that we found is linear, by estimating recursive regressions based on the same specification as Eq.(2). The way we run recursive estimates is the following: We sort the countries in ascending order from those with small net liabilities (e.g. NOR, LUX and FIN among others) to those featuring large net liabilities (e.g. BEL, ITA, GRC). We then consider an initial sample of as many as 11 units comprising of the most virtuous countries only. As the lower bound of the sample shifts forward, one country is added one at times, so that the same sample gradually incorporates those economies featuring more and more negative net liabilities.[16] We then repeat the same exercise using a dataset sorted from the least virtuous to the most virtuous countries.

Figure 2 displays the recursive slopes of Eq.(2). In the left panels the countries are sorted from the least to the most indebted, whereas in the right panels the ordering is reversed. Such sorting makes it possible to identify in correspondence to what countries the recursive estimates feature the most marked change in values, if any. The diagrams show that the relationship is extremely different in low- and high-debt countries, with the sensitivity of adjustments — in both levels and volatility — that is far larger for

[16]Estimates are obtained by making use of the OLS robust estimator.

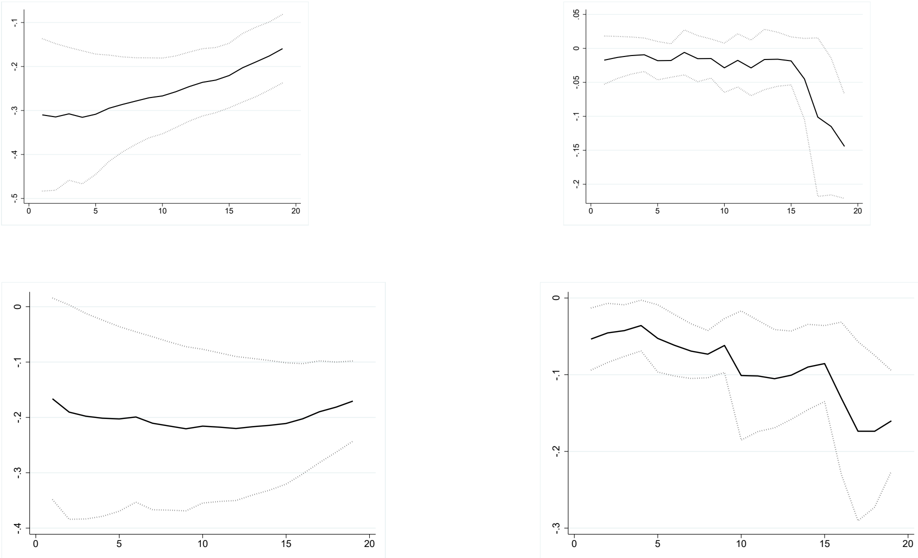

Figure 2: Recursive regressions of Eq.(2) with $\overline{SFA}_j$ (top panels) and $SD_j(SFA)$ (bottom panels) as dependent variable.

low-debt economies. The slope estimates show a marked change in their patterns in correspondence with Ireland. Thus, we take this country as cut-off unit to partition the full sample into two cohorts of high-debt, and low-debt economies.[17]

We have previously reported that stock-flow adjustments are stationary processes, albeit they do not revert to a zero mean. We now analyze their mean reversion since the overall impact of adjustments on debt depends not just on the level, but also on how persistent are the shocks affecting the adjustments.

More specifically, we fit AR(1) processes to each of the adjustment series in order to compute their half-life. We estimate SUR systems of equations to account for the possible presence of cross sectional correlation. For this analysis, we resort to the partition of the full dataset into two cohorts featuring large and small net liabilities. We carry out such sorting from the most virtuous to the least virtuous country by taking IRL as a cut-off unit.[18]

[17]We then replace in Eq.(2) Average Net Liabilities with Average Net Interests as explanatory variable, obtaining very similar results. Also in this case, we identify Ireland as the cut-off unit. Such results are available from the authors upon request.

[18]Thus, the cohort of economies with small liabilities consists of AUS, AUT, CZE, CYP, EST, FIN, FRA, DEU, ISL,IRL,KOR, LVA, LTU, MLT, NED, NZL, NOR, SVK, SVN, SWE, CHE, GBR, The

Figure 3: Half-life (solid line) and estimated AR(1) coefficient (dotted line) for individual countries belonging to the cohort of large (left panel) and small (right panel) net liabilities. Countries featuring a statistically significant AR(1) coefficient denoted in grey area.

Figure 3 displays the empirical estimates of the AR coefficients, as well as the computation of the half-life for each of the countries belonging to the two partitions. The left panel shows that the AR coefficients of the countries featuring large net liabilities are not statistically significant, with the exception of JP and ESP. For this cohort, 7 out of 9 countries feature AR coefficients not significant, with the half-life figures spanning from a maximum of 1.62 for JPN to a minimum of 0.2 years for ITA. This pattern of results changes quite dramatically for the cohort of low net liabilities, where 14 out of 24 countries feature a significant AR coefficient, with the half-life figures spanning from a maximum of 2.2 for FIN to a minimum of 0.12 years for LTU. Overall, these empirical results show that the cohort of countries holding negligible net liabilities feature SFAs more persistent than those holding large liabilities.

We then investigate whether the degree of mean reversion is the same across countries. Unsurprisingly, the restriction that the AR coefficients are the same across the individual units of the two cohorts is soundly rejected at the 1% level.[19] Despite this evidence, we estimate two separate systems of equations applied to the two usual partitions, where we encode the restriction that the AR(1) coefficients are equal across units. Empirical results show that such coefficients are 0.30 for the cohort of low, and 0.21 for that of large net liabilities. Such coefficients are statistically significant at the

cohort featuring large liabilities comprises of BEL, CAN, ESP, GRC, ITA, JPN, PRT, and the US.

[19]We carry out two separate Wald tests applied to the two cohorts of countries featuring large and small net liabilities. For each of the two partitions, the null that the AR(1) coefficients are equal across the units is soundly rejected at the 1% level.

1% level. Finally, we carry out a Wald test for the null that the above two AR coefficients are equal, rejecting such hypothesis at the 1% level. Also in this last case, the obtained figures suggest that the cohort of countries holding negligible net liabilities feature SFAs more persistent than those holding large liabilities.[20]

4 Multivariate regressions

Do stock-flow adjustments change with the business cycle, responding is a systematical way to macroeconomic variables? On the one hand, if adjustments originate from unpredictable events then one might argue that the standard measure of reported interest costs is still the relevant variable to use in debt analyses, as long as the extra volatility induced by the adjustments is purely random. On the other hand, if such adjustments are correlated with macroeconomic variables then a strong argument for using the shadow cost holds.

We develop our empirical analysis by making use of three baseline specifications. In line with the literature, we initially regress stock-flow adjustments ($SFA_{j,t}$) on inflation ($\pi_{j,t}$) and output gap ($OUT_{j,t}$) as main macroeconomic determinants, and supplement such specification with a set of explanatory variables that can potentially be relevant. More specifically, we focus on:

a Public finance variables to test if adjustments emerge because some costs are not properly recorded on government's accounts. We consider the governments' primary balance ($PS_{j,t}$), the reported interest cost of public debt ($i_{j,t}$) and the book value of the stocks of debt $D_{j,t}$.[21]

b The structure of debt issuance, and in particular the duration of debt. Since no comprehensive data on debt maturities are available, we use as a proxy the difference between the market and book value of governments' outstanding liabilities ($MtB_{j,t}$).[22] This last variable, in fact, changes over time because of fluctuations of market interest rates, and it does so in proportion to the average duration of the existing stock of debt.

[20] Casalin et al. (2020) using a time-series approach, provide evidence of non-linearities in the dynamics of U.S. public debt, after controlling for a full set of public finance and macroeconomic variables.

[21] E.g. Beetsma et al. (2009) show that adjustments and levels of debt are negatively correlated.

[22] The liabilities evaluated at market and book value are taken from the OECD and WEO database, respectively.

c Changes in the government's financial asset position that the literature has so far suggested to be a major driver, ($\Delta ASST_{j,t} = ASST_{j,t} - ASST_{j,t-1}$).[23] The volume of financial assets would rise, for instance, following the acquisition of financial institutions as a result of banking, debt, or currency crises. The value of financial assets changes because of short-term interest rates and risk-premia. Many scholars have shown that such fluctuations in value are a major driver of adjustments (see, e.g., Seiferling (2013)).

Thus, we carry out empirical estimates of Eq.(5) below. We do so by partitioning the sample of countries according to their net liabilities, as well as their EU membership.

$$\begin{aligned} SFA_{j,t} = \beta_0 + \beta_1 \pi_{j,t} + \beta_2 OUT_{j,t} + \beta_3 PS_{j,t} + \beta_4 i_{j,t} \\ + \beta_5 MtB_{j,t} + \beta_6 \Delta ASST_{j,t} + \beta_7 D_{j,t} + \epsilon_{j,t}. \end{aligned} \quad (5)$$

We then analyse the dynamics of adjustments from a different angle, by looking at the relationship between the shadow and reported interest cost. We start this analysis by estimating the baseline specification of Eq.(6) to test the hypothesis that two interest costs are not statistically different. Such hypothesis boils down to testing the null that the estimated slope of the reported interest cost is equal to one.[24] We then supplement Eq.(6) with the set of explanatory variables previously defined.

$$i^*_{j,t} = \beta_0 + \beta_1 i_{j,t} + \epsilon_{j,t}. \quad (6)$$

$$i^*_{j,t} = \beta_0 + \beta_1 i_{j,t} + \beta_2 \pi_{j,t} + \beta_3 OUT_{j,t} + \beta_4 PS_{j,t} + \beta_5 MtB_{j,t} + \beta_6 \Delta ASST_{j,t} + \beta_7 D_{j,t} + \epsilon_{j,t}. \quad (7)$$

Finally, we carry out a third round of estimations where we replace one at times in Eq.(5) the $SFA_{j,t}$ variable with reported and shadow interest costs. More specifically, we estimate the following two specifications:

$$i_{j,t} = \beta_0 + \beta_1 \pi_{j,t} + \beta_2 OUT_{j,t} + \beta_3 PS_{j,t} + \beta_4 MtB_{j,t} + \beta_5 \Delta ASST_{j,t} + \beta_6 D_{j,t} + \epsilon_{j,t}. \quad (8)$$

$$i^*_{j,t} = \beta_0 + \beta_1 \pi_{j,t} + \beta_2 OUT_{j,t} + \beta_3 PS_{j,t} + \beta_4 MtB_{j,t} + \beta_5 \Delta ASST_{j,t} + \beta_6 D_{j,t} + \epsilon_{j,t}. \quad (9)$$

By analysing eqs.(8)-(9) we investigate whether the reported ($i_{j,t}$) and shadow ($i^*_{j,t}$) interest costs are broadly similar processes or if, on the contrary, they respond to

[23]The series measure the outstanding volumes of assets at market value held by governments.

[24]The preliminary analysis of Section 3 has already shown that the intercept of Eq.(6) is not equal to zero.

different macroeconomic determinants. The gauging of such differences is important because governments, rating agencies and international organizations evaluate the stability and sustainability of debt based on the reported costs, but arguably the actual dynamics is captured by the shadow cost.[25] Also for this last empirical exercise, we carry out estimations of eqs.(8)-(9) for two different cohorts of countries that feature high (HIGH) and low (LOW) net liabilities.[26] We then further partition such cohorts to analyse a subset including European economies only.

4.1 Empirical methods

We estimate the above specifications by making use of fixed effects panel estimators. The main challenge is to account for cross-sectional dependence (CSD henceforth) in the disturbance terms, which may arise because of common shocks and unobserved components affecting the series of our panel. To test for CSD in our panles, we make use of both the Breush-Pagan's (1980) as well as the Pesaran's (2021) test (BP and Pesaran henceforth), that are well-suited for settings featuring $T > N$ and $T < N$, respectively.[27]

We find that CSD is an important feature of our dataset, being much more pervasive for highly indebted economies, and somehow weaker for low-debt countries.[28] Since the two tests consistently reject the null of absence of CSD, we apply the Eberhardt and Teal's (2010) Augmented Mean Group (AMG) estimator (see also Eberhardt (2012)). The AMG estimator has the desirable feature of providing a time-series estimation of the common factor, making therefore possible the assessment of the relative importance of global drivers in stock-flow adjustments, as well as the shadow and reported interest costs series.[29]

We therefore adopt the following common factor specification where $j = 1, 2, ...,$

[25] Cerniglia et al. (2020) discusses the issue of stability vs sustainability.

[26] The two classifications produce virtually identical results.

[27] Since our analysis is based on datasets featuring relatively similar values of T and N (yet with $T > N$), we choose to rely on both the aforementioned tests, with the caveat of privileging the outcomes obtained from the BP statistics in case of conflicting results.

[28] CSD can severely affect the empirical results, especially when the explanatory variables are correlated with unobserved common macroeconomic shocks. In such an instance, the slopes parameters of the estimated specifications become unidentified (see, e.g., Eberhardt (2012)).

[29] An alternative to the AMG estimator is the Pesaran's (2006) CCEMG estimator, which accounts for CSD by supplementing the baseline specification of each unit-specific regression with cross-section averages of both the dependent and explanatory variables. However, unlike the AMG, the CCEMG cannot detect the common factors, and the estimates we obtain very often features cross-section averages not statistically significant.

N, $t = 1, 2, ..., \mathrm{T}$, and m is the number of common factors (from 1 to k) affecting both the disturbance term as well as the explanatory variables:

$$y_{j,t} = \beta_i^{'} x_{j,t} + u_{j,t} \tag{10}$$

$$u_{j,t} = \alpha_j + \lambda_j^{'} f_t + e_{j,t} \tag{11}$$

$$x_{j,t} = \pi_j + \sum_{k=1}^{K} \delta_{k,j}^{'} g_{kt} + \sum_{k=1}^{K} \phi_{k,j} f_{k,t} + v_{j,t} \tag{12}$$

$$f_t = \rho f_{t-1} + \epsilon_t \tag{13}$$

$$g_t = \chi^{'} g_{t-1} + \epsilon_t^{'} \tag{14}$$

where $y_{j,t}$ represents either the $SFA_{j,t}$, shadow interest $i^*_{j,t}$, or reported interest costs $i_{j,t}$ series, and $x_{j,t}$ is a vector of observables as specified in Eqs.(5)-(9). We account for the presence of common factors through a combination of a country-specific intercept α_j, and a set of common factors f_t with country-specific factor loadings λ_j. We then complete the set up by specifying an AR law of motion for both the common factor, and the specific g_t factor. Eq.(12) provides an empirical representation of the explanatory variables, which are modeled as linear combinations of both unobserved common and specific factors f_t and g_t, with country-specific factor loadings.

5 Empirical results

We begin our analysis by estimating Eq.(5) for the cohorts of high- and low-debt economies previously specified, to analyze the driving forces behind stock-flows adjustments.

The first and fourth column of Table 3 display the basic results for the two cohorts. Since the common factor for the latter partition is not significant, we display in column 5 the results of a fixed effects regression with Driscoll-Kray standard errors. The pattern of results is very different for the two groups: Inflation is highly significant and positive for low-debt countries, but not significant for the high-debt ones. Instead, the output gap is highly significant for high-debt economies, but not for the low-debt ones. More specifically, we find that an increase in stock-flow adjustments is associated with above-trend output in high-debt countries, and with inflation in low-debt economies. On the one hand, the sensitivity of the adjustments to the output gap is explained by changes in deposits with the central bank, since with output above trend governments need larger deposit positions to manage their payments, and governments therefore increase debt to have more deposits and vice-versa, following their working capital needs.[30] On the other hand, the sensitivity of adjustments to inflation could be produced by either changes in the market value of debt denominated in foreign currency, or by cash-flows produced by the currency swaps derivatives used to offset these risks. This pattern remains after introducing several control variables, including a proxy for the duration of debt, changes in net asset position, as well as other public finance variables such as debt or primary deficits.

Public finance variables are relevant. The primary surplus always generates a strong positive impact on adjustments, suggesting that expenditure may be systematically over-reported or tax revenues under-estimated in accrual accounting, probably because of time lags in cash payments. Debt levels are positive and significant, but only for the high-debt countries. Thus, low-debt economies feature adjustments on average larger, yet not respondent to the levels of debt, whereas high-debt countries feature adjustments smaller but strongly dependent on debt.[31] Finally, the level of interest costs is not associated with adjustments in high-debt countries, so that stock-flows do not emerge as a response to a rising interest burden. In low-debt countries, adjustments decline when interest cost rise, providing a hedge whenever interest costs rise. low-debt economies can therefore manage their financial asset positions to offset higher interest costs.

Changes in the market value of financial assets held by governments represent an important explanatory variable, but more so in the case of low-debt countries. Finally, we find that the duration of debt plays an important role, particularly for high-debt economies, with countries with a long debt maturity featuring lower adjustments, since a wider market to book gap is associated with longer maturities and the sign of the slope coefficient is negative.[32] The corresponding columns in Table 4, displaying the

[30] Fiscal data revisions are large and the cyclical stance of fiscal policies is more counter-cyclical when real-time data are used instead of the ex-post data that are normally used in public finance (see Cimadomo (2016)).

[31] In turn, the positive link between debt and adjustments might impair the ability of high-debt countries to tap markets for debt refinancing (see Bassanetti et al. (2018)).

[32] The t-statistics displayed in Tables from 3 to 6 are the Mean Group t-stats based on the country-

results for the European countries only, provide nearly identical results.[33]

5.1 Adjustments and market interest rates

We then carry out a second empirical exercise to investigate whether there is a specific link between market interest rates on short- and long-term interest rates and stock-flow adjustments. One of the main sources of such adjustments are, in fact, reimbursements of treasuries (mainly zero-coupon bonds) issued below or above par (see, e.g., Von Hagen and Wolff (2006)).

As short-term rates rise, the issuance price of treasuries, like for instance T-bills, declines progressively below par, while on the contrary, with negative rates, the issuance price gets above par. Consequently, positive market rates generate positive adjustments, while negative rates generate negative ones. This effect is offset by the difference between interest rate accrued and paid, since reported government expenditure on interest is spread over time, in line with the accrual principle, whereas the cash impact occurs only when interests are actually paid. Given that debt is measured on a cash basis, interest accrued is excluded from the stock of government debt. In the case of short-term debt, therefore, interest accrued is reported as interest costs and the overall amount becomes correspondingly higher than the actual cash disbursement. So the higher the rates, the higher the interest costs reported, but also the corresponding stock-flow adjustment caused by a below-par issuance. To avoid double counting, an accounting item reports the difference between interest accrued and paid. However, this figure is typically smaller than its counterpart measuring the impact of issuance below or above par, probably because accrual accounting does not fully reflect expected trends in interest costs.[34] Part of the interest cost is therefore reported as a positive stock-flow adjustment in periods of high and rising short-term rates, and negative adjustment when rates are negative or declining.

The same mechanism is in place when long-term debt is repurchased above or below par and therefore the adjustments may respond not only to short-term, but also to long-

regression averages, and measure the dispersion for the sample of country-specific estimates. We also compute the Pedroni's (2000) panel t-statistic which are calculated as a linear combination of the country-specific t-stats, and capture the precision of the country-specific estimates. Computations for such statistics deliver results fully consistent with those obtained from the Mean Group t-stats. Figures for these last statistics are not reported, but available from the authors upon request.

[33] In turn, the different dynamics in the adjustments of high- and low-debt economies might generate further issues for the implementation of a common EU fiscal policy, as suggested by Cottarelli (2016).

[34] See the data reported in EUROSTAT (2020).

term interest rates, since variations in these last generate the incentives to actively trade debt: for instance, higher long-term rates makes it possible the repurchase of debt below par.

Our prior is that higher rates are associated with larger stock flow adjustments, however, if governments choose to hedge interest rate risks, they use derivatives, mainly interest rate swaps, and the cash flows produced by transactions in derivatives are registered as stock-flow adjustments. A survey conducted by the OECD in 2011 on a sample of 32 countries largely overlapping with our own, found that interest rate swaps had been used for more than 15 year by 9 countries, while 24 of them had used derivatives since 2005 at the latest. The average notional amount of the derivatives outstanding for the years 2007-2010 was around 8 percent of central government debt, with five countries in the 20-to-50 percent range and two countries above 100 percent.[35] These data suggest that the resources involved in these transactions are substantial and that, since the incentive for using derivatives is far stronger for highly indebted countries that need to stabilize their interest costs, such economies extensively use interest rate swaps to hedge their short-term exposure against the risk of higher interest rates. They typically do so by entering a payer swap contract, involving paying a fixed amount to receive a variable rate. This strategy allows an extension of the actual debt maturity, mitigating the effects of higher market rates. The high-debt countries that adopted this strategy, such as Italy, particularly before the financial crisis, have benefited from positive cash-flows in years when interest rates were rising, while more recently they took losses in the face of declining rates.[36] These flows are accounted as stock-flow adjustments and offset the adjustment produced by short term issuance. Small countries with limited amount of debt outstanding, on the contrary, typically undertake interest rate swap contracts as receivers, paying a variable interest rate to receive a fixed one. This strategy allows to increase the liquidity of the outstanding bonds by concentrating the issuance on one or a few maturities (typically the 10 years) and it involves cash-flows and stock-flow adjustments that are inversely correlated with the interest rates.[37]

On top of these effects, whenever short-term yields increase, then also a secondary related effect might be in place — as governments that actively manage issuance to minimize the cost of debt may respond by substituting short-term with long term

[35]See OECD (2011).
[36]See Bucci et al. (2020).
[37]See Luby (2012).

securities. Missale et al. (2002), in fact, find evidence that when high-debt countries introduce stabilization processes, they increase the share of fixed-rate long-term debt denominated in the domestic currency, proportionally more as the level of current and expected long-term interest rates declines. More recently, Beetsma et al. (2021), analyzing new issuance in the EU6, find a strong negative relationship between the average maturity of new debt and the level of the yield curve, as well as the yield curve slope.

When this second effect is at work, that might translate into fewer adjustments. We control for these two effects by analyzing the impact of short-term yields ($s/t_{j,t}$) — as a proxy of the cost of short-term debt — and yield spreads ($YS_{j,t}$) - as a proxy of the opportunity cost of long versus short debt. The rationale of using the yield spread is that when it widens, then the cost of long debt increases in comparison to short debt — making therefore the issuance of short debt relatively cheaper, and vice-versa.

The hypotheses under scrutiny are therefore the followings:

> Higher short-term yields are related with higher adjustments for low-debt countries that use swap contract as receivers, while the relationship is potentially ambiguous for the high-debt one that write swap contracts as payers.
>
> Wider yield spreads — by signalling that long debt is relatively more expensive — can induce governments to issue debt at shorter maturities and this would eventually result into larger volumes of adjustments. Thus, one should expect a positive link between yield spreads and adjustments.

We test for such hypotheses by supplementing Eq.(5) with the aforementioned series for short-term yields and yield spreads in their contemporaneous as well as lagged (by one year) values, since the adjustments may arise with a time lag. We estimate the specification by including the two couplets of variables one at time, and report on Table 3 only the regression estimates for which such variables are statistically significant.

The figures of columns 2 and 5 of Tables 3 and 4 provide strong support for the two hypotheses. More specifically, we find a strong and positive link between adjustments, and both s/t and (lagged) YS for low-debt countries, and a negative contemporaneous relationship for high-debt units. These results suggest that high-debt countries hedge their short-term debt exposure substantially, so that the flows generated by derivatives more than compensate those produced by short-term issuance. On the contrary, low-debt ones use swaps as receivers, amplifying the impact of short-term rates on the adjustments.

Our results on the yield spread suggest that both high- and low-debt countries respond to interest rate variations by altering the relative share of long and short term issuance. However, as in the case of short-term issuance, and for the same reasons, the final impact on the adjustments goes in the opposite direction.[38]

Finally, for the sample of high-debt countries, we find that debt is highly significant, indicating that the adjustments rise with the level of debt, after controlling for all other variables. This result is in line with the findings of Missale and Blanchard (1994) that high-debt European countries are forced to issue more short-term debt. Our results for the cohort of EU countries provide further support, since the estimated coefficient for debt becomes larger in this sample.

5.2 Macroeconomic drivers of shadow and reported interest costs

We then carry out a third exercise based on the specifications of Eqs.(6)-(7). First, we estimate Eq.(6) to test whether the reported and shadow interest costs follow the same data generating process. We then supplement this baseline specification with the same set of macro and public finance variables previously considered to obtain Eq.(7). Finally, we top up this last specification with series for short-term yields and yield spreads to investigate the nexus between the shadow interest cost i_t^*, and the short and long-end of the term structure.

The empirical results displayed in Tables 5 are largely consistent with those of the previous sections, with one important exception. In this case, the null that the estimated slope of Eq.(6) is equal to one is soundly rejected for both samples, but for opposite reasons: in the case of low-debt countries the coefficient is negative and large, indicating that these countries can offset in full any increase in interest costs by managing their financial assets portfolio. On the contrary, in the case of high-debt countries, the shadow interest cost is a multiplier of its reported counterpart that can be of a magnitude twice as large. And this result holds after controlling for the full set

[38] We also estimate Eq.(5) supplemented with contemporaneous observations of s/t and YS for low-debt countries, as well as their lagged counterpart for high-debt economies. In both cases, empirical results show that such couplets of variables are not significant, whereas the remaining set of explanatory variables feature the same pattern of results previously obtained. We do not report such results to save space, but are available from the authors upon request.

Table 3: Empirical estimates of Eq.(5) for the full cohort of European and non-European economies.

	(1) HIGH	(2) HIGH	(3) LOW	(4) LOW	(5) LOW
π_t	-0.024	0.257	1.215**	1.460***	0.891**
	(0.313)	(0.226)	(0.602)	(0.455)	(0.362)
OUT_t	0.557**	0.331***	0.390	0.565	-0.180
	(0.255)	(0.119)	(0.574)	(0.578)	(0.562)
PS_t	0.519***	0.444***	1.393*	1.636***	1.469**
	(0.167)	(0.090)	(0.755)	(0.514)	(0.710)
i_t	0.157	0.927	-1.442	-2.516***	-3.688***
	(0.397)	(0.673)	(1.009)	(0.388)	(0.945)
MtB_t	-0.089**	-0.185**	-0.117	-0.354*	-0.543
	(0.035)	(0.084)	(0.386)	(0.201)	(0.414)
$\Delta ASST_t$	0.335	0.369***	0.866***	0.617***	0.945***
	(0.215)	(0.140)	(0.184)	(0.133)	(0.161)
D_t	0.128***	0.175***	0.047	0.154	-
	(0.022)	(0.035)	(0.234)	(0.095)	(-)
s/t_t		-1.002**			-
		(0.423)			(-)
YS_t		-0.737*			-
		(0.432)			(-)
s/t_{t-1}		-			2.826***
		(-)			(0.818)
YS_{t-1}		-			1.277**
		(-)			(0.503)
CF	0.502***	0.573***	0.130	-	0.428***
	(0.194)	(0.150)	(0.158)	(-)	(0.133)
Const	-13.274***	-16.071***	11.500	3.660	10.195
	(3.892)	(4.500)	(15.160)	(4.157)	(6.808)
$N \times T$	388	388	301	301	268
N	13	13	11	11	10
$\bar{T}$	29.84	29.84	27.36	27.36	26.80
Mthd	AMG	AMG	AMG	SCC	AMG

Notes: Dataset consists of annual series over the period 2001 - 2019 of shadow cost of debt (i_t^*), inflation ($\pi_{j,t}$), output gap ($OUT_{j,t}$), interest cost of public debt ($i_{j,t}$), primary surplus ($PS_{j,t}$), market-to-book spread ($MtB_{j,t}$), changes of government's assets ($\Delta ASST_{j,t} = ASST_{j,t} - ASST_{i,t-1}$), stock of public debt ($D_{j,t}$)), short-term interest rate (st_t), and yield spread (YS_t). Primary surplus defined as revenues minus expenditures (other than interest costs). Output gap defined as GDP growth minus its long-run trend. Yield spread defined as the difference between long-term and short-term yields on government bonds. The panel of 19 countries is partitioned into those featuring high-debt level (SPA, PTG, GRC, JP, CAN, NLD, ITA, DEU, FRA, BEL, AUT, GBR, US), and low-debt level (SVN, EST, SVK, NZL, AUS, IRL, FIN, SWE, NOR, LUX, DNK). The term CF is the common time-specific (dummy year) factor obtained from pooled regressions in first differences of Eq.(7) supplemented with series of short-term yields and yield spread (see Eberhardt (2012)). AMG is the Eberhart and Teal's (2010) Augmented Mean Group estimator. SSC is the Driscoll and Kraay's estimator (see Hoechle (2007)). Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 4: Empirical estimates of Eq.(5) for the cohort of European economies only.

	(1) HIGH	(2) HIGH	(3) LOW	(4) LOW	(5) LOW
π_t	0.152	0.321	1.278	1.364**	1.213***
	(0.357)	(0.226)	(0.893)	(0.547)	(0.207)
OUT_t	0.601**	0.387***	0.950	0.651	-0.042
	(0.251)	(0.123)	(0.612)	(0.562)	(0.709)
PS_t	0.405**	0.435***	1.399	1.742***	1.828**
	(0.199)	(0.099)	(0.920)	(0.552)	(0.785)
i_t	0.624	1.055	-1.144	-2.876***	-5.041***
	(0.556)	(0.857)	(1.607)	(0.476)	(1.440)
MtB_t	-0.098***	-0.167	-0.011	-0.553**	-0.639
	(0.013)	(0.111)	(0.301)	(0.273)	(0.637)
$\Delta ASST_t$	0.426*	0.410***	0.880***	0.606***	0.747***
	(0.230)	(0.141)	(0.196)	(0.131)	(0.163)
D_t	0.206***	0.223***	0.231	0.214**	0.299
	(0.043)	(0.035)	(0.214)	(0.098)	(0.223)
s/t_t		-0.577			-
		(0.471)			(-)
YS_t		-0.482**			-
		(0.235)			(-)
s/t_{t-1}		-			1.437**
		(-)			(0.594)
YS_{t-1}		-			1.447
		(-)			(0.945)
CF	0.456***	0.480***	0.450	-	0.428**
	(0.121)	(0.111)	(0.320)	(-)	(0.167)
Const	-1.757	-27.010***	-32.566**	1.549	-14.674
	(3.937)	(5.960)	(14.123)	(4.867)	(12.410)
$N \times T$	295	295	246	246	213
N	10	10	9	9	8
$\bar{T}$	29.50	29.50	27.33	27.33	26.62
Mthd	AMG	AMG	AMG	SCC	AMG

Notes: Dataset consists of annual series over the period 2001 - 2019 of shadow cost of debt (i_t^*), inflation ($\pi_{j,t}$), output gap ($OUT_{j,t}$), interest cost of public debt ($i_{j,t}$), primary surplus ($PS_{j,t}$), market-to-book spread ($MtB_{j,t}$), changes of government's assets ($\Delta ASST_{j,t} = ASST_{j,t} - ASST_{i,t-1}$), stock of public debt ($D_{j,t}$)), short-term interest rate (st_t), and yield spread (YS_t). Primary surplus defined as revenues minus expenditures (other than interest costs). Output gap defined as GDP growth minus its long-run trend. Yield spread defined as the difference between long-term and short-term yields on government bonds. The panel of 19 countries is partitioned into those featuring high-debt level (SPA, PTG, GRC, JP, CAN, NLD, ITA, DEU, FRA, BEL, AUT, GBR, US), and low-debt level (SVN, EST, SVK, NZL, AUS, IRL, FIN, SWE, NOR, LUX, DNK). The term CF is the common time-specific (dummy year) factor obtained from pooled regressions in first differences of Eq.(7) supplemented with series of short-term yields and yield spread (see Eberhardt (2012)). AMG is the Eberhart and Teal's (2010) Augmented Mean Group estimator. SSC is the Driscoll and Kraay's estimator (see Hoechle (2007)). Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

of macro and public finance variables in use.

The figures of Table 6 for the cohort of European economies are fully consistent with the above pattern, but the size of the impact of the reported interest cost on the shadow one is larger.

5.3 Common factors

Figure 4 depicts the underlying (unobservable) common factors for both adjustments and shadow interest cost i^*. The two common factors exhibit strong time variation, and are almost identical, suggesting that common factors largely influence the adjustments rather than reported interest costs.

The pattern differs between high- and low-debt countries. While the factors influencing high-debt countries feature pronounced downward trends, those underlying the low-debt economies tend to fluctuate about an average value. The finding of a clear trend for one group of countries is surprising, since if adjustments are the sole result of reconciliations of national accounts, their time dynamics should be purely random. Thus, we formally test for the hypothesis that the common factors series do not feature any stochastic trend. We do so by fitting AR(1) processes to the two series, and find that the AR coefficients are significant at the 1% level, with point estimates for high- and low-debt countries of 0.90 and 0.63, respectively. We thus reject the null that such series are purely random processes.

Alternatively, the setting of Eqs.(10)-(14) makes it possible the tackling of the same hypothesis from a different angle. In such a context, the null would consist of the restrictions that $\rho = 0$, and $\lambda = 0$. Since we cannot impose such restriction contemporaneously, we treat this as a sequential test. Thus, we apply the Bonferroni adjustment and tweak the p-values down to 0.025 (=0.05/2) from the standard benchmark of 0.05. In the case of high-debt countries, empirical results show that both the AR(1) coefficient ρ and the factor loading λ are significant with adjusted p-values $<$ 0.025. Figures for the low-debt economies are less clear-cut, as the factor loadings λ feature adjusted p-values < 0.025 only for certain specifications, whereas for others they do not. Thus, we soundly reject the null for the high-debt countries only, whereas the same null stands at the margin for low-debt economies.

Focusing now on the common factors underlying the shadow interest costs i^*, the AR coefficients are 0.92 and 0.78 for high and low-debt countries, respectively. These empirical results show that the common factors feature substantial levels of persistence,

Table 5: Empirical estimates of Eqs.(6)-(7) for the full cohort of European and non-European economies.

	(1) HIGH	(2) HIGH	(3) HIGH	(4) LOW	(5) LOW	(6) LOW	(7) LOW
i_t	2.168***	1.157***	1.927***	-1.141*	-0.442	-1.516***	-3.496***
	(0.428)	(0.397)	(0.673)	(0.655)	(1.009)	(0.388)	(1.005)
π_t		-0.024	0.257		1.215**	1.460***	1.034***
		(0.313)	(0.226)		(0.602)	(0.455)	(0.072)
OUT_t		0.557**	0.331***		0.390	0.565	0.036
		(0.255)	(0.119)		(0.574)	(0.578)	(0.367)
PS_t		0.519***	0.444***		1.393*	1.636***	1.338**
		(0.167)	(0.090)		(0.755)	(0.514)	(0.522)
MtB_t		-0.089**	-0.185**		-0.117	-0.354*	-0.878*
		(0.035)	(0.084)		(0.386)	(0.201)	(0.531)
$\Delta ASST_t$		0.335	0.369***		0.866***	0.617***	0.738***
		(0.215)	(0.140)		(0.184)	(0.133)	(0.124)
D_t		0.128***	0.175***		0.047	0.154	0.214
		(0.022)	(0.035)		(0.234)	(0.095)	(0.204)
s/t_t			-1.002**				-
			(0.423)				(-)
YS_t			-0.737*				-
			(0.432)				(-)
s/t_{t-1}			-				1.233
			(-)				(0.831)
YS_{t-1}			-				0.782
			(-)				(0.966)
CF	0.443***	0.502***	0.573***	0.571**	0.130	-	0.546**
	(0.118)	(0.194)	(0.150)	(0.283)	(0.158)	(-)	(0.235)
Const	-1.740	-13.27***	-16.07***	22.90*	11.50	3.660	12.44
	(1.353)	(3.892)	(4.500)	(12.03)	(15.16)	(4.157)	(8.621)
$N \times T$	447	388	388	408	301	301	268
N	14	13	13	15	11	11	10
$\bar{T}$	31.9	29.8	29.8	27.2	27.3	27.3	26.8
Mthd	AMG	AMG	AMG	AMG	AMG	SCC	AMG

Notes: Dataset consists of annual series over the period 2001 - 2019 of shadow cost of debt (i_t^*), inflation ($\pi_{j,t}$), output gap ($OUT_{j,t}$), interest cost of public debt ($i_{j,t}$), primary surplus ($PS_{j,t}$), market-to-book spread ($MtB_{j,t}$), changes of government's assets ($\Delta ASST_{j,t} = ASST_{j,t} - ASST_{i,t-1}$), stock of public debt ($D_{j,t}$)), short-term interest rate (st_t), and yield spread (YS_t). Primary surplus defined as revenues minus expenditures (other than interest costs). Output gap defined as GDP growth minus its long-run trend. Yield spread defined as the difference between long-term and short-term yields on government bonds. The panel of 19 countries is partitioned into those featuring high-debt level (SPA, PTG, GRC, JP, CAN, NLD, ITA, DEU, FRA, BEL, AUT, GBR, US), and low-debt level (SVN, EST, SVK, NZL, AUS, IRL, FIN, SWE, NOR, LUX, DNK). The term CF is the common time-specific (dummy year) factor obtained from pooled regressions in first differences of Eq.(7) supplemented with series of short-term yields and yield spread (see Eberhardt (2012)). AMG is the Eberhart and Teal's (2010) Augmented Mean Group estimator. SSC is the Driscoll and Kraay's estimator (see Hoechle (2007)). Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 6: Empirical estimates of Eqs.(6)-(7) for the cohort of European economies only.

	(1) HIGH	(2) HIGH	(3) HIGH	(4) LOW	(5) LOW	(6) LOW	(7) LOW
i_t	2.145***	1.624***	2.055**	-0.951	-0.144	-1.876***	-4.041***
	(0.567)	(0.556)	(0.857)	(0.835)	(1.607)	(0.476)	(1.440)
π_t		0.152	0.321		1.278	1.364**	1.213***
		(0.357)	(0.226)		(0.893)	(0.547)	(0.207)
OUT_t		0.601**	0.387***		0.950	0.651	-0.042
		(0.251)	(0.123)		(0.612)	(0.562)	(0.709)
PS_t		0.405**	0.435***		1.399	1.742***	1.828**
		(0.199)	(0.099)		(0.920)	(0.552)	(0.785)
MtB_t		-0.098***	-0.167		-0.011	-0.553**	-0.639
		(0.013)	(0.111)		(0.301)	(0.273)	(0.637)
$\Delta ASST_t$		0.426*	0.410***		0.880***	0.606***	0.747***
		(0.230)	(0.141)		(0.196)	(0.131)	(0.163)
D_t		0.206***	0.223***		0.231	0.214**	0.299
		(0.043)	(0.035)		(0.214)	(0.098)	(0.223)
s/t_t			-0.577				-
			(0.471)				(-)
YS_t			-0.482**				-
			(0.235)				(-)
s/t_{t-1}			-				1.437**
			(-)				(0.594)
YS_{t-1}			-				1.447
			(-)				(0.945)
CF	0.365***	0.456***	0.480***	0.671*	0.450	-	0.428**
	(0.093)	(0.121)	(0.111)	(0.352)	(0.320)	(-)	(0.167)
Const	-2.047	-1.757	-27.01***	21.37**	-32.56**	1.549	-14.67
	(1.832)	(3.937)	(5.960)	(10.71)	(14.12)	(4.867)	(12.41)
$N \times T$	332	295	295	344	246	246	213
N	10	10	10	13	9	9	8
$\bar{T}$	33.2	29.5	29.5	26.4	27.3	27.3	26.6
Mthd	AMG	AMG	AMG	AMG	AMG	SCC	AMG

Notes: Dataset consists of annual series over the period 2001 - 2019 of shadow cost of debt (i^*_t), inflation ($\pi_{j,t}$), output gap ($OUT_{j,t}$), interest cost of public debt ($i_{j,t}$), primary surplus ($PS_{j,t}$), market-to-book spread ($MtB_{j,t}$), changes of government's assets ($\Delta ASST_{j,t} = ASST_{j,t} - ASST_{i,t-1}$), stock of public debt ($D_{j,t}$)), short-term interest rate (st_t), and yield spread (YS_t). Primary surplus defined as revenues minus expenditures (other than interest costs). Output gap defined as GDP growth minus its long-run trend. Yield spread defined as the difference between long-term and short-term yields on government bonds. The panel of 19 countries is partitioned into those featuring high-debt level (SPA, PTG, GRC, JP, CAN, NLD, ITA, DEU, FRA, BEL, AUT, GBR, US), and low-debt level (SVN, EST, SVK, NZL, AUS, IRL, FIN, SWE, NOR, LUX, DNK). The term CF is the common time-specific (dummy year) factor obtained from pooled regressions in first differences of Eq.(7) supplemented with series of short-term yields and yield spread (see Eberhardt (2012)). AMG is the Eberhart and Teal's (2010) Augmented Mean Group estimator. SSC is the Driscoll and Kraay's estimator (see Hoechle (2007)). Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

especially those extracted from the cohort of high-debt countries. When we tackle the same hypothesis by means of the sequential testing of the restrictions $\rho = 0$ and $\lambda = 0$, we obtain of pattern very similar to the previous estimates made for the stock-flows.

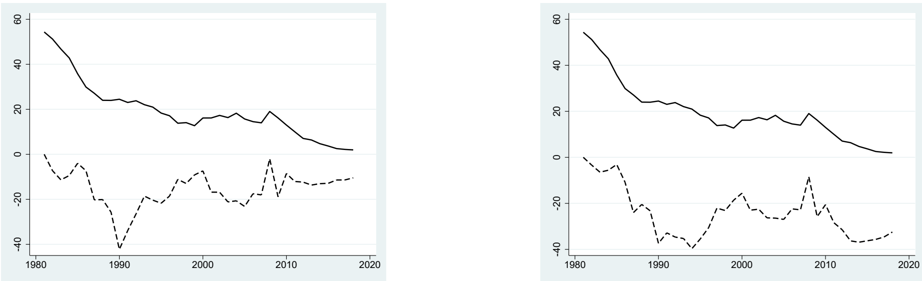

Figure 4: Common factors estimated from the SFAs specification of Eq.(5) supplemented with short-term yield and yield spread (left panel), and from the shadow interest costs i_t^* specification of Eq.(7) supplemented with lagged short-term yield and yield spread (right panel). Factors for high- and low-debt countries are depicted in solid and dashed lines, respectively.

The downward trend for the common factors in high-debt countries seem to match quite closely the trend in interest rates and inflation, indicating that high-debt countries systematically resort to stock-flow adjustments to offset interest costs. We leave any further analysis of the drivers of common factors for future research.

5.4 The sensitivity of reported and shadow interest costs

Table 9 reports the estimation results for Eqs.(8)-(9). Columns 1 and 2 compare the results for high-debt countries, while columns 6 and 7 compare the results for high-debt countries that are EU members; columns 3 and 4 display the results for shadow costs using alternative estimation methods,[39] while column 5 displays the results for actual costs in the low-debt-countries sample.

The comparison suggests that the differences are striking. The reported interest costs respond in all samples exclusively to the common factor and, only in the case of high-debt countries, to inflation, while in the case of the high-debt-EU countries to inflation and output gap. Shadow costs instead respond to all of the variables that influence stock-flow adjustments, and behave very differently in the case of low or

[39]Since the common factor is not significant, we report also the results of a fixed effect estimator with a Driscoll-Kray correction for the standard errors.

Table 7: Empirical estimates of eqs.(8)-(9) for the cohorts of countries featuring large and small net liabilities, as well as for the cohort of European economies with large liabilities.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	HIGH			LOW		HIGH-EU	
	i_t^*	i_t	i_t^*	i_t^*	i_t	i_t^*	i_t
π_t	0.065	0.047***	1.289**	1.197***	0.068	0.310*	0.035***
	(0.226)	(0.013)	(0.587)	(0.361)	(0.132)	(0.179)	(0.009)
OUT_t	0.454**	-0.004	0.472	0.725	-0.087	0.459**	0.058**
	(0.193)	(0.022)	(0.353)	(0.602)	(0.096)	(0.220)	(0.026)
PS_t	0.378**	-0.016	0.554*	1.393***	0.129	0.226	-0.027
	(0.175)	(0.023)	(0.321)	(0.454)	(0.135)	(0.157)	(0.027)
MtB_t	-0.118*	-0.022	0.083	-0.317	-0.083*	-0.182*	-0.021
	(0.063)	(0.022)	(0.306)	(0.204)	(0.048)	(0.095)	(0.018)
$\Delta ASST_t$	0.386	0.011	0.904***	0.658***	0.004	0.451*	0.016
	(0.241)	(0.011)	(0.171)	(0.145)	(0.014)	(0.254)	(0.011)
D_t	0.104***	0.016	0.054*	0.012	0.137	0.169***	0.017
	(0.026)	(0.011)	(0.028)	(0.087)	(0.089)	(0.043)	(0.014)
CF	0.260***	0.861***	0.409	-	0.464*	0.336***	1.012***
	(0.065)	(0.176)	(0.280)	(-)	(0.274)	(0.105)	(0.204)
Const	-7.073***	0.636	21.80*	8.900**	-0.028	-11.64**	0.225
	(2.114)	(1.227)	(11.578)	(3.745)	(4.139)	(4.562)	(1.561)
$N \times T$	388	388	301	301	301	295	295
N	13	13	11	11	11	10	10
$\bar{T}$	29.84	29.84	27.36	27.34	27.36	29.50	29.50
Mthd	AMG	AMG	AMG	SCC	AMG	AMG	AMG

Notes: Dataset consists of annual series over the period 2001 - 2019 of shadow cost of debt (i_t^*), inflation ($\pi_{j,t}$), output gap ($OUT_{j,t}$), interest cost of public debt ($i_{j,t}$), primary surplus ($PS_{j,t}$), market-to-book spread ($MtB_{j,t}$), changes of government's assets ($\Delta ASST_{j,t} = ASST_{j,t} - ASST_{i,t-1}$), stock of public debt ($D_{j,t}$)), short-term interest rate (st_t), and yield spread (YS_t). Primary surplus defined as revenues minus expenditures (other than interest costs). Output gap defined as GDP growth minus its long-run trend. Yield spread defined as the difference between long-term and short-term yields on government bonds. The panel of 19 countries is partitioned into those featuring high-debt level (SPA, PTG, GRC, JP, CAN, NLD, ITA, DEU, FRA, BEL, AUT, GBR, US), and low-debt level (SVN, EST, SVK, NZL, AUS, IRL, FIN, SWE, NOR, LUX, DNK). The term CF is the common time-specific (dummy year) factor obtained from pooled regressions in first differences of Eq.(7) (see Eberhardt (2012)). AMG is the Eberhart and Teal's (2010) Augmented Mean Group estimator. SSC is the Driscoll and Kraay's estimator (see Hoechle (2007)). Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

high-debt countries. Thus, focusing the analyses of debt sustainability exclusively on reported interest costs would not allow understanding the importance of debt maturities, or changes in the stock of assets. Even mores strikingly, the level of debt has no impact whatsoever on reported interest costs; on the contrary, in the sample of indebted economies the level of debt is extremely significant and positive, indicating that debt generates non linear costs, but these costs are reported as stock-flow adjustments.[40]

6 Conclusion

In our sample of developed economies stock-flow adjustments revert to a positive and significant mean, are larger and highly persistent for countries holding low net liabilities, and smaller and weakly persistent for economies featuring high net debts. The relationship between adjustments and net liabilities is highly non-linear, with size and dynamics of the adjustments being very different between high- and low-debt economies.

The shadow interest costs that we calculate, matching the actual variations in the stock of debt that we observe, revert to substantially higher means than the reported interest costs, and they are way more volatile.

Our multivariate regressions provide evidence of pervasive cross-sectional dependence in all our regressions featuring stock-flow adjustments and shadow costs as a dependent variable. Hence, the international business cycle plays a major role in shaping these adjustments. Moreover, we find a structurally different pattern that depends on the level of indebtedness, with above-average output generating adjustments in high debt countries, whereas inflation does so in low-debt economies.

Shadow interest costs do not move in lock-step with actual reported interest costs in low-debt countries, they rather move in opposite directions. In the case of high-debt economies, shadow costs are highly correlated with reported costs, even though the former are far larger, more persistent and volatile. In addition, shadow costs rise substantially with debt levels in high-debt countries, while reported costs do not, highlighting the presence of large non-linear debt costs that are not detected by standard accounting figures.

These results cause serious concern, because standard sustainability analyses typi-

[40]In a related work, Lian et al. (2020) find that the difference between market interest rates on public debt and growth rates declines with high levels of debt.

cally fail to recognize the systematic and structural nature of stock-flow adjustments, and because adjustments are large enough to place public debts on completely different, and normally much less sustainable trajectories.

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7 Appendix

Table 8: Unit-root tests of i_t^*, i_t, as well as for the gap $(i_t^* - i_t)$.

	i_t^*			i_t			$i_t^* - i_t$		
Units	LLC	IPS	Fisher	LLC	IPS	Fisher	LLC	IPS	Fisher
ALL	-12.74	-9.26	-12.31	-7.89	-3.86	-10.24	-12.22	-8.66	-11.73
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
EU6	-5.28	-4.64	-7.23	-2.64	-2.57	-2.58	-5.34	-4.84	-5.85
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
EU21	-10.72	-7.91	-10.16	-7.06	-3.23	-8.14	-10.52	-7.71	-9.53
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
OTH	-8.50	-5.34	-7.27	-4.25	-1.62	-5.91	-8.13	-5.21	-7.20
	(0.00)	(0.00)	(0.00)	(0.00)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)

Notes: Unbalanced panel of annual data for 33 countries over the period 1989-2019 (N=33, T=31). The cohorts of countries are defined as follows: EU6 = BEL, ITA, LUX, NED, GER and FR. EU21= EU6 plus AUT, CZE, CYP, DAN, EST, FIN, GRE, ISL, IRL, LVA, LTU, MAL, NED, POR, ESP, SWE, CHE, SVK, SLV. OTH= AUS, UK, US, CAN, ISR, KOR, NOR, and NZL. ALL gathers the full cohort of 33 countries. Levin et al. (2002) (LLC), Im et al. (2003) (IPS), and Choi's (2001) Fisher-type unit-root tests. */**/*** denote rejection of the null of unit root at the 10/5/1 % significance level. The above statistics are designed for the null of unit-root against the alternative that all units feature same AR parameter (LLC), or that the AR parameters are unit-specific (IPS and Fisher). All specifications are computed by subtracting from original series across the panel the time-varying mean to account for cross-sectional dependence, and include a time trend. Both the IPS and Fisher tests are computed over the full period, whereas LLC tests are calculated over the period 2001-2019. The reported values are the t-statistic for each test with respective p-values in parentheses. Lag length is based on the minimum of the AIC.

Table 9: Comparison between SFAs series taken from WEO and AMECO, as well as Interest Paid series taken from WEO and OECD.

	SFAs					**Interest Paid**				
Units	Ave(WEO)	Ave(AM)	mean[a]	SD[b]	Corr(WEO:AM)[c]	Ave(WEO)	Ave(OECD)	mean[a]	SD[b]	Corr(WEO:OECD)[c]
EU6	3.32	4.51	-1.18	1.14	0.95	3.31	3.26	0.05	1.02	1.00
			(0.09)	(0.41)	(0.00)			(0.00)	(0.91)	(0.00)
EU21	3.66	3.76	-0.10	1.15	0.94	2.45	2.37	0.07	1.01	0.99
			(0.80)	(0.10)	(0.00)			(0.00)	(0.88)	(0.00)
US	55.51	-55.54	111	1.56	0.72	2.03	2.87	-0.84	0.03	0.39
			(0.04)	(0.32)	(0.00)			(0.00)	(0.00)	(0.00)
JP	4664	6329	-1665	1.04	1.00	1.14	0.91	0.24	0.75	0.97
			(0.00)	(0.94)	(0.00)			(0.00)	(0.37)	(0.00)
UK	7.16	3.91	3.26	0.63	0.97	1.79	2.37	-0.58	0.56	0.79
			(0.01)	(0.20)	(0.000)			(0.00)	(0.08)	(0.00)
OTH	919	1212	-293	0.22	0.99	1.23	0.89	0.34	1.22	0.96
			(0.00)	(0.00)	(0.00)			(0.00)	(0.12)	(0.00)

Notes: Annual data for 33 countries over the period 1989-2019 (N=33. T=31). The cohorts of countries are defined as follows: EU6 = BEL. ITA. LUX. NED. GER and FR. EU21= EU6 plus AUT. CZE. CYP. DAN. EST. FIN. GRE. ISL. IRL. LVA. LTU. MAL. NED. POR. ESP. SWE. CHE. SVK. SLV. OTH= AUS. CAN. ISR. KOR. NOR. NZL and SWE. [a] Paired t test for the null of equality of means. [b] Levene test for the null of equality of standard deviations. [c] Test for the null that the correlation is equal to 0. P-values for the above statistics in parentheses. */**/*** denotes rejection of the null at the 10/5/1 percent level.

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