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The unexplained part of public debt

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Abstract

This paper shows that budget deficits account for a relatively small fraction of debt growth and that stock-flow reconciliation, which is often considered a residual entity, is one of the key determinants of debt dynamics. After having explained the importance of the stock-flow reconciliation, the paper shows that this residual entity can be partly explained by contingent liabilities and balance-sheet effects.

JEL classification: H63; F34; C82

Keywords: Public debt; Deficit; Balance-sheet effects

1. Introduction

How do countries get into debt? The answer to this question may seem trivial. Countries accumulate debt whenever they run a budget deficit (i.e., whenever public expenditure is higher than revenues). In fact, the standard Economics 101 debt accumulation equation states that the change in the stock of debt is equal to the budget deficit:

$$\text{DEBT}_t - \text{DEBT}_{t-1} = \text{DEFICIT}_t \quad (1)$$

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and that the stock of debt is equal to the sum of past budget deficits: $\mathrm{DEBT}_t = \Sigma_{i=0}^{t}\mathrm{DEFICIT}_{t-i}$. Whoever has worked with actual debt and deficit data knows that Eq. (1) rarely holds and that debt accumulation can be better described as:

$$\mathrm{DEBT}_t - \mathrm{DEBT}_{t-1} = \mathrm{DEFICIT}_t + \mathrm{SF}_t \tag{2}$$

where SF_t is what is usually called "stock-flow reconciliation". Clearly, Eq. (1) is a good approximation for debt accumulation only if one assumes that SF_t is not very large. The purpose of this paper is to describe some of SF_t's main characteristics. The paper shows that, contrary to what is usually assumed, the budget deficit accounts for a small fraction of the within-country variance of the change in debt over GDP and that stock-flow reconciliation plays an important role in explaining debt dynamics. The paper also shows that, on average, SF_t tends to be positive and that there are large cross-country differences in the magnitude of this residual entity. This suggests that the magnitude of stock-flow reconciliation is not likely to be purely due to random measurement error. In particular, the paper shows that the problem is especially serious in developing countries and, among this group of countries, the difference between debt and deficit is particularly large in Latin America and Sub-Saharan Africa.

The paper also runs a set of regressions aimed at explaining the main determinants of the magnitude of the stock-flow reconciliation and finds that balance-sheet effects due to real depreciations and contingent liabilities that arise at time of banking crises are strongly correlated with the difference between deficit and change in debt. However, the paper also shows that the regressions can only explain 20% of the within-country variance of the stock-flow reconciliation and that there is still much that we do not understand about one of the main determinants of debt accumulation.

While we are not the first to show that stock-flow reconciliation is an important part of debt dynamic (see, among others, International Monetary Fund, 2003; Martner and Tromben, 2004; European Commission, 2005; Budina and Fiess, 2005), we are not aware of any other paper that systematically describes the main characteristics of this residual, but extremely important, determinant of debt accumulation.

2. Data

The purpose of this section is to describe our data on fiscal deficit and public debt. In this context, it is worth mentioning that obtaining reliable and comparable data on the stock public debt is a rather difficult exercise. In fact, the International Monetary Fund International Financial Statistics (IFS) and International Monetary Fund Government Finance Statistics (GFS), which are the most common sources of cross-country data on government statistics, report data for a rather limited set of countries. This is even the case for industrial countries; these sources do not report recent data on public debt for Japan and Italy, for example. Furthermore, most cross-country datasets do not make an effort to make the data comparable across countries (for a discussion of these issues, see International Monetary Fund, 2003).[1]

Although there are now some papers that attempt to build comparable cross-country datasets on public debt (Cowan et al., 2006; Jeanne and Guscina, 2006; International Monetary Fund, 2003; Budina and Fiess, 2005), some of these datasets are not publicly available and all of them have a limited country and time coverage. As a consequence, we do not rely on these new data and only use publicly available sources (hence, the caveats mentioned above should be kept in

[1] The most important problems include the treatment of sub-national governments and the use of gross versus net debt (for a methodological note, see Cowan et al., 2006).

Table 1
Deficit over GDP

Country group	μ (%)	σ (%)		Min (%)	Max (%)	N countries	N observations
		Overall	Between				
All countries	4.04	5.27	3.62	−18.26	66.05	117	1872
By region							
EAP	2.65	3.08	2.86	−2.35	17.87	8	126
ECA	3.38	3.51	2.89	−10.02	19.64	15	142
IND	3.29	3.78	2.92	−6.89	20.79	24	485
LAC	3.93	7.38	4.56	−5.27	66.05	25	417
MNA	5.57	6.24	6.02	−9.92	26.78	11	201
SAS	6.53	3.16	1.75	−1.73	18.28	5	119
SSA	4.24	4.77	2.74	−18.26	45.15	29	382
By income groups							
Low	4.67	4.40	2.76	−18.26	45.15	34	440
Medium	4.13	6.18	4.28	−10.02	66.05	59	947
High	3.29	3.78	2.92	−6.89	20.79	24	485

The income group and regional classifications are those used by the World Bank.

mind). In particular, we start with IFS and GFS and supplement them with data collected from national sources (mostly from the websites or publications of the various Ministries of Finance), the UN Economic Commission for Latin America and Caribbean (ECLAC, see Martner and Tromben, 2004), and the Organization for Economic Cooperation and Development (OECD).[2]

Using these various sources, we assemble an unbalanced panel covering 117 countries and consisting of approximately 1900 observations. Our sample includes 24 high-income countries, 59 middle-income countries and 34 low-income countries. The regions with the largest number of countries are Sub-Saharan Africa (27 countries) and Latin America (25 countries). South Asia and East Asia are the regions with the smallest number of countries (5 and 8 countries, respectively). While our sample spans a period of over 30 years (1972–2003), it is important to note that we do not have long time series for all countries. In the cases of Albania, Algeria, Gabon, Sudan, Togo, and Yemen, for instance, we have less than 5 years of data. On average, we have 16 years of data for each country, with most of them concentrated in the 1985–2003 period.

Table 1 shows that the sample mean of the deficit to GDP ratio is 4.04% and that average deficit tends to decrease with the level of income. The region with the highest average deficit is South Asia (6.5%), followed by the Middle East (5.6%), and Sub-Saharan Africa (4.2%).

Table 2 focuses on the change in debt divided by GDP ($d_{i,t}$).[3] If Eq. (1) were to hold, the change in debt should be equal to the budget deficit. By comparing Table 1 with Table 2, we find that the value of $d_{i,t}$ is almost five percentage points higher than average deficit over GDP, indicating that more than 50% of the average change in debt is not explained by deficit. The Table also shows that while the difference between $d_{i,t}$ and the deficit is fairly small in industrial countries (about 0.3 percentage points), this difference is extremely large in Latin America and Sub-Saharan Africa, where the average deficit is about one-third the average change in debt.

[2] For more information on the public debt dataset used in this paper see Jaimovich and Panizza (2006).

[3] It is important to note that we do not use the change in the debt-over-GDP ratio (i.e., $\theta_{i,t} = \left(\frac{D_t}{Y_t} - \frac{D_{t-1}}{Y_{t-1}}\right) \times 100$) but the change in debt divided by GDP at time t (i.e., $d_{i,t} = \left(\frac{D_t}{Y_t} - \frac{D_{t-1}}{Y_{t-1}(1+g)}\right) \times 100$). As nominal GDP growth (g) tends to be positive, $d_{i,t}$ is usually larger than $\theta_{i,t}$. We use this measure, rather than the standard $\theta_{i,t}$ because we want to isolate changes in debt from changes in the level of GDP.

Table 2
Change in debt over GDP

Country group	μ (%)	σ (%)		Min (%)	Max (%)	N countries	N observations
		Overall	Between				
All countries	8.97	23.42	14.66	−118.17	303.57	117	1872
By region							
EAP	5.11	9.08	6.42	−7.05	51.81	8	126
ECA	6.74	9.34	5.74	−5.71	74.38	15	142
IND	4.05	4.52	3.16	−10.77	22.49	24	485
LAC	11.45	31.31	16.37	−72.38	303.57	25	417
MNA	12.59	34.05	17.25	−31.86	300.14	11	201
SAS	7.98	8.12	3.18	−35.33	42.19	5	119
SSA	13.00	29.02	22.13	−118.17	233.42	29	382
By income groups							
Low	14.30	31.28	22.25	−118.17	243.68	34	440
Medium	9.00	24.39	11.54	−61.52	303.57	59	947
High	4.05	4.52	3.16	−10.77	22.49	24	485

The income group and regional classifications are those used by the World Bank.

We can now describe the characteristics of the stock-flow reconciliation by defining the following measure of the difference between change in debt and deficit for country i at time t.

$$\delta_{i,t} = \frac{(\mathrm{DEBT}_{i,t} - \mathrm{DEBT}_{i,t-1}) - \mathrm{DEFICIT}_{i,t}}{Y_{i,t}} \times 100 \tag{3}$$

Clearly, $\delta_{i,t}$ is just the stock-flow reconciliation of Eq. (1) expressed in terms of GDP $\left(\delta_{i,t} = \frac{\mathrm{SF}_{i,t}}{Y_{i,t}}\right)$. Table 3 describes $\delta_{i,t}$ and shows that the change in debt is nearly five

Table 3
Change in debt minus deficit (δ)

Country group	μ (%)		σ (%)		Min (%)	Max (%)	N countries	N observations
	All	Without outliers*	Overall	Between				
All countries	4.93	3.15	21.84	13.29	−116.61	281.93	117	1872
By region								
EAP	2.46	2.46	7.99	4.28	−10.00	51.14	8	126
ECA	3.35	2.86	8.37	4.91	−11.03	72.56	15	142
IND	0.77	0.79	2.83	1.07	−12.16	14.07	24	485
LAC	7.52	4.32	28.82	13.68	−73.29	281.93	25	417
MNA	7.02	2.44	31.39	14.62	−39.15	273.36	11	201
SAS	1.45	2.14	7.55	1.86	−38.58	37.41	5	119
SSA	8.76	6.11	28.12	21.22	−116.61	226.90	29	382
By income groups								
Low	9.63	6.09	30.85	21.57	−116.61	247.90	34	440
Medium	4.87	3.09	21.88	8.87	−64.66	281.93	59	947
High	0.77	0.79	2.83	1.07	−12.16	14.07	24	485

The income group and regional classifications are those used by the World Bank.
* Outliers are the top and bottom 2% of the distribution.

Table 4
Episodes with $|\delta_{i,t}|>10$

	Episodes with $\delta>5$		Episodes with $\delta<-5$	
	Number	Share of total	Number	Share of total
EAP	12	9.52	1	0.79
ECA	18	12.68	1	0.7
IND	6	1.24	1	0.21
LAC	71	17.03	12	2.88
MNA	35	17.41	13	6.47
SAS	7	5.88	3	2.52
SSA	89	23.3	19	4.97
All countries	238	12.71	50	2.67

The income group and regional classifications are those used by the World Bank.

percentage points higher than the deficit (with the highest values in Latin America and Sub-Saharan Africa). However, the table also shows that there are several countries with extremely large values of $\delta_{i,t}$ (in some cases well above 200%). In Latin America, for instance, the difference between the change in debt and deficit has a range of 350 percentage points (from −73 to 281). The industrial countries have the smallest range, but even in this case the range is close to 30 percentage points. These extreme values are due either to exceptional events or measurement error. In the second column of Table 3, the average value of $\delta_{i,t}$ is computed by dropping the top and bottom 2% of the distribution. After dropping these outliers, we find that $\delta_{i,t}$ has an average value of 3% and that the average values of $\delta_{i,t}$ for Latin America and the Middle East drop from 7% to 4% and 2%, respectively.

It is also interesting to see which countries tend to have large values of $\delta_{i,t}$. Table 4 summarizes all the episodes for which $|\delta_{i,t}|>10$. There are 238 country-years (corresponding to 13% of observations) for which $\delta_{i,t}>10$, and 50 country-years (3% of observations) for which $\delta_{i,t}<-10$. The industrial countries, East Asia, and South Asia are the regions with the lowest number of episodes (and very few episodes where $\delta_{i,t}<-10$). Sub Saharan Africa, the Middle East and North Africa, and Latin America are the regions with the largest number of episodes.

3. Debt and deficit

The previous section showed that simple comparisons of average values of deficit over GDP and change in debt indicate that Eq. (1) is far from being a good approximation of the main determinants of debt accumulation and that what is usually considered a residual entity is a key determinant of debt accumulation. In this section, we use different strategies to provide more evidence in this direction.

3.1. Regressions analysis

One way to assess the importance of SF_t is to divide debt and deficit by current GDP and use our large panel to estimate the following fixed effects regression:

$$d_{t,i} = \alpha_i + \beta^{*}\text{def}_{t,i} + \varepsilon_{t,i} \tag{4}$$

where α_i is a country fixed effect (which controls for the fact that the data come from different sources, countries have different levels of debt, and they use different methodologies for computing debt and deficit) and $def_{t,i}$ is deficit over GDP. If Eq. (1) holds, we expect a high R^2, $\alpha_i=0$, and $\beta=1$. Hence, the regression's coefficients and R^2 can be used to asses the relative (un) importance of the deficit in explaining changes in debt. Table 5 reports the results of the estimation of Eq. (4) for different sub-samples of countries. Column 1 describes the basic pattern. First of all, we find that β is greater than 1 (but not significantly different from 1) indicating that a 1% increase in the deficit to GDP ratio tends to translate into a 1.3% increase of the debt to GDP ratio. More interestingly, the regression's R^2 shows that, in the full sample, deficits explain less than 8% of the within-country variance of $d_{t,i}$ and that SF_i explains more than 90% of the variance.[4]

As the low R^2 could be due to the presence of outliers, in Column 2 we drop 47 observations that have residuals with an absolute value greater than 2.5 standard deviations. After eliminating these outliers, β drops to 1.18, but we still find that our model can only explain 23% of the variance of $d_{t,i}$. Column 3 of Table 5 addresses the outlier issues by running the same regression as in Column 1 using a median quantile regression with bootstrapped standard errors (STATA's BSQREG) and shows that in this case, the coefficient of the deficit variable drops to 0.87 and the R^2 goes to 0.24.

The remaining columns run separate regressions for different regions of the world. Column 4 focuses on 29 countries located in Sub-Saharan Africa and finds that the deficit explains only 3% of the variance of $d_{t,i}$. Columns 5 and 6 show that in Latin America and the Caribbean (25 countries) and South Asia (5 countries), the deficit explains between 5% and 6% of the variance of $d_{t,i}$. Columns 7 and 8 focus on East Asia (8 countries) and the Middle East and North Africa (11 countries) and show that the deficit explains between 14% and 20% of the within-country variance of $d_{t,i}$. The developing region with the best fit is East Europe and Central Asia (Column 9, 15 countries). In this case, the deficit explains 23% of the variance of $d_{t,i}$. Only in the sub-group of industrial countries (Column 10, 24 countries) does the deficit explain more than one-quarter of the within-country variation of $d_{t,i}$ but even in this case, the regression can only explain half of the variance of the dependent variable.

3.2. Theoretical R^2

As an alternative way to describe the pattern documented above, we build a measure aimed at determining which countries have the largest deviation from the theoretical identity $d=def$. Clearly, such a measure cannot be the country average of $\delta_{i,t}$ described in Table 3 because negative and positive values of $\delta_{i,t}$ would compensate each other. One possibility would be to adopt a strategy similar to the one of the previous section and run country-by-country regressions of ΔDEBT over DEFICIT and use the fit of these regressions (their R^2) as a measure of how much a country deviates from $d=def$. One problem with this strategy is that it would not help to differentiate countries that have a

[4] We also ran separate regressions for the 58 countries for which there are at least 15 years of data. We found that β had average and median values of approximately 1 and ranged between −1.8 (Zaire) and 5.9 (Rwanda). The regressions' R^2 had an average value of 0.32, a median value of 0.25, and ranged between 0.007 (Egypt) and 0.87 (Italy). There are only four countries (all industrial) that have an R^2 above 0.8, +16 countries (11 of them industrial) for which the R^2 is higher than 0.5, and 18 countries for which the R^2 is less than 0.1.

Table 5
Change in debt over GDP and deficit (regressions with country fixed effects)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Deficit	1.316	1.189	0.872	1.102	1.101	0.706	1.346	2.486	1.426	0.914
	(0.226)***	(0.052)***	(0.066)***	(0.430)**	(0.354)***	(0.295)**	(0.361)***	(0.840)***	(0.346)***	(0.056)***
N observations	1872	1825	1872	382	417	119	126	201	142	485
N countries	117	117	117	29	25	5	8	11	15	24
R^2	0.074	0.23	0.246	0.032	0.051	0.065	0.135	0.199	0.228	0.514
Sample	All countries	Quantile regression	No Outliers	SSA	LAC	SAS	EAP	MNA	ECA	IND

Robust standard errors in parentheses.
*Significant at 10%.
**Significant at 5%.
***Significant at 1%.

good fit in which $d=def$ holds, from countries that have a good fit but where the relationship between debt and deficit can be better described with an equation of the type: $d_t=\alpha+\beta * def$ with $\alpha\neq 0$ and $\beta\neq 1$. An index that addresses these problems and relates to a regression's R^2 can be defined as:

$$\phi_i = \frac{\sum_{t=1}^{T} (\delta_{i,t})^2}{\sum_{t=1}^{T} (d_{i,t} - \bar{d}_i)^2} \tag{5}$$

Note that ϕ_i is always non-negative and naturally relates to the R^2 of a regression of $d_{i,t}$ over def. In fact, if we write $d_t=\alpha+\beta * def_t+\varepsilon_t$ and, if instead of estimating the regression's parameter, we force $\alpha=0$ and $\beta=1$, the R^2 of the model would be $1-\phi_i$. Hence, if the true parameters describing the relationship between debt and deficit were $\alpha=0$ and $\beta=1$, ϕ_i would be equal to 0. Thus, higher values of ϕ_i indicate larger deviations of the true parameters from $\alpha=0$ and $\beta=1$. Fig. 1 illustrates the theoretical distribution of ϕ_i for different values of β under the assumptions that $\alpha=0$, $\alpha=10$, and $\alpha=-10$. The figure shows that when $\alpha=0$ the distribution is asymmetrical with ϕ_i rapidly going towards infinite when β tends to 0, and ϕ_i converging to around 1.5 when β goes to infinite, the figure also shows that ϕ_i is equal to 0 when $\beta=1$. When $\alpha=10$, the distribution becomes monotone but still going to infinite when β goes to 0 and converging to approximately 1.5 when β goes to infinite. When $\alpha=-10$ the distribution reaches a minimum when β is around 4 and then starts increasing and, again, converges at around 1.5.

We find that few countries have a value of ϕ_i close to 0 and most countries are concentrated in the 0.5–1.5 range. In particular, 15% of countries have values of ϕ_i that are below 0.5 (the lowest value, 0.009, is for Finland), 30% of countries have values that range between 0.5% and 1, 35% of countries have values that range between 1 and 1.5, and the remaining 20% have higher values. Table 6 shows that the mean and median of the distribution of ϕ_i is approximately 1 and that, as

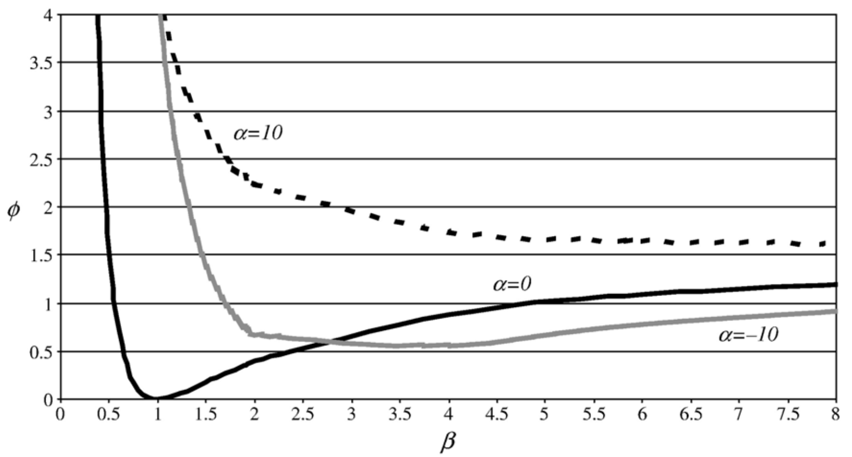

Fig. 1. Distribution of ϕ under different assumptions for α and β.

Table 6
Φ index

Country group	μ (%)	σ (%)	Median (%)	Max (%)	Min (%)	N countries
All countries	1.03	0.50	1.03	2.46	0.13	110
By region						
EAP	0.98	0.32	0.95	1.56	0.58	8
ECA	0.98	0.62	1.00	2.06	0.15	14
IND	0.60	0.36	0.55	1.37	0.13	23
LAC	1.21	0.51	1.23	2.41	0.15	25
MNA	1.35	0.47	1.29	2.46	0.89	10
SAS	1.01	0.12	1.04	1.11	0.81	5
SSA	1.15	0.42	1.15	2.13	0.19	25
By income groups						
Low	1.15	0.43	1.15	2.13	0.19	31
Medium	1.13	0.50	1.14	2.46	0.15	56
High	0.60	0.36	0.55	1.37	0.13	23

The income group and regional classifications are those used by the World Bank.

expected, the industrial countries have the lowest value of ϕ_i and Latin America and the Middle East have the highest values of ϕ_i.[5]

3.3. Debt explosions

So far, we documented that there are a large differences between deficit and change in debt. Now we explore whether the difference between these two variables is positively correlated with debt growth. In Table 7, we regress the growth rate of debt over GDP (defined as $\theta_{i,t}(D_{i,t}/Y_{i,t}-D_{i,t-1}/Y_{i,t-1})\times 100$) over the ratio between deficit and change in debt (defined as $\rho_{i,t}=def_{i,t}/d_{i,t}$) controlling for country fixed effects. We find that a negative and statistically significant relationship between these two variables. While the fit of the regression is rather poor, the table shows that the fit improves if extreme values of $\theta_{i,t}$ are not considered (compare, for instance, Column 1 with Column 3 where episodes in which $\theta_{i,t}>50$ are dropped). The table also shows that the relationship between $\theta_{i,t}$ over $\rho_{i,t}$ does not vary much across groups of countries.

As a last exercise, we look at debt explosions (defined as episodes in which $\theta_{i,t}>10$); Table 8 summarizes the data and shows that in the 172 episodes for which $\theta_{i,t}>10$ (9% of the country-years for which we have data), the average increase in debt over GDP was close to 28 percentage points, the average change in debt was around 46 percentage points (the difference between these two values is nominal GDP growth which, in presence of high inflation, can be very high), and the average ratio between these two variables was 70%. The fourth column of the table shows that in our sample of debt explosions, average deficit was close to 10% of GDP and the ratio between deficit and change in debt was about 27%. This is close to one-third of the same ratio during normal times (when $10>\theta_{i,t}>0$, the ratio between deficit and change in debt is 75%). The table

[5] It may seem surprising that while the theoretical distribution is highly skewed, the data of Table 6 indicate that the mean is identical to the median. This is due to the fact that Table 6 does not include four countries that have values of ϕ greater than 4 (these countries are Estonia, Seychelles, Luxembourg, and Sudan). If we include these countries, the median goes to 1.05, but the average jumps to 2.7.

Table 7

Change in debt and ρ (controlling for country fixed effects)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
θ	−0.007 (0.002)***	−0.011 (0.003)***	−0.020 (0.005)***	−0.018 (0.013)	−0.006 (0.008)	−0.019 (0.012)	−0.003 (0.004)	−0.024 (0.006)***	−0.008 (0.003)**	−0.005 (0.008)
Constant	0.718 (0.030)***	0.746 (0.033)***	0.788 (0.036)***	0.837 (0.121)***	0.640 (0.079)***	0.817 (0.049)***	0.593 (0.061)***	0.877 (0.044)***	0.576 (0.068)***	1.053 (0.179)***
Observations	1061	1055	1039	64	77	285	235	67	223	110
N countries	110	110	110	8	14	24	24	5	25	10
R^2	0.01	0.01	0.02	0.03	0.01	0.01	0.00	0.22	0.03	0.00
Sample	$\theta>0$	$0<\theta<100$	$0<\theta<50$	EAP, $\theta>0$	ECA, $\theta>0$	IND, $\theta>0$	LAC, $\theta>0$	SAS, $\theta>0$	SSA, $\theta>0$	MNA, $\theta>0$

Robust standard errors in parentheses.

*Significant at 10%.

**Significant at 5%.

***Significant at 1%.

Table 8
Debt explosions

	θ	d	θ/d (%)	def	def/d (%)	N	Share (%)
All episodes with $\theta > 10$							
ALL	27.45	46.34	69.25	9.42	27.40	172	9.19
EAP	18.82	26.98	74.47	6.11	24.40	12	9.52
ECA	20.90	27.23	72.50	5.07	18.65	11	7.75
IND	12.59	15.25	82.78	9.11	60.79	13	2.68
LAC	34.08	58.92	74.43	14.63	35.27	41	9.83
MNA	30.22	63.75	60.28	13.37	41.48	23	11.44
SAS	19.87	26.71	69.79	7.57	32.61	6	5.04
SSA	28.63	47.08	64.95	6.35	12.58	66	9.52
All episodes with $10 < \theta < 20$							
ALL	13.77	24.39	67.88	6.93	29.42	104	5.56
EAP	13.45	21.20	73.66	4.79	24.38	9	7.14
ECA	13.33	19.60	69.10	3.81	18.04	9	6.34
IND	12.59	15.25	82.78	9.11	60.79	13	2.68
LAC	14.40	22.21	72.73	7.76	31.71	18	4.32
MNA	13.07	40.93	62.40	11.05	48.67	15	7.46
SAS	11.97	20.49	59.21	8.74	42.15	4	3.36
SSA	13.65	24.33	61.56	5.13	11.64	36	9.42

The income group and regional classifications are those used by the World Bank.

also shows that the regions with the highest occurrence of debt explosions are Latin America and Sub-Saharan Africa (41 and 66 episodes, respectively) and that East Europe and Sub-Saharan Africa are the regions with the lowest average ratio between deficit and change in debt (18% and 13%, respectively).

Since the average values discussed above may be driven by extreme values of $\theta_{i,t}$, we restrict the sample in the second panel of Table 8 to 104 episodes for which $\theta_{i,t}$ ranges between 10% and 20%. In this case, we find that the average increase of the debt-to-GDP ratio is approximately 14%, the average change in debt is 24% and the average ratio between these two variables is 68% (basically identical to the top panel of the table). The fourth column of the table shows that the average deficit is 7% and that the ratio between average deficit and change in debt is 29%, which again is close to the top panel of the table. As before, we find that Latin America and Sub-Saharan Africa have the highest occurrence of debt explosions (18 and 36, respectively), but now we find that the Middle East and the industrial countries have a number of episodes that are not much lower than those of Latin America. In fact, we now find that Latin America has the second lowest (after the industrial countries) relative share of debt explosions. This confirms that debt explosions in Latin America tend to be very large. In fact, Latin America is the only region in the world where there are more episodes in which debt grows by more than 20% of GDP than episodes in which debt grows between 10% and 20% of GDP.

4. What drives the difference?

After having documented that there are large differences between deficits and change in debt, we now run a set of regressions aimed at exploring the determinants of these differences. We start by estimating the following model:

$$\delta_{i,t} = \alpha_i + \beta X_{i,t} + \gamma \pi_{i,t} + \varepsilon_{i,t} \tag{6}$$

where α_i is a set of country fixed effects, $X_{i,t}$ a set of country-year specific variables that can explain the difference between deficit and change in debt, and $\pi_{i,t}$ is a measure of inflation (defined as ln(1 + INF)). Although we do not have a clear theory of how inflation should affect $\delta_{i,t}$, we include this variable because the various components of $\delta_{i,t}$ are nominal variables measured in different periods of time (a stock at time t, a stock at time $t-1$ and a flow variable measured between $t-1$ and t). Hence, whenever the deficit is different from the change in debt, the value of $\delta_{i,t}$ should be positively correlated with nominal GDP growth, which is heavily influenced by inflation.

One reason why the change in debt could be higher than the recorded deficit are valuation effects due to currency depreciations in the presence of foreign currency debt. To explore this possibility, we start by focusing on developing countries (industrial countries do not have large stocks of foreign currency debt) and use data from the World Bank's Global Development Finance (GDF) to create three dummy variables that classify all developing countries into groups of equal size.[6] The three dummies are defined as follows: (i) LOW takes a value of 1 for all country-years where the external debt-to-GDP ratio is below 38%; (ii) MEDIUM takes a value of 1 for all country-years where the external debt-to-GDP ratio ranges between 38% and 64%; (iii) HIGH takes a value of 1 for all country-years where the external debt-to-GDP ratio is above 64%. Next, we interact the three dummies with the change in the real exchange rate (DRER, an increase in DRER corresponds to a real depreciation).

Column 1 of Table 9 reports the results of our baseline estimation. As expected, we find that inflation has a positive and statistically significant coefficient. Furthermore, we find that currency depreciations are positively and significantly correlated with δ, a finding that provides evidence of the presence of balance-sheet effects. More interestingly, we find that the effect of currency depreciations is particularly large in countries with high levels of external debt. Consider, for instance, a real depreciation of 30% (not an uncommon event in some of the countries included in our sample). In countries characterized by low or medium levels of external debt, such a depreciation is associated with an increase of δ of approximately three to four percentage points, but in countries with high levels of debt, a similar depreciation would instead cause δ to increase by more than 10 percentage points. At the bottom of the table we show that the difference between coefficients is also statistically significant (this is not the case for the difference between the coefficients associated with low and medium external debt).

Next, we include industrial countries and assume that this set of countries has no foreign currency denominated external debt. Therefore, the regression coefficients should be interpreted as follows: DRER measures the effect of real depreciations in industrial countries; DRER + DRER * LOW measures the effect of a real depreciation in developing countries with low levels of external debt; DRER + DRER * MEDIUM measures the effect of a real depreciation in developing countries with average levels of external debt; and DRER + DRER * HIGH measures the effect of a real depreciation in developing countries with high levels of external debt. Column 2 shows that the coefficient of DRER is low and not statistically significant, indicating that there are no balance-sheet effects in industrial countries. As before, we find that balance-sheet effects are important in developing countries and that the effect of a real depreciation in all three groups of developing countries is significantly different (both in economic and statistical terms) from the

6 Since the GDF data have information for total external debt, we are implicitly assuming that most external debt is public (or generates contingent liabilities of the public sector). We checked the validity of this assumption by computing the correlation between GDF data on total external debt and IFS data on public external debt and found that this correlation is 0.91.

Table 9
The determinants of δ

	(1)	(2)	(3)	(4)	(5)	(6)
INFLATION	25.526	24.869	25.428	25.136	25.223	25.885
	(11.454)**	(11.199)**	(11.285)**	(10.775)**	(11.346)**	(11.581)**
DRER * LOW	14.034	11.496			11.331	5.288
	(6.522)**	(6.732)*			(6.787)*	−6.794
DRER * MEDIUM	11.358	9.218			8.315	1.996
	(5.059)**	(5.171)*			−5.323	−6.22
DRER * HIGH	32.987	30.835			32.229	25.802
	(10.423)***	(10.469)***			(10.588)***	(10.738)**
DRER		2.22			1.95	8.676
		(1.513)			(1.589)	(3.715)**
DEFAULT			−0.077		−1.754	−2.471
			(2.015)		(1.981)	(1.963)
BANKING CRISIS				3.204	2.812	2.182
				(1.918)*	(1.908)	(1.909)
R^2 (within)	0.218	0.224	0.19	0.199	0.234	0.244
Observations	1065	1529	1529	1529	1529	1529
N countries	78	102	102	102	102	102
Sample	Developing countries	All countries	All countries	All countries	All countries	All countries
Fixed effects	Country	Country	Country	Country	Country	Country-year
DRER * LOW = DRER * MEDIUM	0.7654	0.7392			0.6757	0.6536
DRER * HIGH = DRER * MEDIUM	0.0612	0.0524			0.0396	0.0359
R^2 with country FE	0.4783	0.4825	0.4559	0.4584	0.4852	0.5025

Robust standard errors in parentheses.
*Significant at 10%.
**Significant at 5%.
***Significant at 1%.

effect of a depreciation in industrial countries. Finally, we still find that balance-sheet effects tend to be particularly important in countries with high levels of debt.

Column 3 explores the role of default, we expect defaults to be associated with debt reduction and hence negatively correlated with δ. To capture the effect of default, we use data from Standard and Poor's and build a dummy variable that takes a value of 1 around the last year of a default episode (in particular, it takes a value of 1 in the last year of the episode and in the year before and the year after the last year of the episode). Next, we build a default dummy that takes a value of 1 in the last year of a Paris club rescheduling and then another dummy that takes a value of 1 whenever the GDF reports that a country has rescheduled its debt. Finally, we build a dummy called DEFAULT that takes a value of 1 whenever one of the previously described dummies takes a value of 1. Column 3 shows that the default dummy has the expected negative sign but that the coefficient is small and not statistically significant (we obtain similar results if we use the three dummies separately).

Column 4 uses data from Caprio and Klingebiel (2003) to explore the role of banking crises. These are important events because they generate a series of contingent liabilities and other off-balance sheet activities that can translate into debt explosions. As expected, we find that the coefficient of the banking crisis dummy is positive and statistically significant. The coefficient is also quantitatively important, indicating that the average banking crisis is associated with an increase of three percentage points in δ.

Column 5 jointly includes all the variables discussed above. We find that the results are qualitatively similar to previous ones, but that the coefficient of DRER * MEDIUM is no longer statistically significant (however, DRER + DRER * MEDIUM remains significant) and that the same is true for banking crisis. In the last column of the table, we control for year fixed effects (which implicitly control for global shocks) and show that their inclusion does not affect our basic results.

It is interesting to note that the set of controls included in the regressions of Table 9 explains about 20% of the variance of δ and that the country fixed effects explain about 30% of the variance of δ (see last row of Table 9). This indicates that country-specific factors explain most of the variance of δ and corroborates the findings of Table 3, which showed that there are large cross-country differences in the average value of δ. There are two possible explanations for this finding. The first has to do with the fact that measurement errors that lead to an underestimation of the deficit are more important in some countries than in others, which is probably related to the fact that poorer countries have less sophisticated accounting and budgeting systems. The other has to do with the fact that the importance of contingent liabilities that lead to debt explosions varies across countries and that our set of controls does not capture all these contingent liabilities.[7]

One problem with the regressions of Table 9 is that they assume a linear relationship between the dependent variable and the set of independent variables. Therefore, the estimated results might be driven by extreme values of δ. To address this issue, we relax the linearity assumption and run two sets of Probit regressions. In the first set of Probits, the dependent variable is a dummy that takes a value of 1 for all country years in the top decile of the distribution of δ (the results do not change if we define the dummies using the $\delta > 10$ threshold).

Table 10 reports the results for events in the top decile (in this group of events, δ ranges between 12.7 and 282 and has an average value of 44.5). We find that most of the results are similar to those in Table 9. In particular, Column 1 shows that the relationship between real depreciations and the probability of observing an extreme event of δ increases with the level of external debt. Column 2 shows that in industrial countries, real depreciations have a negative (but not statistically significant) correlation with the probability of observing an extreme event of δ. This column also shows that in countries with high levels of external debt, depreciations are highly correlated with the probability of observing an extreme event. One puzzling result of Table 10 is that the coefficient of the DEFAULT dummy is large, significant, and *positive* (Column 3). This is exactly the opposite of what we expected, and may have to do with the fact that defaulted debt is not immediately subtracted from the stock of public debt. The coefficient of the BANKING CRISIS dummy variable instead has the expected positive sign. Besides being statistically significant, the impact of this variable is also economically important. In particular, the point estimates indicate that a banking crisis is associated with a 10% increase in the probability of observing an extreme event of δ.

[7] Another key difference is in the size of the regional government, which is often not well captured by our data. We also estimate a set of regressions similar to those in Table 9 but substituting δ with d and including def in the set of controls (results available upon request). This is equivalent to estimating the model of Table 9 by relaxing the restriction that the coefficient of def is 1. We find that the def coefficient is always smaller than 1 but that this coefficient is never significantly different from 1. All our other results are unchanged (this was expected because Table 5 already indicated that the deficit by itself explains an extremely small share of the within-country variance of the change in debt). We also repeated the regressions of Table 9 controlling for GDP growth and for GOOD TIMES and BAD TIMES dummies and found similar results (results available upon request).

Table 10
Probit regressions for episodes in top δ decile

	(1)	(2)	(3)	(4)	(5)	(6)
INFLATION	0.251	0.225	0.160	0.224	0.132	0.151
	(0.084)***	(0.072)***	(0.060)***	(0.077)***	(0.055)**	(0.064)**
DRER*LOW	0.098	0.134			0.140	0.060
	(0.169)	(0.159)			(0.158)	(0.179)
DRER*MEDIUM	0.190	0.249			0.241	0.197
	(0.115)*	(0.122)**			(0.120)**	(0.128)
DRER*HIGH	0.567	0.550			0.402	0.314
	(0.136)***	(0.136)***			(0.129)***	(0.147)**
DRER		−0.067			−0.078	0.005
		(0.075)			(0.080)	(0.099)
BANKING CRISIS		0.099	0.072	0.050		
				(0.029)***	(0.028)***	(0.026)*
DEFAULT			0.222		0.187	0.191
			(0.032)***		(0.032)***	(0.033)***
Observations	1066	1529	1529	1529	1529	1389
N countries	78	102	102	102	102	102
Sample	Developing countries	All countries	All countries	All countries	All countries	All countries
Fixed effects	NO	NO	NO	NO	NO	YEAR

Standard errors in parentheses.
*Significant at 10%.
**Significant at 5%.
***Significant at 1%.

We also tried to run a set of Probit regression aimed at explaining events in the bottom decile of δ (in this group of events, δ ranges between -116 and -3.4 and has an average value of -10.9). As expected, we find that depreciations are negatively correlated with these types of events but the coefficients are rarely significant and, in general, we find that our model does a very poor job at explaining these events (full regression results are available upon request).

5. Conclusions

The finding that most debt explosions have little to do with recorded deficits but arise from contingent liabilities often associated with past policies or with inherent vulnerabilities in a country's debt structure has several important policy implications.

First, it points out that better public accounting systems that allow to keep track of liabilities as soon as they appear would be helpful in avoiding the creation of "skeletons in the closets" and successive sudden debt explosions. It is important to note that poor fiscal accounting is sometimes an explicit choice of politicians. Aizenman and Powell (1998) suggest that governments have incentives to misreport public expenditure and that this comes back to haunt them as debt is re-assessed in the future. Therefore, building independent auditing institutions would not only increase the transparency of public accounts but also be useful in limiting the behavior of spendthrift policymakers.

Second, our results suggest that building a safer debt structure and implementing policies aimed at avoiding the creation of contingent liabilities are key to avoiding debt explosions (for contrasting views on how this can be achieved, see Goldstein and Turner, 2004 and Eichengreen et al., 2003). The finding that debt structure matters suggests that the usual arrangement in which deficits are decided in the political arena and debt management is left to technocrats who often have the explicit objective of minimizing the cost of borrowing may generate perverse incentives towards issuing too much low cost, high risk debt. Policymakers should be aware of the cost/safety trade-off and, by recognizing that more costly debt may have a desirable insurance component, internalize this trade-off in their decision on the costs of financing a given deficit (this would lead to setting technocrats' incentives in terms of both the cost and risk of debt).

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