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Bailing Out the People? When Private Debt Becomes Public

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Prepared by Samba Mbaye, Marialuz Moreno Badia, and Kyungla Chae[1]

Authorized for distribution by Catherine Pattillo

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Abstract

This paper documents a form of private sector bailout that is much more common (and yet unnoticed) than the typical bank bailout. Building on the newly-created *Global Debt Database*, we show that excess private debt systematically turns into higher public debt, regardless of whether the credit boom resulted in a crisis or a more orderly deleveraging process. This debt migration operates mainly through growth rather than explicit bailouts: private deleveraging weighs on activity, prompting a countercyclical government response to support economic activity. Ultimately, whether this debt substitution results in a net increase or a net decline of overall indebtedness in the economy depends on the extent of the growth slowdown during the deleveraging spell. These findings suggest that markets and policymakers should move away from looking at private and sovereign debt in silos and pay closer attention to the total stock of debt in the economy, as the line between the two tends to become blurry.

JEL Classification Numbers: E44, F34, F44, H63, N20

Keywords: deleveraging, public debt, private debt, leverage cycles, bailout

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"While the focus has been on the Dow Jones and Wall Street, we are addressing the real pain felt by Mr. and Mrs. Jones on Main street. They are why we must pass this legislation today"

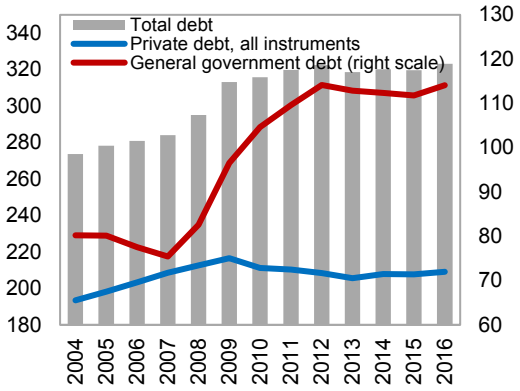
Nancy Pelosi, Statement in support of the Emergency Economic Stabilization Act (October 3, 2008)

I. INTRODUCTION

Few government policies are as controversial and widely disparaged as public bailouts of financial institutions. To the average citizen, the idea of using taxpayers' money to pay for the excessive gambling of a privileged few stirs a deep sense of unfairness, especially when those privileged few are private financial institutions. This is the sentiment that drove thousands to the streets in protest against the "Wall Street bailout" when news about the plan of the U.S. Treasury to purchase up to $700 billion worth of mortgage-backed securities from banks first emerged in September 2008. A group of 230 prominent economists, including several Nobel laureates, penned a letter to the United States Congress to question the "fairness" of the planned bailout.[2] Around the world, news of government intervention to support failing banks were also inescapably met with strong popular backlash.

In this paper, we document another form of private sector "bailout" that is much more common and universal than the typical bank bailout, and yet goes unnoticed. We show that whenever the private sector is caught in a debt overhang and needs to deleverage, governments systematically come to the rescue through a countercyclical rise in government deficits and debt. Thus, excess private debt invariably leads to higher public debt once the private sector is forced to deleverage. Yet, this form of debt "mutualization" does not involve the financial institutions that motivated most of the uproar in recent years, but average households and firms. Similarly, the channel through which this debt substitution takes place is not so much the explicit assumption of private liabilities by the government but instead growth. Private deleveraging weighs on economic activity, thereby prompting both a cyclical deterioration in public finances and a countercyclical rise in public debt as governments borrow on taxpayers' behalf to minimize the drag on the economy.

Figure 1. Advanced Economies: Gross Debt
(Percent of GDP)



Sources: Global Debt Database; and authors' calculations.
Note: Balanced sample of 21 advanced economies. Private debt refers to the gross debt of the nonfinancial private sector and includes all debt instruments: loans; debt securities; special drawing rights; currency and deposits; other account payables; and insurance, pension, and standardized guarantee schemes.

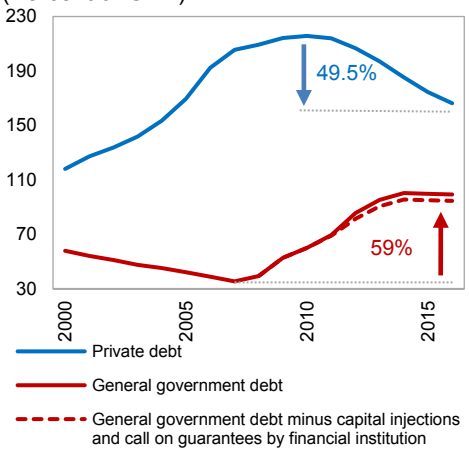
All signs indicate that this other form of bailout, and not the bank rescue packages, should bear most of the blame for the increasing debt levels in advanced economies.

[2] A copy of the letter can be found at the following web page https://faculty.chicagobooth.edu/john.cochrane/research/papers/mortgage_protest.htm

As shown in Figure 1, households and firms in advanced economies have been going through a painfully slow deleveraging process since the onset of the global financial crisis (GFC).[3] By contrast, government borrowing shot up as early as 2007 and continued rising through 2014 before leveling off. Most surprisingly, the total stock of debt in advanced economies markedly increased as a share of GDP over the period. In other words, while the private sector was trying to pare its debt burden, governments were taking on new debt, and on balance, countries were left with higher total debt than when the private deleveraging started off. Thus, a decade after the onset of the GFC, advanced economies are 39 percent of GDP deeper in debt.

To be sure, part of this increase in public indebtedness was the byproduct of direct interventions in banks' balance sheets. However, the size of the government support packages was nowhere close to accounting for the full rise in public debt (Bova and others 2016, Laeven and Valencia 2013; Reinhart and Rogoff 2013). Spain is a very telling example in this respect: public debt has increased by close to 59 percent of GDP since 2007 but only 4¾ percent of GDP stems from capital injections and called guarantees (Figure 2). As it turns out, automatic stabilizers and the large fiscal stimulus that many advanced economies implemented in the aftermath of the crisis have been the main factors behind the higher public debt ratios (October 2016 Fiscal Monitor). Thus, to the extent that the slowdown prompting the fiscal policy response had its roots in the private debt overhang, one could see the post-GFC rise in public debt as nothing more than another way of bailing out the struggling households and firms.

Figure 2. Spain: Gross Debt
(Percent of GDP)



Sources: Global Debt Database; Eurostat; and authors' calculations.

In this paper we ask whether this post-crisis debt substitution is an artifact of the GFC or, more fundamentally, a mainstay of private deleveraging episodes. To answer this question, we turn to the newly created *Global Debt Database* (GDD), which offers an unmatched coverage of the world's private and public debt since World War II (Mbaye, Moreno-Badia, and Chae, 2018a). Based on a combination of event studies and Inverse Propensity Weighting Regression Adjustment (IPWRA) estimates, we document a recurring pattern through history where households and firms are forced to deleverage in the face of a debt overhang, dampening growth and eliciting the injection of public money to kickstart the economy. One of our main findings is that this debt substitution takes place irrespective of whether the private deleveraging episode is associated with a financial crisis. Thus, it is not just a crisis story but a more prevalent phenomenon that affects countries at various stages of

[3] Contrary to what one might think, households and firms in advanced economies have been making significant efforts towards deleveraging but debt-to-GDP ratios have remained stubbornly high mostly due to unfavorable interest rate-growth differentials (October 2016 Fiscal Monitor).

financial and economic development. We also find that whether the country's total debt ends up increasing or decreasing at the end of the process critically depends on growth. When the growth slowdown is relatively benign, the overall debt burden ultimately goes down. However, in the face of a protracted slowdown, countries are left with more debt than what they began with at the start of the private deleveraging. The ongoing private deleveraging process in advanced economies belongs to this latter family, which we call "growthless deleveraging" episodes. Finally, our results also suggest that private deleveraging happens before one can see it in the private debt ratio. Indeed, most of the underlying macro-dynamics —i.e. the decrease in borrowing flows, growth slowdown, and rise in public debt— take place before any decline in private debt-to-GDP.

The mechanism we document in this paper is not the typical bailout scheme, but can in many ways be characterized as a "form of bailout". First, there are negative spillovers as in the typical bailout: the over-borrowing of some individuals creates a burden on all, either through future taxes or cuts in the provision of public services to repay the public debt created along the way. Second, the overly-indebted individuals get relief from the government's intervention, although in an indirect way. Indeed, as shown in this paper, healthy growth is one of the most important ingredients for a "successful" private deleveraging. Thus, by supporting growth—for example, through demand creation, tax reliefs, and employment support for households and businesses—the government indirectly eases the deleveraging process.[4] Finally, there is also some degree of moral hazard; although arguably less acute than in a standard bailout (see Section VI).

Our paper joins the chorus of warnings against the dangers of unchecked private borrowing (Koo 2008; Reinhart and Rogoff 2011; Schularick and Taylor 2012; Gourinchas and Obstfeld 2012; Beck, Degryse, and Kneer 2014; Arcand, Berkes, and Panizza 2015; Jorda Schularick and Taylor 2016a; Mian, Sufi, and Verner 2017).[5] Relative to this literature, we make three main contributions. First, to our knowledge, we are the first establishing a causal link between private deleveraging and public debt. Existing studies on the potential spillovers of private leverage into the public sector have mainly focused on credit booms that resulted in financial crises (Reinhart and Rogoff 2009a and 2013; Gourinchas and Obstfeld 2012; Jordà, Schularick, and Taylor 2016) and stopped short of establishing causality. Second, we show that private debt spillovers during crises are just the visible trees of a much larger forest, in that they are part of a common phenomenon that takes place whenever the private sector undergoes deleveraging. Finally, the unparalleled coverage of our private debt series allows

[4] Although we do not provide evidence of the growth-impact of government interventions in this paper, there is ample evidence in the literature that fiscal multipliers tend to be generally positive (Blanchard and Perotti 2002; Ilzetzki, Végh, and Mendoza 2013), especially during periods of slack (Auerbach and Gorodnichenko 2012; Blanchard and Leigh 2013) such as deleveraging episodes (Batini, Melina, and Villa 2016).

[5] Other papers in this booming literature include Reinhart and Rogoff (2009a, 2009b, 2013), Mian, Rao, and Sufi (2009, 2013), Mian and Sufi (2010, 2011, 2014a, 2014b), Cecchetti and Kharroubi (2012, 2015), Pagano (2012), Kneer (2013), Jordà, Schularick, and Taylor (2011, 2013, 2015a, 2015b, 2016b), Claessens and others (2013), Laeven and Valencia (2013), Hasan, Horvath, and Mares (2016), Bouis (2015), October 2016 Fiscal Monitor, Bernardini and Forni (2017), and Alter, Feng, and Valckx 2018.

us to study the dynamics of private deleveraging beyond the realm of a few major advanced and emerging markets economies typical of most studies.

The rest of the paper is organized as follows. Section II offers a brief overview of the data and discusses our various measures of private deleveraging. Section III provides some basic stylized facts on deleveraging episodes in modern history. Section IV analyzes the key salient features of private deleveraging episodes by means of a series of event studies, in the same spirit as Gourinchas and Obstfeld (2012). This approach has the benefit of uncovering the stories as they are told in the data, away from the influence of our choice of econometric approach to dealing with endogeneity, which is taken on separately in section V. Section VI concludes.

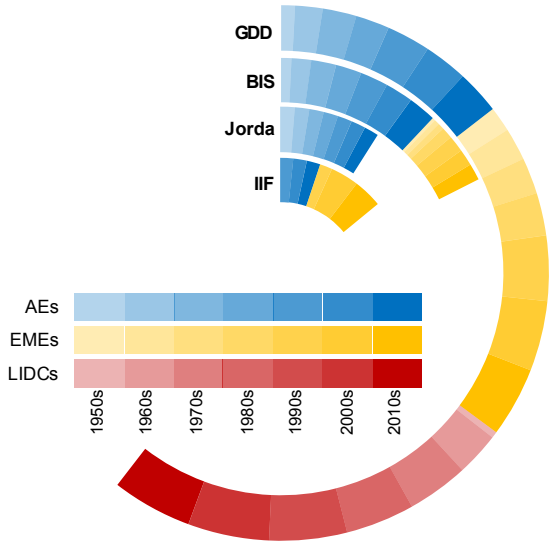
II. Data and Definitions

A. Data

One of the main contributions of this paper relates to the use of the GDD, a unique dataset that provides an unmatched account of private, public, and total debt for 190 countries going as far back as 1950.[6] The GDD is the result of a multiyear investigative process that started with the October 2016 Fiscal Monitor. Its coverage increases from a sample of 45 countries accounting for 63 percent of global output in 1950, to 99 percent of the world's GDP in 2016, falling only 8 countries short of the universe of sovereign states or territories.[7]

Figure 3 showcases the appeal of the GDD to study private deleveraging by comparing its country coverage of private debt with that of the main existing datasets. The size of each stripe in the figure is proportional to the number of countries covered, with different colors for each income group. The graph also captures the time dimension of the data, with darker colors referring to the most recent decades. The first feature that

Figure 3. Private Debt in the Global Debt Database
(Country coverage per decade)



Sources: Global Debt Database; Dembiermont, Drehmann, and Muksakunratana (2013); IIF (2017); Jordà, Schularick, and Taylor (2017); and authors' calculations.
Note: Blue color refers to advanced economies (AEs); yellow to emerging market economies (EMEs); and red to low-income countries LIDCs). Darker shades refer to the most recent decades. Size of each stripe is proportional to the number of countries covered.

[6] For more details on the GDD and review of existing debt datasets, see Mbaye, Moreno-Badia, and Chae (2018a).

[7] Sovereign states and territories not included in the database are Andorra, Cuba, Liechtenstein, Monaco, North Korea, Palau, Somalia, and the Vatican.

jumps out of Figure 3 is that the GDD more-than doubles the country coverage of the largest existing dataset. The main improvements relate to the GDD's extensive coverage of emerging market economies (56) and low-income countries (65), as well as some additional advanced economies (8). Coverage improves gradually over time in two distinct waves in the 1960s and 1970s. The large cross-section of countries and relatively long time-series allow us to work with a sufficiently large number of deleveraging episodes to test for differences across various aspects of deleveraging episodes (income groups, size, macroeconomic conditions, etc.). Because of our focus, we restrict the sample to countries for which data are available for both public and private debt, leaving us with a sample of 158 countries (Annex 1).

Another noteworthy feature of our data is the inclusion of relatively broad aggregates of debt. In particular, our preferred measure of private debt includes loans and securities (both domestic and external). This is a significant departure from other studies that typically focus on longer time dimensions and, thus, rely solely on domestic bank credit (which tends to underestimate the extent of leverage, particularly in the corporate sector). Finally, the GDD offers various measures of public debt—from the narrower central government to the wider nonfinancial public sector. Our approach is to use a consistent institutional coverage of public debt through time (which, in some instances, means focusing on narrower concepts of debt to maximize the time series dimension). The metric of total debt used throughout is the sum of nonfinancial private and public debt.

B. Private Deleveraging: Definitions and Statistics

We measure private deleveraging in two alternative ways: one standard and another more experimental. In the standard metric, a private deleveraging episode is the distance from a peak to the ensuing trough in the private debt to GDP ratio. Peaks and throughs are respectively defined as local maxima and minima within a five-year period, based on the widely-used algorithm for dating cycles of Harding and Pagan (2002), with the added restriction that a deleveraging should last for at least two years (Chen and others. 2015; Claessens, Kose, and Terrones2011). As all income-based measures of leverage, the debt-to-GDP ratio is admittedly a second-best to asset-based measures. We rely on the debt-to-GDP ratio, as many before us, for lack of historical cross-country data on private assets (Jordà, Schularick, and Taylor 2016; Buttiglione and others 2014).

Irrespective of the denominator (whether GDP or assets), understanding changes in the debt ratio can be challenging at times. The same rise in private debt-to-GDP may correspond to a credit boom (United States in 2006–07) or a severe recession (Japan in 2008-09). To account for this difficulty and come to as close a measure of private borrowing as possible, we also experiment with an alternative definition of private deleveraging, based on standard debt decompositions as in Escolano (2010). More specifically, we break down changes in the private debt ratio into "macro-related changes" and "leverage flows", and define private deleveraging as periods of negative "leverage flows" (see Annex 2 for a detailed discussion). Broadly speaking, the decomposition strips the impact of the macroeconomic environment—i.e., nominal GDP growth (g, which affects the denominator) and the interest rate (r, which mechanically affects rollover cost on the numerator)—from the debt ratio. By isolating the

impact of these macro-factors, we get a closer, though imperfect, measure of the true leveraging/deleveraging flows.

Formally, changes in the private debt-to-GDP ratio (d_t) are broken down into the impact of the interest rate-growth differential ($r - g$), net borrowing/lending excluding interest payments (p_t), and a residual term commonly dubbed "stock-flow adjustments" (SFA). The last two elements are combined in the estimates below due to data constraints.

$$d_t - d_{t-1} = \underbrace{\left(\frac{r-g}{1+g}\right) d_{t-1}}_{\text{Macro-related change}} - \underbrace{p_t + SFA}_{\text{Leverage flows}} \quad (1)$$

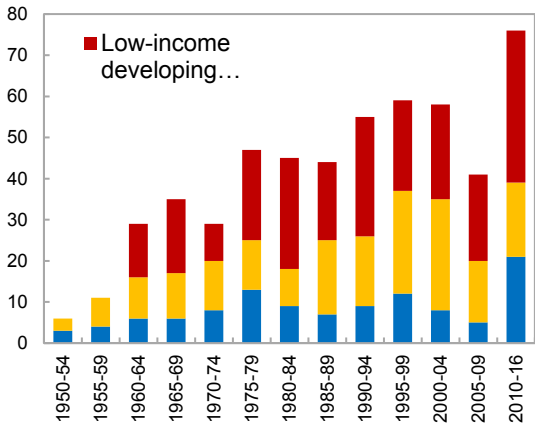
One important benefit of this decomposition is that it helps isolate the impact of GDP trends on the private debt ratio—in addition to the interest rate. Moreover, as shown in Annex 2, "leverage flows" are equal to the excess growth in nominal private debt relative to the debt service, expressed as a share of GDP. They turn negative whenever private debt grows at a slower pace than the interest rate, and vice versa. In other words, leverage flows are negative whenever new debt issuances are lower than what is needed to service the existing stock of debt. Negative leverage flows, thus, reflect cases of *net debt repayments*, once the cost of the debt service is accounted for, which could be considered a form of deleveraging.

These two measures are complementary in many ways. The standard metric provides a familiar starting point and a useful benchmark for comparisons with existing studies, while the second metric goes beyond the surface and attempts to isolate sources of change in the debt ratio, especially those driven by GDP. As discussed in Annex 2, the two metrics imply the same periods of private deleveraging most of the time. However, they tend to differ during "abnormal times"—such as crises, recessions, and high growth episodes—which will be the focus of most of our analysis. In what comes, we will systematically use the debt-ratio metric as a starting benchmark and flag divergences with leverage flows when useful.

III. STYLIZED FACTS

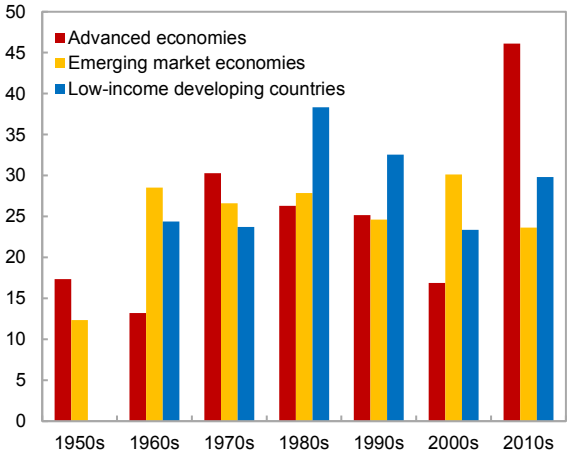
Based on our standard definition, we identified 535 private deleveraging episodes, involving 159 countries over 1950–2016. Figure 4 plots the number of episodes per decade, showing that the sample sizes in most decades is respectable, with a low of 17 episodes in the 1950s, and a high of 114 in the 1990s. Figure 5 shows the probabilities of deleveraging in each decade—measured by the ratio of deleveraging observations over total private debt observations in the sample. It reveals three distinct "private deleveraging waves": the 2010s for advanced economies with 21 episodes over the 6 years covered; the 2000s in emerging market economies; and the 1990s in low-income countries. Overall, virtually every country in our sample undergoes deleveraging at some point in time, although the incidence varies widely across countries (Figure 6).

Figure 4. Number of Deleveraging Episodes



Sources: Global Debt Database; and authors' calculations.

Figure 5. Probability of Deleveraging by Decades

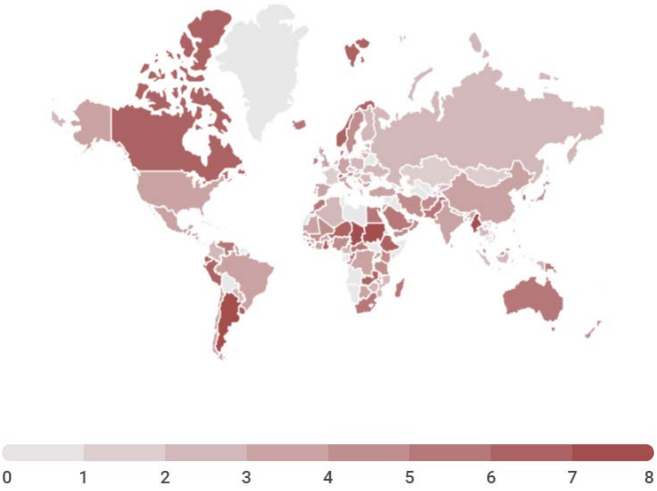


Sources: Global Debt Database; and authors' calculations.

A cursory look at the private deleveraging episodes in our sample reveal the following features (Tables 1 and 2):

- Private deleveraging episodes become less frequent, longer, and larger in size as countries develop. Relative to other country groups, deleveraging episodes in advanced economies take place at lower frequency (27 percent of the time) and are further apart (on average every 11 years). Private deleveraging is more common place in low-income countries and emerging market economies, where it happens every 8 years but these episodes tend to be slightly shorter (about 3½ years). Moreover, private debt peaks at significantly lower levels in these countries. The average size of deleveraging is relatively similar in advanced and emerging market economies (about 15-19 percent of GDP), three times that of low-income countries.

Figure 6. Incidence of Private Deleveraging, 1950–2016
(Number of Episodes)



Sources: Global Debt Database; and authors' calculations.

- Growth tends to be lower in the run up to a deleveraging episode than during the actual deleveraging episode. This somewhat puzzling observation previews one of the key findings of our analysis below, namely that most of the "deleveraging" and associated

activity slowdown happens before the private debt ratio starts to show any decline (more on this point below).

- The correction in private debt during deleveraging episodes tends to be larger than the (5-year) pre-deleveraging increase in debt except for the case of advanced economies.

- Most of deleveraging episodes do not take place during crises. In particular, less than 15 percent of deleveraging episodes occur within a +/- 3-year window of a financial crisis.[8]

- Overall, deleveraging episodes last longer and are larger in size during crises. The peak of the private debt ratio during a crisis deleveraging is almost 40 percent of GDP higher than in a non-crisis episode. This may explain why the size of the deleveraging during crises is doubled. Growth prior to deleveraging is not significantly different between the crisis and non-crisis episodes. However, during the deleveraging itself, growth is more than 1 percentage lower in crisis episodes and the difference is statistically significant.

- As evidenced by the size of the associated standard deviations, there is considerable dispersion around average characteristics, especially when it comes to the size, peak value, and growth conditions during deleveraging episodes. The analysis below exploits some of this heterogeneity to tell the different sub-plots that make up the overall story of private deleveraging since World War II.

Table 1. Average Features of Private Deleveraging Episodes

	World		Adv. Eco.		Em. Mark.		Low Inc.	
	Mean	(Stand. Dev)	Mean	(Stand. Dev)	Mean	(Stand. Dev)	Mean	(Stand. D
Length (*years*)	3.6	(1.9)	3.9	(2.2)	3.4	(1.6)	3.5	(2.0)
Size (*drop from peak to through, % of GDP*)	-11.6	(22.3)	-18.7	(37.7)	-14.5	(20.3)	-6.1	(9.4)
Rate (*Size/Length*)	-3.2	(4.8)	-4.3	(5.6)	-4.4	(5.4)	-1.7	(2.5)
Distance between episodes (*years*)	8.5	(7.6)	10.9	(9.4)	7.9	(6.9)	8.0	(6.9)
Peak private debt (*average, % of GDP*)	54.1	(60.9)	131.2	(75.7)	51.8	(41.4)	20.4	(20.6)
Pre-delev. change in debt (*average of 5-yr cum. change, % of GDP*)	9.2	(17.6)	19.0	(27.6)	9.4	(16.1)	3.9	(6.8)
Pre-delev. growth (*average of 5-yr, percent*)	3.5	(3.9)	3.1	(2.5)	4.1	(3.7)	3.3	(4.5)
Growth during delev. episodes (*average, percent*)	3.8	(4.2)	3.5	(2.5)	4.0	(4.2)	3.8	(4.8)
Number of epidodes	535		111		184		240	
Probability of deleveraging (*share of deleveraging obs.*)	27%		25%		26%		29%	

Sources: Global Debt Database; and authors' calculations.
Note: AEs = advanced economies; EMEs = emerging market economies; LIDCs = low-income developing countries.

[8] The crisis variable was generously provided by Bernardini and Forni (2017) who aggregate crisis dates from three datasets (Reinhart and Rogoff 2009b; Laeven and Valencia 2013; and Jordà, Schularick and Taylor 2017) based on two criteria: (i) at least one of the three sources documents a crisis date; (ii) when alternative sources document a crisis starting within one year, they use the earliest date.

Table 2. Private Deleveraging Episodes: Crisis vs. Non-crisis

	Crisis	Non-crisis	P-value
Length (years)	4.03	3.51	0.03
Size (drop from peak to through, % of GDP)	-19.21	-9.34	0.00
Rate (size/length)	-5.26	-2.67	0.00
Peak private debt (average, % of GDP)	89.67	50.32	0.00
Pre-delev. change in debt (average of 5-yr cum. change, % of GDP)	17.41	7.66	0.00
Pre-delev. growth (average of 5-yr, percent)	3.18	3.59	0.41
Growth during delev. episodes (average, percent)	2.82	4.03	0.02
Number of episodes	77	456	-

Sources: Global Debt Database; and authors' calculations.
Note: The last column reports the p-value of comparing crisis versus non-crisis deleveraging episodes.

IV. PRIVATE DELEVERAGING IN MODERN HISTORY

A. Methodology

In this section, we characterize the key features of private deleveraging episodes and ask whether there are differences depending on the prevailing macroeconomic conditions, including the occurrence of crises. Our empirical tool is an adapted version of the framework developed by Gourinchas and Obstfeld (2012):

$$y_{it} = \alpha_i + \sum_k \beta_{t+k} T_{ik} + \varepsilon_{it} \quad (1)$$

where y is an economic aggregate of interest (changes in private, public and total debt, "leverage flows" or growth); α_i is a full set of country-fixed effects, and ε_{it} is a well-behaved error term. Our variable of interest, T_{ik}, is a dummy equal to 1 when the country i is k years away from the start of a deleveraging episode in year t, and 0 otherwise. Most estimates below contain 9 dummies (four years before, four years after), each coding a given distance away from the start of a deleveraging episode. In this setup, each parameter, β_{t+k}, captures the average change in y, at time $t + k$, relative to observations outside the 9-year window around deleveraging episodes, which we interpret as "normal times". Thus, by estimating (1) over our entire sample, and plotting the estimated parameters β_{t+k}, one can trace the typical dynamics in y relative to "normal times" around deleveraging episodes.

"Normal times" in the above setting correspond to periods of leveraging as well as private debt declines that lasted only for a year. These "normal times" represent 71–75 percent of observations depending on the country group. Table 3 summarizes the average values of our economic variables of interest during "normal times", which will serve as benchmark for the analysis of "deleveraging times".

The empirical framework above offers a number of convenient features. First, because they are estimated relative to the same "normal times" benchmark, parameters β_{t+k} are directly comparable. Second, one could easily compute the cumulative impact over $\{t-k \ldots t+k\}$ by summing up the corresponding parameters $\{\beta_{t-k} \ldots \beta_{t+k}\}$. This will come particularly handy when we look at the cumulative change in total debt during deleveraging episodes. Third, for any $y_1 = y_2 + y_3$, estimated coefficients $\beta^1_{t+k}, \beta^2_{t+k}, \beta^3_{t+k}$ are such that $\beta^1_{t+k} = \beta^2_{t+k} + \beta^3_{t+k}$. This follows from the mean-additivity properties of linear models. We exploit this feature below to explore the breakdown of the debt ratio into different components.

Table 3. Average Macro-Economic Conditions during Normal Times

	World	AEs	EMEs	LIDCs
Real GDP growth	3.9	3.6	4.4	3.8
Change in private debt	2.8	5.0	3.2	1.2
Leverage flows	2.2	4.6	2.0	0.7
Change in public debt	0.2	0.5	0.6	-0.4
Change in total debt	3.2	5.5	3.8	1.1

Sources: Global Debt Database; and authors' calculations.
Note: AEs = advanced economies; EMEs = emerging market economies; LIDCs = low-income developing countries.

B. What Happens Before, During, and After Private Deleveraging?

1. The Typical Private Deleveraging

We now evaluate the relative behavior of five macroeconomic variables—private debt, leverage flows, public debt, growth, and total debt—around private deleveraging episodes by estimating (1). The baseline results are presented in Figure 7. Because we will use this figure extensively in this section, it is worth describing the information it contains. Period 0 denotes the start of the private deleveraging episode based on our standard debt-to-GDP metric. Panels *a, b*, and *c* plot the β_{t+k} parameters estimated for the annual change in private debt (and its subcomponents), real growth, and the annual change in public debt, respectively.[9] Thus, each bar/line corresponds to the annual change in the aggregate in question relative to normal times, when the economy is *k*-years away from the start of a deleveraging episode. Panel *d* plots the cumulative change in total debt, computed as sum of the β_{t+k} parameters estimated for the annual change in total debt. To ease interpretation, we use a starting total debt stock of 100 in $t-5$. Dotted lines denote 90 percent confidence intervals.

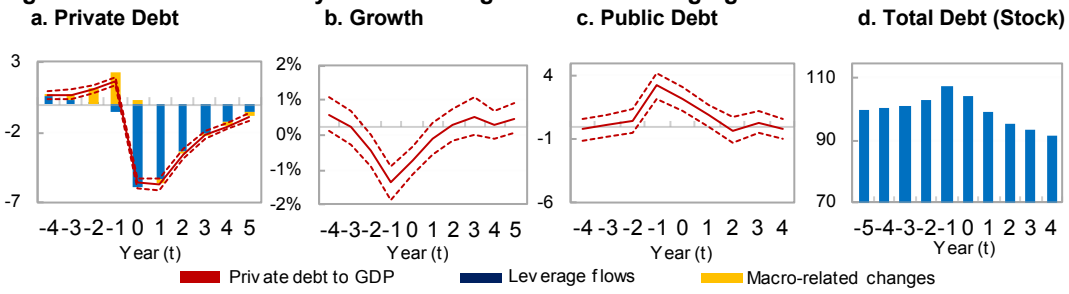
As expected, the private debt ratio grows faster than "normal times" in the run up to the deleveraging episode and contracts afterwards. However, a closer look at the underlying dynamics shows a less predictable picture: while the debt ratio is rising at an increasingly faster pace before the deleveraging episode, leverage flows (blue bars) are growing at an increasingly slower pace. The divergence is even starker one year before deleveraging starts, with leverage flows turning negative—signaling a net debt repayment once we account for debt service cost—while the debt ratio is still rising. This suggests that the private sector

[9] Due to restrictions on the private interest rate data necessary to calculate leverage flows, these results are based on a smaller sample of 283 deleveraging episodes

starts to make efforts towards deleveraging before the actual deleveraging (based on the debt ratio) takes place. In other words, the process of debt repayment starts earlier than visible in the private debt ratio.

The reason why early deleveraging efforts are not visible in the debt ratio lies in the dynamics of the "macro-related changes" (Figure 7, panel a, yellow bar), especially GDP growth (panel b). Economic growth switches from a slight expansion to a deep contraction relative to normal times, hitting a trough one year before the start of the deleveraging episode—exactly when leverage flows turn negative. The adverse impact on GDP more than offsets the deleveraging efforts of the private sector, thus contributing to keeping the debt ratio on the rise. But the recession is short-lived, with growth returning to normal about a year after the start of the deleveraging episode.

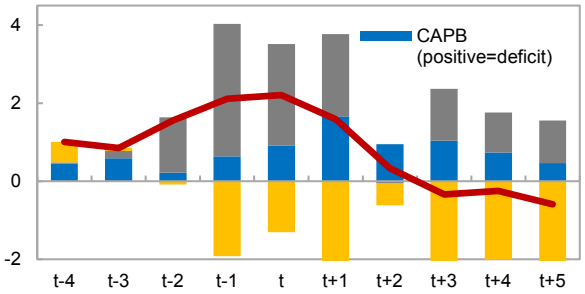
Figure 7. Macroeconomic Dynamics During Private Deleveraging



Sources: Global Debt Database; and authors' calculations.
Note: t = 0 refers to the start of deleveraging in the private sector. The dotted line denotes 90 percent confidence interval for each conditional mean.

Next, we turn to the average dynamics in the public debt ratio (Figure 7, panel c). The first key finding is that public debt tends to increase faster than in normal times during private deleveraging episodes. Second, and perhaps more interestingly, the surge in public debt is front-loaded, following the same patterns as growth and leverage flows. Public debt starts to increase one year before the start of the deleveraging episode. This is also when public debt registers its largest increase, coinciding with leverage flows turning negative and growth reaching its trough. The increase in public debt continues one year into the deleveraging episode, before subsequently tapering off, as growth bounces back and the deleveraging process takes root. This front-loaded pattern further confirms the economic importance of the period leading up to a deleveraging episode.

Figure 8. Sources of Change in Public Debt During Private Deleveraging in Advanced Countries
(Percent of GDP)



Sources: Global Debt Database; IMF, *World Economic Outlook*; and authors' calculations.

Figure 8 takes a closer look at the underlying drivers behind public debt dynamics during private deleveraging episodes. It breaks down changes in the public debt ratio into the cyclically adjusted primary balance (CAPB), "macro-related changes", and residual

stock flow adjustments.[10] Due to data availability constraints, the sample is restricted to advanced economies. Our estimates suggest that most of the increase in public debt during private deleveraging spells is driven by cyclically adjusted primary deficits along with macro-related flows. This suggests that the increase in public borrowing partly reflects true countercyclical policy intentions to stimulate the economy. Interestingly, stock flow adjustments—which are likely to capture the cost of off-budget bailouts and contingent liabilities among other things-—do not seem to be one of the major driving factors behind the public debt surge. Reinhart and Rogoff (2009a) reached the same conclusion while documenting the aftermath of financial crises.

Finally, we turn to the behavior of total debt during a typical deleveraging episode (Figure 7, panel d). The results broadly mirror previous findings. Total debt goes up in the run up to the deleveraging episode, before stabilizing early in the deleveraging process, and eventually declining.

Overall, these findings tell a story of private deleveraging that, for the most part, takes place, before the actual decline in the debt-to-GDP ratio. Before the debt ratio ever goes down, private agents already start repaying debt in net terms, public and total debt increase, while activity markedly slows down. However, as soon as the private deleveraging takes hold, economic activity gradually picks up, the surge in public debt tapers off, and total debt progressively declines to a lower level.[11] All of this suggests that our leverage-flow definition of private deleveraging captures more accurately the true start of the deleveraging process. Annex 3 explores the universality of these patterns by replicating our baseline estimates for advanced and emerging market economies and low-income countries. The results show that, although the narrative is broadly similar across country groups, there are some nuances—e.g., leverage flows turn negative earlier (at $t-2$) and the rise in public debt is more prolonged in advanced economies.

In what follows, we slice the data in several alternative ways to explore to what extent the baseline results still hold and get some further insights into the dynamics of private deleveraging.

2. "Growthless" Deleveraging

The story of a typical private deleveraging episode, as just described, is a success story in many ways. Although private debt is partially "replaced" with public debt, in the end, the total stock of debt in the economy declines and activity bounces back to normal. But are there any cases where countries are left with higher total debt than before the deleveraging? In this section, we look at a special type of private deleveraging events, which we label "growthless", where activity remains depressed throughout the episode. We define "low

[10] Macro-related flows are defined as the combined impact of the interest rate–growth differential and the cyclical component of the primary balance (see Escolano, 2010 for an extended discussion).

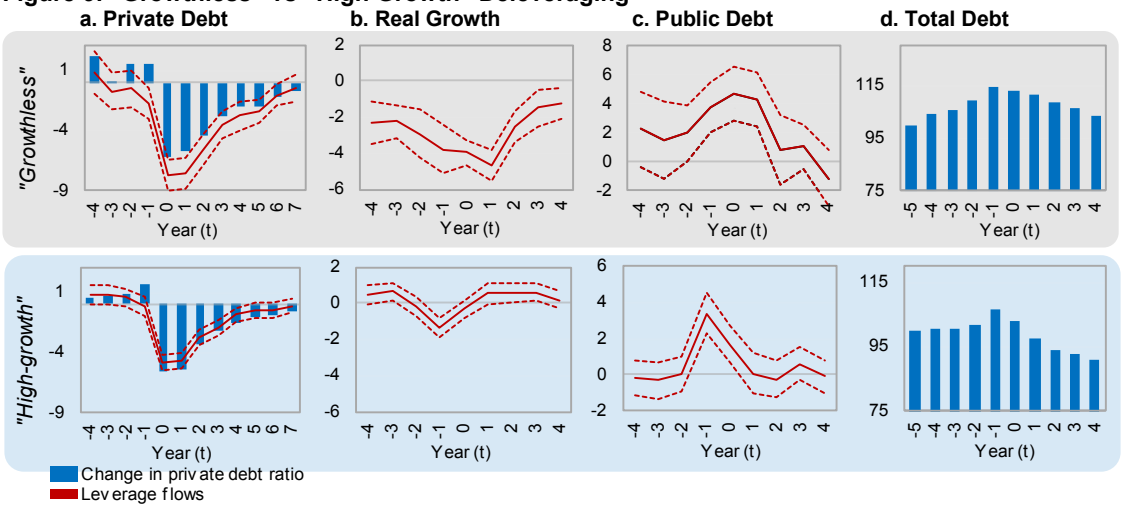
[11] These findings echo, in many ways, those of Pescatori and others (2014) for public debt. They find that although high levels of public debt tend to put a drag on activity, this effect disappears as soon as the public sector starts to deleverage.

growth" benchmarks as the 25th percentiles of growth observations since the 1950s by income groups (1.6 percent for advanced economies, 1.9 percent for emerging market economies, and 1.1 percent for low-income countries). Our sample of deleveraging episodes is then broken into two groups—"high growth" and "growthless"—based on whether the average growth throughout the episode is higher or lower than the above benchmarks.

Figure 9 replicates our baseline estimates, comparing "growthless" with "high growth" deleveraging episodes. The results paint a stark contrast between these two typologies. While "high growth" deleveraging cases are very similar to the average deleveraging episode described above—moderate government support and a short-lived slowdown in activity—"growthless" deleveraging episodes look particularly painful. They last two years longer, require larger efforts from the private sector, and entail a larger and continuous increase in public borrowing. Despite these efforts however, growthless deleveraging episodes (ironically) result in more total debt at the end of the process. This less-successful story of private deleveraging is hardly an exception. It fits about a quarter of our sample of deleveraging, including episodes at all levels of income (from the United States in 2009 to Haiti in 1980).

Differences in growth dynamics seem to make a world of difference in deleveraging outcomes. But this begs the question of what makes growth strong in some episodes and weak in others. A first potential culprit is the very process of deleveraging (Chen and others 2015; Eggertson and Krugman 2010). Although private debt declines in both cases by roughly the same magnitude (17 percent of GDP cumulatively in growthless cases versus 15 percent in the high growth cases), this is achieved through twice as much effort in growthless cases (cumulative leverage flows were -24 percent of GDP in the latter versus -11% in high growth cases). Another noteworthy difference is the reaction of fiscal policy. Whereby, public debt increases only moderately (6 percent of GDP) in high growth deleveraging cases, it rises cumulatively by 17 percent GDP faster than normal in growthless episodes. Of

Figure 9. "Growthless" vs "High Growth" Deleveraging



Sources: Global Debt Database; and authors' calculations.
Note: t = 0 refers to the start of deleveraging in the private sector. The dotted line denotes 90 percent confidence interval for each conditional mean.

course, none of this is to say that the fiscal expansions led to lower growth. The counterfactual could have been even lower growth absent government support.

3. Fiscal Policy to the Rescue?

In an ultimate effort to uncover the potential role of fiscal policy, we devise an experiment that exploits the diversity of governments' reactions during growthless deleveraging episodes. Focusing on the latter sample of growthless cases, we explore whether differences in government support in the pre-deleveraging period—when the private sector is making efforts to deleverage —induce differences in ex-post growth during the deleveraging phase. To this end, the sample of growthless deleveraging episodes is broken down into two equal sub-samples of "strong" and "limited government support", defined respectively as the top and bottom half of the distribution of cumulative changes in public debt over the two years leading up to deleveraging episodes.[12] We then replicate the previous estimates for each sub-sample of growthless deleveraging (see Annex 4, Figure A.4.1).

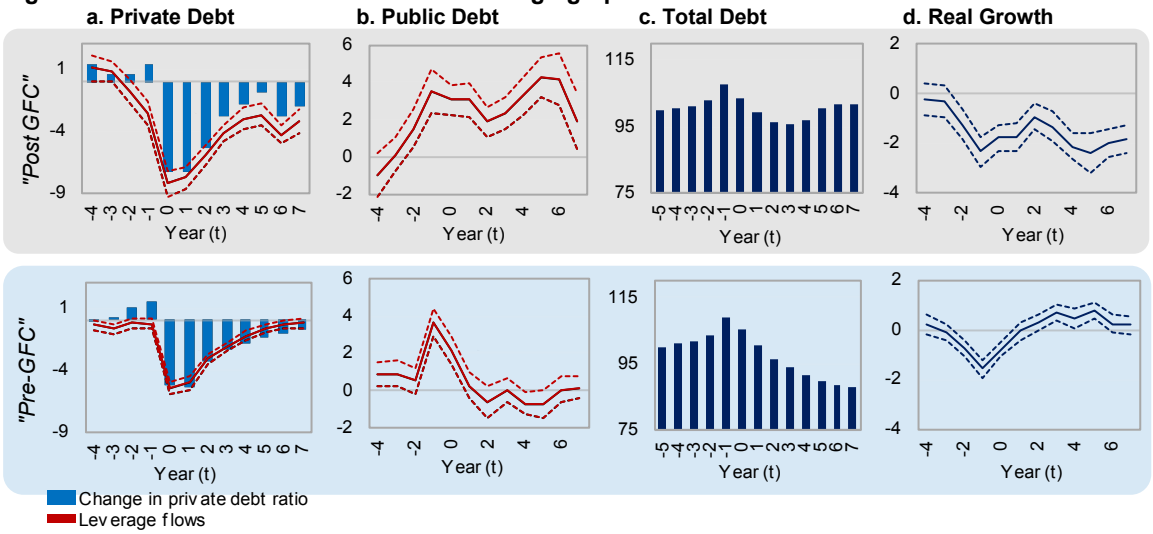
The results are surprisingly similar to the ones contrasting growthless deleveraging cases with high growth ones. Episodes that involve the largest government support tend to be those where growth is the weakest (i.e., the lowliest of the "growthless" deleveraging episodes). These episodes entail more efforts than other growthless cases and, eventually, result in a higher total debt than before the deleveraging. As discussed earlier, this robust correlation between increased public debt and lower growth does not necessarily imply that government support curtails growth. It most likely highlights the endogeneity of public debt to growth outcomes, which our (mostly descriptive) framework is not designed to address.

4. Is This a GFC Story?

Given the magnitude and historical significance of the post-GFC private deleveraging, one could have legitimate reservations as to whether our findings are purely driven by the post-GFC experience. To examine whether there are any differences pre- and post-GFC, we split the deleveraging episodes into cases before and after 2007. Figure 10 shows that our baseline results still hold in general: private deleveraging episodes that took place before the GFC followed the same patterns as typical deleveraging episodes described above. More striking, however, is the observed deleveraging pattern during the post-GFC era, which appears to have started as the typical episode but quickly morphed into a growthless one.

[12] Results are similar when government support is measured by the cumulative change in the CAPB. We favored the estimates above out of concern for the small sample size in the estimates using the CAPB.

Figure 10. "Post-GFC" vs. "Pre-GFC" Deleveraging Episodes

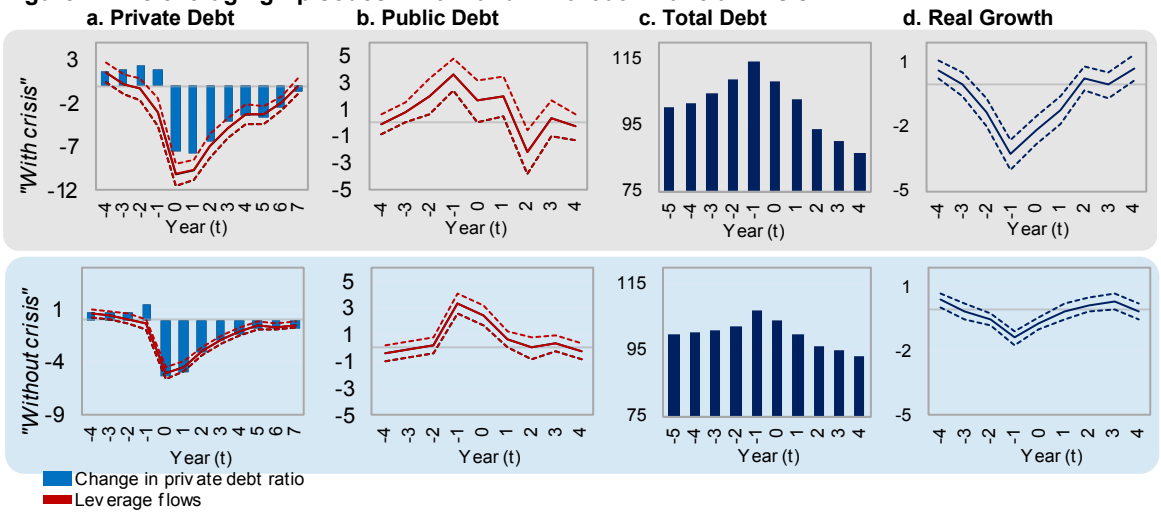


Sources: Global Debt Database; and authors' calculations.
Note: t = 0 refers to the start of deleveraging in the private sector. The dotted line denotes 90 percent confidence interval for each conditional mean.

5. Is This a Crisis Story?

Another relevant question is whether the patterns of deleveraging differ depending on whether a financial crisis takes place as well. We classify as "crisis-related" deleveraging episodes those that start within a centered 5-year window around the occurrence of a financial crisis, as defined in section III. The results are still broadly the same irrespective of whether the deleveraging episode is accompanied by a financial crisis: growth slows down, public debt rises, and total debt eventually comes down, after a temporary increase (Figure

Figure 11. Deleveraging Episodes "With" and "Without Financial Crisis"



Sources: Global Debt Database; and authors' calculations.
Note: t = 0 refers to the start of deleveraging in the private sector. The dotted line denotes 90 percent confidence interval for each conditional mean.

11).

V. TACKLING CAUSALITY

To summarize our findings so far, we have shown that economic activity slows down and public debt rises during private deleveraging episodes. One interpretation of this historical regularity is that excess private debt tends to spill over into the government balance sheet through "indirect bailouts". That is, private debt overhangs force households and firms to deleverage, which then weighs on growth and compels the government to intervene through a countercyclical injection of public money to kick-start the economic recovery. But this is not the only possible explanation. Private debt, public debt, and growth are mutually endogenous. Thus, one could build alternative explanations starting from other ends of the knot—say crowding-out effects from excess public borrowing, or a (non-debt-related) growth shock that triggers a slowdown in private borrowing. To ascertain whether "indirect" bailouts are (at least) part of the story behind these facts, one needs to establish that there is causality running from private deleveraging to public debt and growth.

To make the case, in what follows, we switch to an Inverse Propensity Weighting Regression Adjustment (IPWRA) framework to estimate the causal impact of private deleveraging on growth and public debt, building on Imbens and Wooldridge (2009) and Acemoglu, Restrepo and Robinson (forthcoming). This framework should help address the endogeneity of private debt and give us some comfort that our findings are not exclusively driven by the other potential stories.

Before proceeding further, it is worth mentioning that evidence of causality running from private deleveraging to growth and public debt does not negate the possibility of feedback loops running in the opposite direction. Our burden of proof stops at showing that indirect bailouts are one of the stories behind the trends documented in section IV, not that it is the only story.

A. The IPWRA Method

The IPWRA estimator is designed to deal with endogeneity of treatment. It belongs to the family of "doubly-robust" estimators, in that it simultaneously implements two standard ways of dealing with endogeneity of treatment: Inverse Propensity Weighting (IPW) and Regression Adjustment (RA). By combining both estimators, the IPWRA guards the results from misspecification in one of them (Wooldridge 2007).

To start with, we define private deleveraging as a dichotomous "treatment", $d_{i,t}$, where $d_{i,t} = 1$ signals the start of a private deleveraging episode in country i at time t. In what follows, we consider the latter to be the first year that leverage flows turn negative, echoing findings from the previous section. We define the outcome variable $Y_{i,t}$, alternatively standing for GDP and public debt, and $Y_{i,t}^{s}(d)$ their "potential" values at time $t+s$, depending on whether country i deleveraged or not. Our outcome of interest is $\Delta Y_{i,t}^{s}(d) = Y_{i,t}^{s}(d) - Y_{i,t}$, the potential growth in GDP and public debt s periods after the start of a deleveraging spell.

In this setting, the causal impact of private deleveraging, for each country i, is given by the difference in potential outcomes between the case where country i deleveraged and the case where it did not.

$$\beta_i^S = \Delta Y_{i,t}^S(1) - \Delta Y_{i,t}^S(0) \quad (2)$$

Only one of the above potential outcomes $\Delta Y_{i,t}^S(d)$ is observed, as country i either deleverages or does not. Thus, β_i^S cannot be computed for each country i. However, one can estimate the average treatment effect for the entire sample, β^S, as the difference in means between the treatment and control groups, provided that the treatment is randomly assigned.

$$\beta^S = E\left[\Delta Y_{i,t}^S(1)\right] - E\left[\Delta Y_{i,t}^S(0)\right] \quad (3)$$

But private deleveraging is not randomly assigned in our sample (Tables 1 and 2) and there lies the endogeneity challenge that we set out to address with the IPWRA. Because deleveraging countries differ from those that did not deleverage along various dimensions leading up to a deleveraging spell—what is commonly known as selection bias—a direct comparison of means as in (3) would yield biased estimates. Thus, one needs to account for the way countries self-select into the treatment. The key identification assumption, common to both IPW and RA methods, is that this selection can be modeled as a function of observable country characteristics $(X_{i,t})$. In other words, we assume that conditional on a set of observable drivers, private deleveraging is as good as random (see some supportive evidence of this assumption in section V.2).

$$\Delta Y_{i,t}^S(d) \perp d_{i,t} | X_{i,t} \quad (4)$$

Below, we provide some intuition on how to address the endogeneity of private deleveraging, under "selection-on-observables", using the IPW and RA methods.

1. Inverse Propensity Weighing (IPW)

The IPW method addresses the endogeneity of selection by re-weighing observations in a way that replicates random selection. In a first step, we estimate the probability $\hat{P}_{i,t}$ of going through a deleveraging spell as a function of $X_{i,t}$.

$$P = pr\left(d_{i,t} = 1 \middle| X_{i,t}\right) \quad (5)$$

This helps capture how each country's characteristics affect its odds of deleveraging. The estimated odds are subsequently used to build a counterfactual for deleveraging countries, computed as a weighted average of non-deleveraging countries, building on the weighting scheme of Hirano, Imbens, and Ridder (2003).

$$\widehat{w}_{i,t} = \frac{1}{\hat{E}\left[d_{i,t}\right]}\left(\mathbb{I}\{d_{i,t} = 1\} - \mathbb{I}\{d_{i,t} = 0\}\frac{\widehat{P_{i,t}}}{1 - \widehat{P_{i,t}}}\right) \quad (6)$$

The rationale behind this approach is to give greater weight to non-deleveraging countries that resemble those going through a deleveraging spell. From there, the average treatment effect on the treated units is computed as the difference in means in the reweighted sample:

$$\hat{\beta}^S = \hat{E}\left[\hat{w}_{i,t} \cdot \Delta Y_{i,t}^S\right] \quad (7)$$

For weights, $\hat{w}_{i,t}$, to be computed from (6), one needs to guard against cases where $\widehat{P_{i,t}} = 1$ by postulating the existence of "overlap" or "common support" between treatment and control units.

$$0 < pr\left[d_{i,t} = 1 \middle| X_{i,t}\right] < 1 \quad (8)$$

This is a standard assumption implying that, for any value of $X_{i,t}$, there is a non-zero probability to observe both deleveraging and non-deleveraging observations.

2. Regression Adjustment (RA)

Unlike IPW which approaches the endogeneity of selection through modeling of the treatment (private deleveraging), the RA method approaches it through modeling of the outcomes (growth and public debt). Its basic structure can be summarized as follows:

$$\Delta Y_{i,t}^S(d) = \pi_d^S X_{i,t} + \varepsilon_{i,t}^d \quad (9)$$

$$E\left[\varepsilon_{i,t}^d | X_{i,t}, d_{i,t}\right] = 0 \quad (10)$$

where the second equality follows from the selection-on-observables assumption in (4). Knowledge of π_d^S in this setting is sufficient to compute the counterfactual outcomes, $\Delta Y_{i,t}^S(d)$, for both the treatment and control groups. Below we estimate the latter through separate linear regressions in both groups, in line with Kline (2011). The average impact of the treatment then follows as:

$$\hat{\beta}^S = \hat{E}\left[X_{i,t}\hat{\pi}_1^s - X_{i,t}\hat{\pi}_0^s\right] \quad (11)$$

Imbens and Wooldridge (2009) show that $\hat{\beta}^S$ can be recast as:

$$\hat{\beta}^S = \overline{\Delta Y^S(1)} - \overline{\Delta Y^S(0)} - \left(\frac{N_0}{N_0 + N_1} \cdot \hat{\pi}_1^S + \frac{N_1}{N_0 + N_1} \cdot \hat{\pi}_0^S\right)' (\overline{X_1} - \overline{X_0}) \quad (12)$$

where overlines denote sample averages and N_d stands for the sample size in each group. This representation shows that the RA estimator simply subtracts from the difference in mean outcomes, $\overline{\Delta Y^S(1)} - \overline{\Delta Y^S(0)}$, the difference in the means of country characteristics, $\overline{X_1} - \overline{X_0}$, evaluated at (the weighted average of) their estimated marginal impacts ($\hat{\pi}_1^S$, $\hat{\pi}_0^S$). Hence, the RA estimator is simply yet another way of accounting for differences in country characteristics across treatment status.

3. Putting It Together

The IPWRA estimator simultaneously implements both methods described above. We first estimate the probability of deleveraging, compute weights $\widehat{w}_{i,t}$ in line with (6), and reweight the sample using the latter. Next, we estimate linear regressions of $\Delta Y_{i,t}^{S}$ on covariates $X_{i,t}$ for both the re-weighed treatment and control groups in line with (8). The causal impact of private deleveraging is then computed as:

$$\hat{\beta}^{S} = \hat{E}[X_{i,t}\hat{\pi}_1^{s} - X_{i,t}\hat{\pi}_0^{s}] \cdot \widehat{w}_{i,t} \quad (12)$$

B. Estimating the Causal Impact of Private Deleveraging

1. Model Selection

As laid out above, the IPWRA estimator will go as far as our empirical models of growth, public debt, and private deleveraging go. We take, therefore, particular care in the choice of empirical specifications. For each model, we start from a large pool of tested determinants in the literature, aiming to be as inclusive as possible, and follow an iterative procedure, where we drop non-significant determinants, one at the time, starting from the longest lag. We then settle on the specification with the best predictive power, based on the Akaike and Bayesian Information Criteria (AIC & BIC). For growth, our starting pool of determinants includes: (i) lagged GDP per capita and lagged GDP growth to account for convergence and hysteresis in growth dynamics (Barro and Sala-i-Martin 1992), (ii) the quality of institutions proxied by the ICRG's Law and Order index (Acemoglu, Restrepo and Robinson 2001), (iii) trade openness proxied by the sum of imports and exports as a share of GDP (Frankel and Romer 1999), (iv) inflation (Fischer 1983), (vi) government spending, (Barro 1990) and (v) both stocks and 3-year cumulative growths in private and public debt as a share of GDP (Chudik and others 2017; and Mian, Sufi, and Verner 2017).[13]

For public debt, our list of covariates includes: (i) lagged GDP growth and GDP per capita (ii) the elderly (65+) dependency ratio to capture ageing-related pressures (Jensen and Nielsen 1996), (iii) the effective interest rate paid on public debt, (iv) inflation (Reinhart and Sbrancia 2015), (v) an index of political fractionalization from the Polity IV database (Crivelli and others 2016), (vi) the quality of institutions (Woodward 1947) (vii) a dummy capturing the occurrence of a crisis in the last 5 years, (viii) the annual rate of exchange rate depreciation (Céspedes, Chang, and Velasco 2004), and (x) lagged levels in private and public debts (Reinhart and Rogoff 2009b).

Finally, the existing literature is relatively thin in what relates to the determinants of private deleveraging Therefore, our empirical model of private deleveraging is inspired by findings from Section III and the emerging literature on drivers of private debt (Schularick and Taylor 2012; Chen and others 2015). It includes: (i) lagged GDP growth, (ii) lagged private and

[13] Results are qualitatively similar when we control for terms of trade and human capital, proxied by the secondary school enrollment rate, although the sample size markedly shrinks.

public debts as a share of GDP, (iii) lagged 3-year cumulative growth in private debt, (iii) private interest rates, (iv) GDP per capita, (v) global liquidity conditions proxied by the US Treasury 10-year bond yields, (vi) the quality of institutions, and (vii) a dummy capturing the occurrence of a crisis in the last 5 years. We also consider housing and stock prices, for a restricted sample of 16 advanced countries where the data are available from Jordà, Schularick and Taylor (2017).

Tables 4 reports our estimates on the determinants of private deleveraging both for the full sample and separately for each income group. In each case, we start from extended specifications and gradually converge to the ones that offer the best fit, based on the AICs/BICs, as described above. In each model, we see to the inclusion of sufficiently large lags of the outcome variables to ensure that any reverse causality from growth/public debt to private deleveraging is fully accounted for (Acemoglu Restrepo and Robinson forthcoming). The results suggest that lagged GDP growth, lagged public debt, interest rates, and the lagged 3-year cumulative growth in private debt are among the most consistent drivers of private deleveraging. Housing and stock prices, and the previous occurrence of a financial crisis also seem to matter, for the sample for which data are available.[14] Estimated parameters bear the expected signs and are broadly stable across specifications.

To gauge the predictive accuracy of our different models of private deleveraging, we use the Area Under the Receiver Operating Characteristics Curve (AUROC), a standard tool for judging the predictive power of binary models. Intuitively, the AUROC assesses the accuracy of binary models against the alternative of a coin toss (the 45° line in Annex 4, Figure A.2.3). A perfectly accurate model would display an AUROC of 1, while one with no predictive power over a coin toss would show an AUROC of 0.5. Although there is no established threshold for this statistic, an AUROC close to 0.7 is generally considered to be adequate (Schularick and Taylor 2012). Our models consistently beat this standard, with AUROCs above 0.7 for most of the specifications. [15] This gives us some assurances that our deleveraging model fits the data reasonably well and that most empirically meaningful drivers of private deleveraging are captured.

Annex 5 (Tables A.4.1 and A.4.2) reports our modeling of growth and public debt, following the same approach as above. The estimated parameters are also broadly stable and consistent with expectations across specifications. The quality of institutions, cumulative growth in private debt, and past growth performances appear to be among the most consistent predictors of GDP growth. For public debt, growth trends, inflation, the degree of political

[14] Data on financial crises is not available for our LIC sample. We have also tried a specification that controls for the occurrence of crises in our "full sample" (which would effectively include only EMEs and AEs) and the results are qualitatively similar.

[15] We have also tried specifications that include both country and time-fixed effects, which improve the predictive power of our models, especially for LICs where ROCs rise well above 0.7 in those specifications. However, this makes the GMM function underlying the IPWRA estimator unstable and the model converges in only about half of the specifications, due to the implied very large number of parameters.

fractionalization, and lagged levels of public debt seem to be among the most stable predictors.

2. Validation Tests

Before proceeding to the results of IPWRA estimates, we need to ascertain support for our two identification assumptions discussed above. First, we follow Acemoglu Restrepo and Robinson (forthcoming) and Suarez-Serrato and Wingender (2016) in checking whether "selection on observables" is an adequate working assumption, by ensuring that the IPWRA model successfully re-weight past growth and public debt observations in a way that makes them orthogonal to private deleveraging. Annex 4 reports the results of panel estimates, first, without the IPWRA specification (Table A.4.3, columns 1, 3, 6, and 8). It shows that the occurrence of private deleveraging is significantly correlated with past growth and public debt, confirming the selection bias. However, the latter correlation reassuringly disappears once we apply the IPWRA correction, including for longer (4^{th} and 5^{th}) lags, giving us comfort that our model successfully addresses the selection bias.

Table 4. Determinants of Private Deleveraging

	Full Sample		Advanced Economies			Emerging Market Economies		Low-Income Developing Countries	
	X.1	X.2	X.3	X.4	X.5	X.6	X.7	X.8	X.9
Real GDP growth									
1st lag	**-3.968*** **	**-4.067*** **	**-10.35*** **	**-10.61*** **	**-7.532** **	**-4.548** **	**-4.911*** **	**-2.100** **	**-2.002***
	(1.019)	(1.008)	(2.801)	(2.590)	(3.351)	(1.900)	(1.720)	(1.051)	(1.042)
2nd lag	**2.444*** **	**1.999** **	4.729	4.204		**4.766*** **	**3.789*** **	1.216	
	(0.868)	(0.781)	(3.007)	(2.730)		(1.392)	(1.282)	(1.132)	
3rd lag	-1.204		-1.383			-1.560		-1.277	
	(0.741)		(2.241)			(1.465)		(1.021)	
Log Public debt ratio									
1st lag	0.267	0.251	**1.591** **	**1.521** **	**0.317*** **	**1.024** **	**0.945** **	-0.0396	-0.0281
	(0.229)	(0.223)	(0.680)	(0.646)	(0.0986)	(0.508)	(0.462)	(0.225)	(0.225)
2nd lag	-0.0878	-0.104	-1.398	**-1.240** **		-0.656	**-0.992** **	0.106	0.0631
	(0.310)	(0.308)	(1.147)	(0.623)		(0.843)	(0.456)	(0.319)	(0.317)
3rd lag	-0.155	-0.115	0.0720			-0.437		-0.0249	0.0119
	(0.230)	(0.228)	(0.809)			(0.595)		(0.197)	(0.194)
Log GDP per capita (lag)	**-0.118*** **	**-0.116*** **	0.100			0.0176		**-0.113***	**-0.111***
	(0.0438)	(0.0441)	(0.274)			(0.1000)		(0.0671)	(0.0651)
Log Private debt ratio (lag)	**0.0880***	**0.0877***	0.337	**0.392***	**0.977*** **	0.0107		**0.204*** **	**0.199*** **
	(0.0480)	(0.0481)	(0.231)	(0.201)	(0.373)	(0.0967)		(0.0706)	(0.0707)
Log US treasury bond yields (10y, lag)	-0.00373		-0.0236			0.00325		**0.0337** **	**0.0343*** **
	(0.0100)		(0.0370)			(0.0183)		(0.0131)	(0.0132)
Log private eff. interest rate (lag)	**4.007*** **	**3.931*** **	**8.371*** **	**7.234*** **	**10.28*** **	**3.977*** **	**3.797*** **	**2.734*** **	**2.597*** **
	(0.534)	(0.520)	(1.643)	(1.132)	(1.711)	(0.982)	(0.910)	(0.912)	(0.863)
Cum. growth private debt (past 3yrs)	**0.0107*** **	**0.0105*** **	0.00447		0.00937	**0.0158*** **	**0.0154*** **	**0.0235** **	**0.0237** **
	(0.00250)	(0.00245)	(0.00389)	(0.00378)	(0.00691)	(0.00470)	(0.00388)	(0.0103)	(0.0103)
Cum. growth public debt (past 3yrs)	-0.000558	-0.000161	-0.0102	-0.0108		-0.00351	-0.000181		
	(0.00261)	(0.00250)	(0.0102)	(0.00883)		(0.00520)	(0.00363)		
Crisis occurance (past 5yrs)			**0.428*** **	**0.441*** **	**0.480*** **	0.144	0.147		
			(0.143)	(0.146)	(0.166)	(0.104)	(0.114)		
Log Stock price index (lag)					-0.0193				
					(0.0610)				
Log House price index (lag)					-0.246				
					(0.163)				
Constant	**-1.885*** **	**-1.865*** **	**-4.338*** **	**-4.425*** **	**-6.488*** **	**-1.213** **	**-1.184*** **	**-1.768*** **	**-1.770*** **
	(0.488)	(0.247)	(1.113)	(1.097)	(1.373)	(0.613)	(0.268)	(0.300)	(0.306)
Akaike's information criterion (AIC)	2248	2248	566	559	355	573	565	921	920
Bayesian information criterion (BIC)	2322	2310	629	605	392	634	604	977	967
Prob. Hosmer-Lemeshow Chi2 test	0.001	0.184	0.210	0.630	0.795	0.949	0.570	0.077	0.242
Observations	2,231	2,234	708	709	439	557	559	787	788

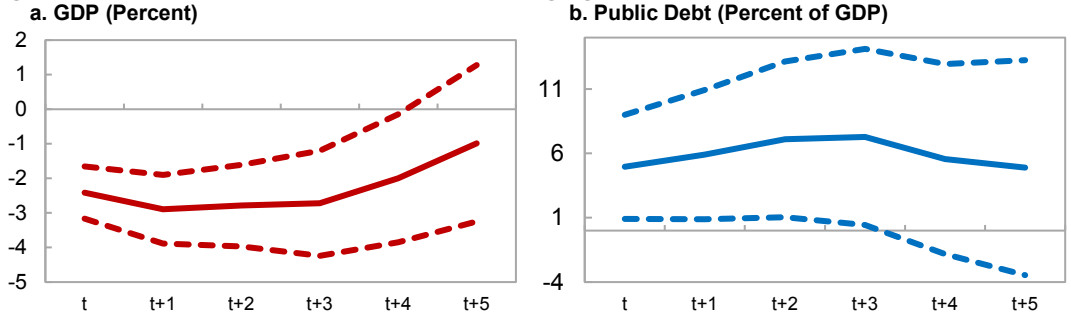
Robust standard errors clustered by countries in parentheses. *, **, *** respectively stands for statistical significance at the 10%, 5%, and 1% threshold.

In Figure A.4.2, we visually inspect the degree of overlap between our treatment and control samples by plotting the distribution of estimated probabilities of deleveraging in both groups for the "full-sample" specification. The results show significant overlap across treatment status.

3. Results

Finally, Figure 12 reports the results of IPWRA estimates for the full sample. It shows the cumulative impact of private deleveraging started in t on GDP and public debt at different horizons over a five-year period. The results give overwhelming support to our "indirect bailout" story. Private deleveraging seems to cause both a slowdown in growth and a rise in public debt. On average, the onset of a private deleveraging spell induces a 7.2 percent of GDP rise in public debt over the following 3 years. The effect subsequently declines in intensity from $t + 4$ onward, eventually becoming statistically insignificant. The size of the estimated effect is slightly larger, than the baseline estimate from event-studies in Section IV (7.2 vs 5.3 percent of GDP).

Figure 12. Cumulative Impact of Private Deleveraging on GDP and Public Debt



Sources: Global Debt Database; and authors' calculations.
Note: The charts show the cumulate impact obtained from IPWRA estimates taking *t-1* as the starting point.

Table 5 offers further extensions of our baseline results—duplicated in column 1 for comparison purposes. Columns 2–5 break down the results across income groups, revealing significant heterogeneity. Although private deleveraging tends to lead to a growth slowdown at all levels of income, "indirect bailouts", in the form of deleveraging-induced rises in public borrowing, seem to become more prevalent only at higher levels of income (and, presumably, financial development). Private deleveraging induces on average up to 9.6 percent of GDP higher public debt in advanced countries; while in emerging markets the impact peaks at 5.7 percent of GDP. In low-income countries, the estimated impact on public borrowing is still positive but fails to meet common significance standards. We observe the same hierarchy in the duration of the estimated impacts. These findings are consistent with the less-countercyclical nature of fiscal policy in emerging markets and low-income countries (Alesina and Tabellini 1990; Kaminsky, Reinhart and Végh, 2005; Talvi and Végh 2005). Finally, we replicate our baseline estimate excluding deleveraging episodes that start within a 5-year window around a financial crisis, in line with our crisis/non-crisis deleveraging

typology in section IV. The results are virtually unchanged (column 6). Private deleveraging still causes a growth slowdown and a rise in public debt.

Table 5. Impact of Private Deleveraging on Growth and Public Debt (IPWRA)

	Full sample	Advanced Economies		Emerging Market Economies	Low-Income Developing Countries	Full sample
	IPWRA	IPWRA	IPWRA (incl. housig and stock prices)	IPWRA	IPWRA	IPWRA (excl. crises)
	X.1	X.2	X.3	X.4	X.5	X.6
Cumulative change in GDP						
(t)	**-0.0241*** **	**-0.0160*** **	**-0.0154*** **	**-0.0329*** **	-0.00767	**-0.0227*** **
	(0.00458)	(0.00458)	(0.00443)	(0.00636)	(0.00481)	(0.00443)
(t+1)	**-0.0289*** **	**-0.0157** **	**-0.0165*** **	**-0.0403*** **	**-0.0146***	**-0.0303*** **
	(0.00604)	(0.00710)	(0.00639)	(0.00843)	(0.00817)	(0.00593)
(t+2)	**-0.0279*** **	**-0.0178***	**-0.0150***	**-0.0381*** **	**-0.0194***	**-0.0283*** **
	(0.00717)	(0.00926)	(0.00807)	(0.0104)	(0.0109)	(0.00718)
(t+3)	**-0.0272*** **	-0.0152	-0.00922	**-0.0402*** **	**-0.0241***	**-0.0237** **
	(0.00925)	(0.0114)	(0.00969)	(0.0136)	(0.0137)	(0.00968)
(t+4)	**-0.0200***	-0.00610	0.00316	**-0.0341** **	**-0.0347** **	-0.0133
	(0.0112)	(0.0140)	(0.0109)	(0.0165)	(0.0170)	(0.0118)
(t+5)	**-0.00987**	-0.000992	0.00872	-0.0240	**-0.0451** **	-0.00238
	(0.0138)	(0.0162)	(0.0123)	(0.0213)	(0.0207)	(0.0151)
Cumulative change in public debt						
(t)	**0.0495** **	**0.0630*** **	**0.0730** **	**0.0560** **	0.0226	**0.0609*** **
	(0.0246)	(0.0226)	(0.0336)	(0.0261)	(0.0191)	(0.0191)
(t+1)	**0.0591***	**0.0962** **	**0.141** **	**0.0576***	0.0429	**0.0702*** **
	(0.0305)	(0.0424)	(0.0709)	(0.0325)	(0.0275)	(0.0225)
(t+2)	**0.0709***	**0.141** **	**0.240** **	0.0393	0.0355	**0.0773*** **
	(0.0368)	(0.0645)	(0.116)	(0.0425)	(0.0361)	(0.0291)
(t+3)	**0.0728***	**0.160** **	**0.285** **	0.0145	0.0440	**0.0824** **
	(0.0416)	(0.0751)	(0.136)	(0.0571)	(0.0423)	(0.0374)
(t+4)	**0.0555**	0.128	0.248*	0.0132	0.0606	0.0520
	(0.0449)	(0.0805)	(0.146)	(0.0637)	(0.0480)	(0.0406)
(t+5)	0.0489	0.103	0.225	0.00875	0.0523	0.0360
	(0.0508)	(0.0904)	(0.155)	(0.0742)	(0.0581)	(0.0467)

Each reported coefficient corresponds to the estimated impact of private deleveraging starting in t on GDP and public debt over different horizons. Robust standard errors clustered by countries are reported in parentheses. *, **, *** respectively stand for statistical significance at the 10%, 5%, and 1% threshold.

VI. CONCLUDING REMARKS

Of the many unpleasant truths that were laid bare by the GFC, the realization that private debts may ultimately become public was by no means a surprise. Academics have long warned of the dangers of excessive private debt and potential spillovers to the public-sector balance sheet (Englund 1999; Claessens, Klingebiel, Laeven 2001; Hoggarth, Reis, and Saporta 2002; Honohan and Klingebiel 2003; and Eschenbach and Schuknecht 2004). However, the existing evidence and policy debate have so far revolved around financial crises and the associated costs of bank bailouts. We showed in this paper that excess private debt tends to spill over into the public-sector balance sheet regardless of whether the leverage cycle resulted in a crisis or a more orderly deleveraging process. Moreover, our findings show that differences in growth dynamics during deleveraging episodes make a world of difference in deleveraging outcomes. When growth grinds close to a halt during deleveraging spells, countries tend to end up with more (total) debt than at the beginning of the private deleveraging process.

These findings invite many interpretations and even more questions. A first (rather provocative) interpretation is that we are all implicitly guaranteeing our neighbors' mortgages and corporate liabilities. In other words, by issuing new debt on behalf of all taxpayers, the government provides a form of "implicit guarantee" to the debt liabilities of households and firms. Second, our findings (intently) do not address the crucial issue of whether the "indirect bailouts" documented in this paper are optimal from a welfare perspective. This question deserves a formal analysis that goes beyond the scope of this paper. But regardless of the answer, it is clear that moral hazard—one of the main arguments against bailouts—is less prevalent precisely due to the "indirect" nature of these bailouts. Indeed, individual borrowers may not necessarily internalize the impact of the government's intervention at the macro-level on their individual balance sheets. Moreover, the large number of borrowers implies that the action of a single individual is not likely to affect the probability of a bailout at the macro-level. Thus, for moral hazard to be significant, one might need some form of coordination between private agents.

Third, our findings highlight the key role of growth dynamics in determining deleveraging outcomes. However, this begs the question of what makes growth strong in some deleveraging episodes and weak in others. Are there certain characteristics of leverage/deleverage cycles that condition growth outcomes? What should be the role of fiscal policy, if any. These are some of the key policy questions the answers of which will bring us closer to the recipe for a successful private sector deleveraging.

Finally, the main policy recommendation that comes out of this paper relates to the need for a more integrated approach to debt sustainability. Our findings suggest that economists and policymakers should move away from looking at private and government debts in silos and pay closer attention to the total stock of debt in the economy, as the line between the two tends to be blurry.

ANNEX 1. DATA: COUNTRY COVERAGE

Advanced Economies	Emerging Market Economies		Low-Income Developing Countries	
Australia	Albania	Kuwait	Afghanistan	Mali
Austria	Algeria	Lebanon	Bangladesh	Mauritania
Belgium	Argentina	Macedonia, FYR	Benin	Micronesia
Canada	Azerbaijan	Malaysia	Bhutan	Moldova
Cyprus	Bahamas	Mauritius	Burkina Faso	Mozambique
Czech Republic	Bahrain	Mexico	Burundi	Myanmar
Denmark	Botswana	Mongolia	Cambodia	Nepal
Estonia	Brazil	Morocco	Cameroon	Nicaragua
Finland	Bulgaria	Oman	Cape Verde	Niger
France	Chile	Pakistan	Central African Republic	Nigeria
Germany	China, Mainland	Paraguay	Chad	Papua New Guinea
Greece	Colombia	Peru	Comoros	Republic of Congo
Hong Kong SAR	Costa Rica	Philippines	Cote D'Ivoire	Rwanda
Iceland	Croatia	Poland	Dem. Rep. of the Congo	Samoa
Ireland	Dominican Republic	Qatar	Djibouti	Sao Tome and Principe
Israel	Ecuador	Romania	Dominica	Senegal
Italy	Egypt	Russian Federation	Eritrea	Sierra Leone
Japan	El Salvador	Saudi Arabia	Ethiopia	Solomon Islands
Latvia	Georgia	Serbia	Gambia	South Sudan
Lithuania	Guatemala	South Africa	Ghana	St. Lucia
Luxembourg	Hungary	Sri Lanka	Grenada	St. Vincent and Grenadines
Malta	India	Thailand	Guinea	Sudan
Netherlands	Indonesia	Trinidad & Tobago	Guinea-Bissau	Tajikistan
New Zealand	Iran	Turkey	Guyana	Tanzania
Norway	Iraq	Ukraine	Haiti	Timor Leste
Portugal	Jamaica	United Arab Emirates	Honduras	Togo
Republic of Korea	Jordan	Uruguay	Kenya	Tonga
Singapore	Kazakhstan	Venezuela	Kyrgyz Republic	Uganda
Slovak Republic			Laos	Vanuatu
Slovenia			Lesotho	Vietnam
Spain			Liberia	Yemen
Sweden			Madagascar	Zambia
Switzerland			Malawi	Zimbabwe
United Kingdom			Maldives	
United States				

ANNEX 2. PRIVATE DEBT AND LEVERAGE FLOWS

Understanding changes in the debt-to-GDP ratio is fraught with difficulties. The same increase in private debt-to-GDP can be the result of a credit boom (take for example the United States in 2006–07) or a severe recession (Japan in 2008–09). The main challenge is to tell apart changes that come from debt and those caused by GDP. Another, more profound, relates to the economics of discriminating between the myriad of factors that could be behind an observed change in the debt ratio, from interest rates and borrowing flows to exchange rates and growth. In this annex, we discuss our approach to addressing these challenges, which is based on the decomposition of changes in the private debt ratio into "leverage flows" and "macro-related changes".

Our starting point is the recursive equation behind changes in the debt-to-GDP ratio—see Escolano (2010) for a detailed discussion:

$$d_t = \left(\frac{1+r}{1+g}\right) d_{t-1} - p_t + SFA_t \quad (1)$$

where d_t is debt-to-GDP at time t; r is the nominal interest rate paid on outstanding debt; g is the nominal GDP growth rate; p_t is the primary balance as a ratio to GDP; and SFA stands for all residual sources of changes in debt between $t-1$ and t, commonly referred to as stock-flow adjustment. The latter typically reflect one-off factors such as exchange rate fluctuations, valuation changes, and debt restructurings.

Equation (1) is usually derived and used in the context of public debt analysis but the underlying law of motion also applies to private debt. In this context, r stands for the aggregate interest rate paid by households and nonfinancial corporates towards their outstanding debt liabilities, and p_t is the conceptual equivalent of the government's primary balance, i.e., households and nonfinancial corporates' net borrowing/lending (excluding interest payments) from national accounts.

Rearranging (1):

$$d_t - d_{t-1} = \underbrace{\left(\frac{r-g}{1+g}\right) d_{t-1}}_{\text{Macro-related change}} \underbrace{- p_t + SFA_t}_{\text{Leverage flows}} \quad (2)$$

Equation (2) shows that annual changes in the private debt ratio can be broken down into three components: (i) the balance between the push-and-pull effects from the interest rate and growth; (ii) net private sector borrowing (excluding interest payments); and (iii) some residual valuation changes. Net private borrowing is the closest reflection of the actual behavior of the private sector. Indeed, while growth and interest rates could certainly be affected by private borrowing trends, they are influenced by a sundry of other political, conjunctural, and structural factors, which makes them a closer reflection of the underlying macroeconomic environment. However, this decomposition is only possible for a limited

number of countries, in most cases from the 1990s-onward, due to the lack of data on net borrowing by the private sector. Thus, we resorted to lumping together p and SFA into "leverage flows". While by no means perfect, this decomposition helps us better track underlying trends in private sector borrowing compared to the alternative of only focusing on the private debt ratio. Moreover, it helps address some of the challenges discussed above, by isolating the impact of GDP growth and the interest rates, which tend to blur the interpretation of short term fluctuations in the private debt ratio.

To better understand the economic meaning of these "leverage flows", consider:

$$\text{LF} = \text{Leverage flows} = p_t + SFA_t$$

From (3):

$$\text{LF} = d_t - d_{t-1} - \left(\frac{r-g}{1+g}\right) d_{t-1} \quad (4)$$

$$= \frac{D_t}{Y_t} - \frac{D_{t-1}}{Y_{t-1}} - \left(\frac{r-g}{1+g}\right)\frac{D_{t-1}}{Y_{t-1}} \quad (5)$$

where D_t and Y_t are respectively the nominal stock of private debt and nominal GDP at the end of time t.

Substituting $Y_{t-1} = \frac{Y_t}{(1+g)}$ and rearranging:

$$\text{LF} = \frac{(D_t - D_{t-1)} - rD_{t-1}}{Y_t} \quad (6)$$

Equation 6 shows that leverage flows are equal to the excess growth in nominal private debt relative to the debt service, expressed as a share of GDP. They turn negative when:

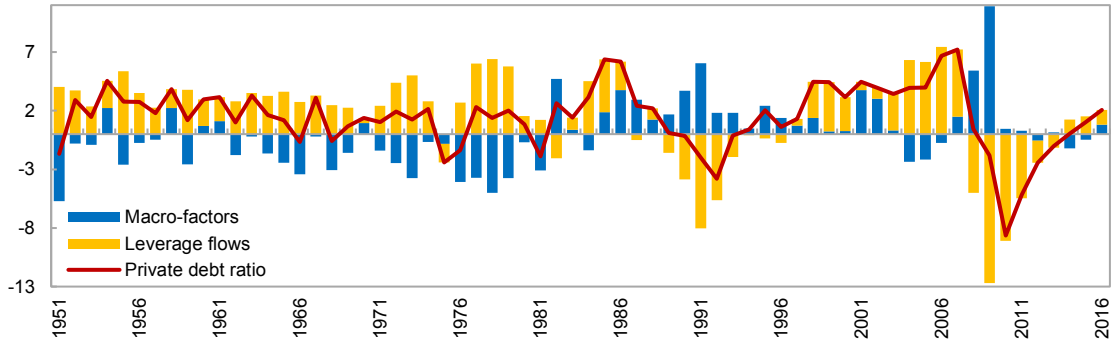
$$\frac{D_t - D_{t-1}}{D_{t-1}} < r \ (7),$$

that is, whenever private debt grows at a slower pace than the interest rate, and vice versa. In other words, leverage flows are negative (positive) when new debt issuances are lower (higher) than what is needed to just service the existing stock of debt. Negative leverage flows, thus, reflect cases of *net debt repayments*, once the cost of the debt service is accounted for, which could be considered a form of deleveraging.

In what follows, we discuss two country examples (the United States and China) that illustrates the merits of the decomposition discussed above. Data on nominal GDP growth are drawn from the World Economic Outlook database. Effective interest rates for the private sector –i.e., interest payments over outstanding debt– are calculated using data on HHs and NFCs' interest payments from national accounts. The latter are proxied by bank lending rates to the private sector from the International Financial Statistics in those instances where national account data are missing.

Starting with the United States, several observations jump out. First, in the overwhelming majority of cases, leverage flows reassuringly follow changes in the debt ratio. In 54 out of the last 66 years in U.S. history, the private debt ratio moved in tandem with leverage flows (Figure A.2.1). But the more interesting observations relate to cases where the private debt ratio and leverage flows move in opposite directions. And here we have two types of divergence. In the first type, the debt ratio is pointing to a private sector deleveraging while leverage flows are positive, suggesting that the private sector is still borrowing in net terms. This occurred repeatedly during the "golden age" (1951, 1966, 1968) and during the rebound in 1976.[16] In all these cases, the debt ratio declined, not because the private sector was "deleveraging", but because of the highly favorable macroeconomic environment, characterized by high growth rates and low interest rates (i.e., a negative interest rate-growth differential).

Figure A.2.1. Private Debt and Leverage Flows in the United States
(Annual change; Percent of GDP)



Sources: Global Debt Database; and authors' calculations.

In the second type of divergence, the debt ratio increased while leverage flows were negative, suggesting the private sector was making efforts to deleverage. This happened mostly during recessions/crises, in 1982, 1987, 1989, 1994–96, and 2008. In this case, the debt ratio increased even when the private sector was not leveraging. Just the opposite, households and nonfinancial corporates were repaying debt in net terms. The debt ratio increased as a result of the ongoing recessions, combined with tighter borrowing conditions.

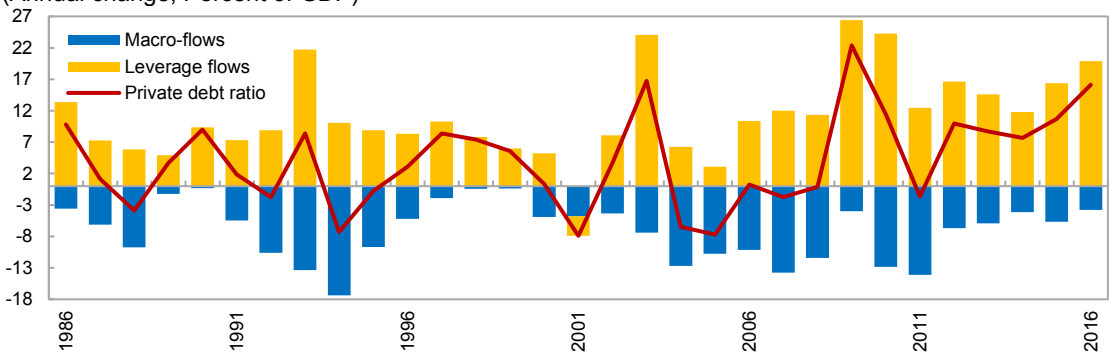
The story of China is one of continuously positive leverage flows over the last two decades, except for a brief period in 2001 (Figure A.2.2). Yet, the private debt ratio has repeatedly declined, in 1988, 1994–95, 2004–05, 2007–08, and 2011. Like the "golden age" era in the United States, the latter episodes do not reflect "true" private deleveraging, but rather the extremely favorable macro-environment, characterized by double digit growth rates (or close) in all the aforementioned years.

The two cases discussed above highlight the challenges of interpreting prima facia changes in the private debt ratio and illustrate the benefits of the decomposition discussed above. The reassuring thing is that leverage flows follow the debt ratio most of the time. But in "abnormal

[16] There was also one episode of declining debt ratio while leverage flows were positive in 1981, but the drivers were different from the previous episodes, in that the nominal GDP expansion was mostly fueled by inflation. Real growth was modest at 2% and interest rate conditions were tightening.

times", such as crises, recessions, and high growth episodes, it pays to look more closely at the underlying drivers of private debt.

Figure A.2.2. Private Debt and Leverage Flows in China
(Annual change; Percent of GDP)

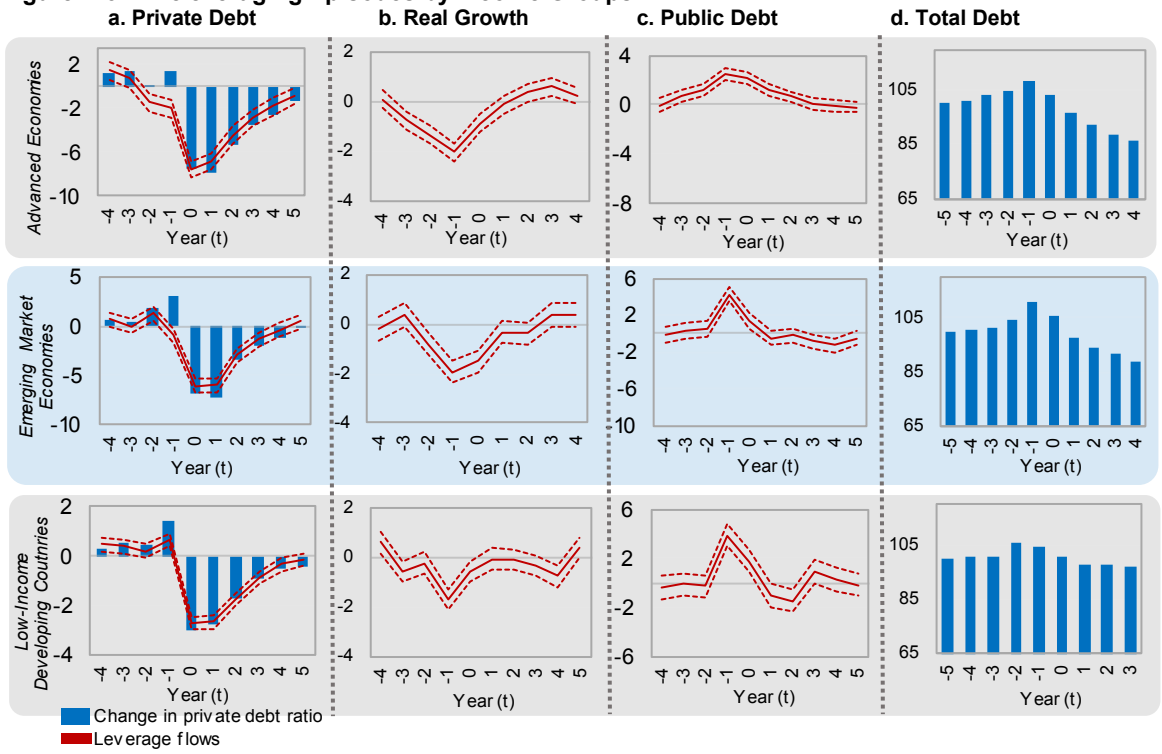


Sources: Global Debt Database; and authors' calculations.

ANNEX 3. DELEVERAGING EPISODES BY INCOME GROUPS

In this Annex, we report the baseline estimates on the dynamics of private deleveraging for advanced, emerging market, and low-income countries separately. Overall, results are broadly consistent across the three income groups but with some small differences (Figure A.3.1). In particular, public debt grows faster-than-normal during private deleveraging episodes in all country groups, but the increase is more gradual and prolonged in advanced economies. Also, activity slows down in the lead up to the deleveraging episode across the board, but the slowdown is markedly milder and shorter in low-income countries. Consistent with this result, leverage flows in low-income countries do not seem to contract ahead of the private debt ratio.

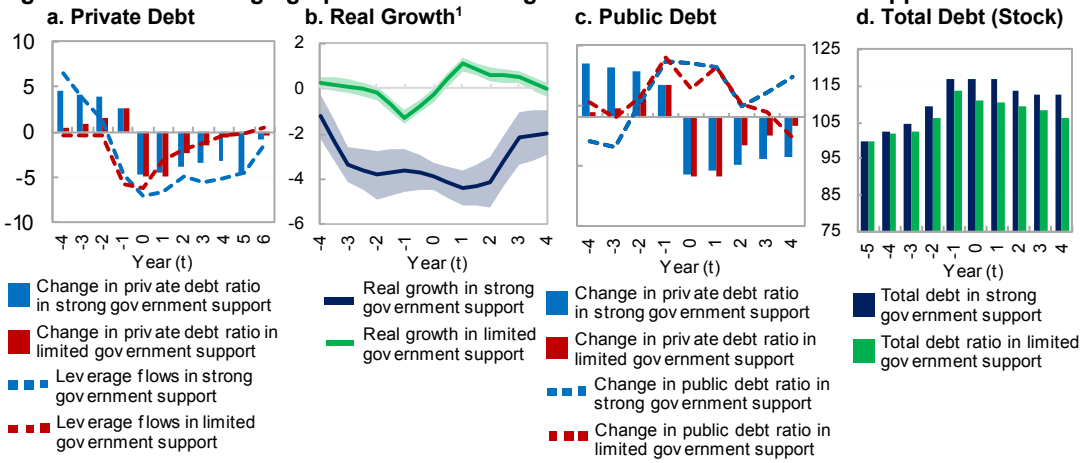
Figure A.3.1. Deleveraging Episodes by Income Groups



Sources: Global Debt Database and author's calculations.
Note: t = 0 refers to the start of deleveraging in the private sector. The dotted line denotes 90 percent confidence interval for each conditional mean.

ANNEX 4. ADDITIONAL FIGURES AND TABLES

Figure A.4.1. Deleveraging Episodes in "Strong" vs. "Limited" Government Support Cases



Sources: Global Debt Database; and authors' calculations.
Note: t = 0 refers to the start of deleveraging in the private sector.
[1] The shaded area denotes 90 percent confidence interval for each conditional mean.

Figure A.4.2. Distribution of Estimated Propensity Scores

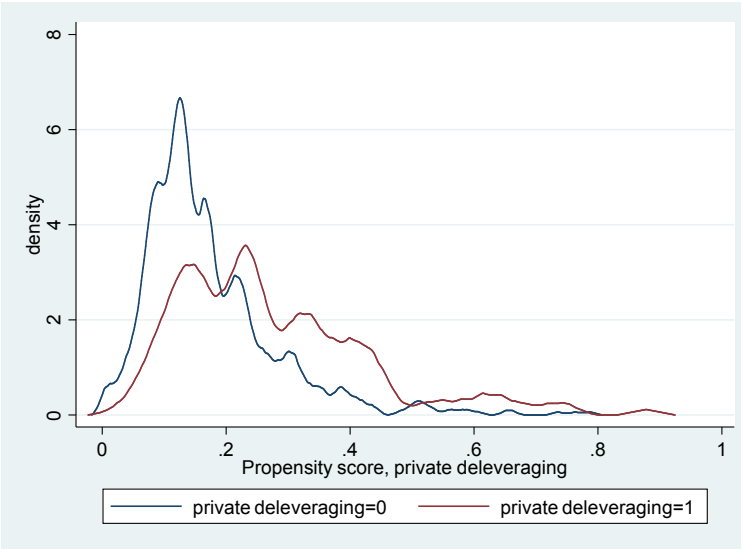
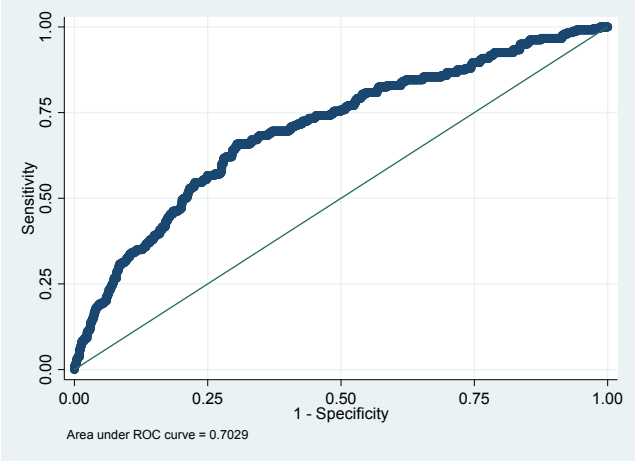
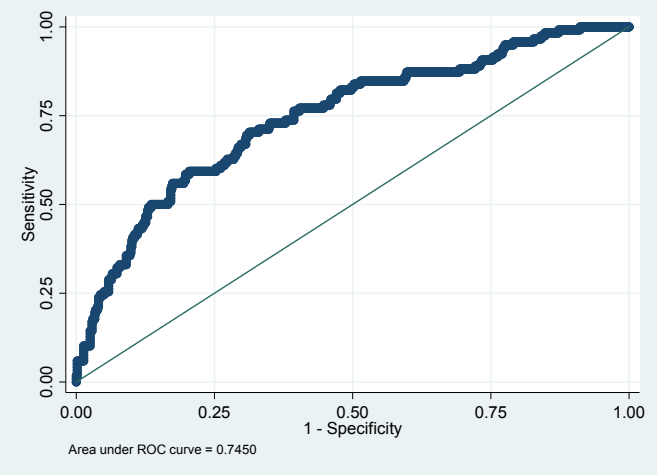


Figure A.4.3. Area under the Receiver Operating Characteristics Curve

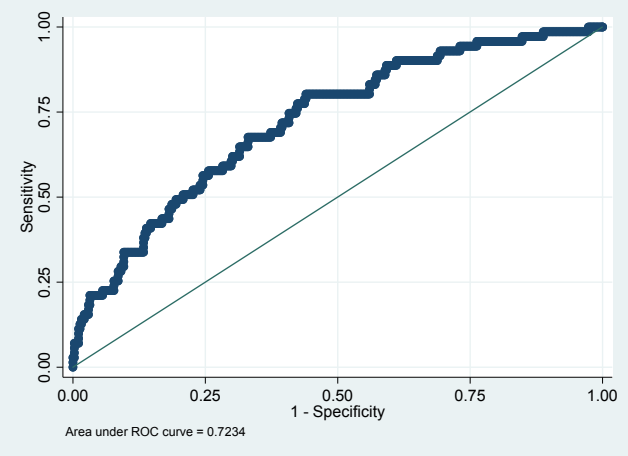
a. Full sample



b. Advanced economies



c. EMEs



d. LICs

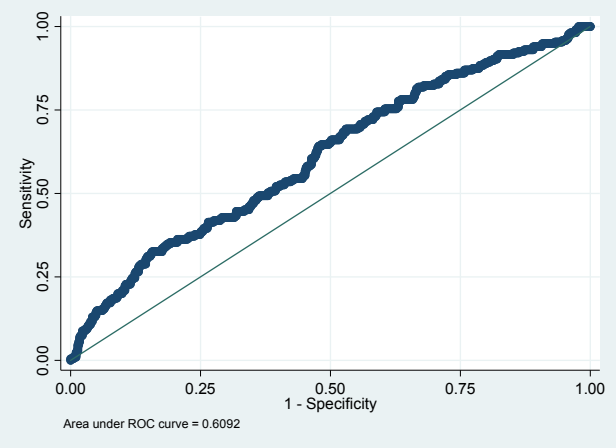


Table A.4.1. Public Debt Determinants

	Full Sample		Advanced Economies		Emerging Market Economies		Low-Income Developing Countries	
	X.1	X.2	X.3	X.4	X.5	X.6	X.7	X.8
Real GDP growth								
1st lag	**-0.627*** **	**-0.405*** **	**-0.499** **	**-0.468***	**-0.810*** **	**-0.584*** **	-0.143	**-0.212***
	(0.165)	(0.0989)	(0.244)	(0.233)	(0.297)	(0.160)	(0.200)	(0.116)
2nd lag	-0.0282	-0.0859	**0.599*** **	**0.546** **	-0.130		-0.172	-0.170
	(0.172)	(0.0932)	(0.213)	(0.210)	(0.213)		(0.287)	(0.109)
3rd lag	**-0.370***	-0.136	-0.284	-0.302	-0.304		**-0.574** **	-0.148
	(0.190)	(0.0833)	(0.187)	(0.194)	(0.339)		(0.263)	(0.117)
Log Public debt ratio								
1st lag	**0.197*** **	**0.187*** **	**0.443*** **	**0.453*** **	0.178	**0.200*** **	0.0716	0.0666
	(0.0500)	(0.0357)	(0.0877)	(0.0861)	(0.114)	(0.0599)	(0.0748)	(0.0524)
2nd lag	**-0.309*** **	**-0.245*** **	**-0.570*** **	**-0.595*** **	-0.165	**-0.263*** **	**-0.302*** **	**-0.152*** **
	(0.0749)	(0.0330)	(0.149)	(0.143)	(0.162)	(0.0544)	(0.0930)	(0.0466)
3rd lag	0.0510		0.0979	0.112	-0.0730		0.126	
	(0.0697)		(0.0697)	(0.0677)	(0.0668)		(0.122)	
Log GDP per capita (lag)	0.00147		0.00220		0.00318		0.0214	
	(0.00921)		(0.0214)		(0.0127)		(0.0234)	
Log Quality of institutions (lag)	-0.0125		**-0.0685*** **	**-0.0649*** **	-0.00734		0.0133	
	(0.0129)		(0.0235)	(0.0229)	(0.0243)		(0.0310)	
CPI inflation (lag)	-0.000653	-0.000308	**0.00630***	**0.00655** **	-0.000860	-0.000746	-0.00182	**-0.00146***
	(0.000969)	(0.000496)	(0.00313)	(0.00296)	(0.00147)	(0.000744)	(0.00167)	(0.000839)
Log Elderly dependency ratio (lag)	-0.0151		**0.0631***	**0.0611***	0.00342		**-0.0764** **	
	(0.0136)		(0.0338)	(0.0333)	(0.0179)		(0.0311)	
Log Political fractionalization (lag)	**-0.00217***	0.000759	**-0.0293*** **	**-0.0304*** **	**-0.0292** **	**-0.0245** **	-0.000814	**-0.00174***
	(0.00112)	(0.00208)	(0.00782)	(0.00649)	(0.0131)	(0.0107)	(0.000848)	(0.00102)
Log Years to elections (lag)	0.00222		**-0.0163***	**-0.0169***	-0.00295		0.0223	
	(0.00873)		(0.00919)	(0.00866)	(0.0140)		(0.0208)	
Log Interest rate on public debt (la	-0.00894		-0.000322		-0.0349	-0.00974	0.00106	
	(0.00794)		(0.00673)		(0.0222)	(0.0105)	(0.0192)	
Log Private debt ratio (lag)	0.0137		**0.0383*** **	**0.0396*** **	0.0221		0.0131	
	(0.00902)		(0.0138)	(0.0127)	(0.0207)		(0.0136)	
Exchange rate depreciation (lag)	**0.144*** **	**0.114*** **	0.0359		**0.194** **	**0.112***	**0.299** **	**0.249*** **
	(0.0474)	(0.0324)	(0.0408)		(0.0866)	(0.0607)	(0.131)	(0.0628)
Constant	**0.242*** **	**0.265*** **	-0.136	-0.136	0.0937	**0.238*** **	**0.463*** **	**0.370*** **
	(0.0593)	(0.0296)	(0.168)	(0.159)	(0.115)	(0.0488)	(0.125)	(0.0528)
Akaike's information criterion (AIC)	-938	-2178	-1027	-1086	-3132	-4060	-1801	-2752
Bayesian information criterion (BIC)	-850	-2121	-954	-1026	-3056	-4009	-1733	-2720
R-squared	0.235	0.212	0.269	0.269	0.262	0.226	0.264	0.220
Observations	1,792	4,022	680	703	688	1,537	424	1,191

Robust standard errors clustered by countries in parentheses. *, **, *** respectively stands for statistical significance at the 10%, 5%, and 1% threshold.

Table A.4.2. Growth Determinants

	Full Sample		Advanced Economies		Emerging Market Economies		Low-Income Developing Countries	
	X.1	X.2	X.3	X.4	X.5	X.6	X.7	X.8
Real GDP growth								
1st lag	**0.400*** **	**0.371*** **	**0.417*** **	**0.435*** **	**0.342*** **	**0.368*** **	**0.209** **	**0.264*** **
	(0.0445)	(0.0410)	(0.0748)	(0.0706)	(0.0559)	(0.0526)	(0.0988)	(0.0694)
2nd lag	0.0308	0.0575	**-0.130** **	**-0.174*** **	0.0921	0.0384	0.0499	0.0941
	(0.0452)	(0.0411)	(0.0532)	(0.0431)	(0.0629)	(0.0426)	(0.0617)	(0.0558)
3rd lag	**0.0785*** **		**0.0913*** **	**0.144*** **	0.0619	**0.0792*** **	0.0447	
	(0.0269)		(0.0300)	(0.0293)	(0.0389)	(0.0281)	(0.0501)	
Log Public debt ratio								
1st lag	0.00129		-0.0170		0.00111	**0.00350*** **	-0.00704	
	(0.00701)		(0.0183)		(0.0113)	(0.00130)	(0.00621)	
2nd lag	0.00323		**0.0562***		0.00961		-0.0105	
	(0.0115)		(0.0296)		(0.0187)		(0.00940)	
3rd lag	-0.00492		**-0.0394** **		-0.00648		0.0109	
	(0.00718)		(0.0148)		(0.0116)		(0.00729)	
Log GDP per capita (lag)	-0.00484		**-0.0179*** **	**-0.0184*** **	0.000608		-0.00797	**-0.00904** **
	(0.00316)		(0.00435)	(0.00369)	(0.00514)		(0.00528)	(0.00432)
Log quality of institutions (lag)	**0.00996*** **	**0.00724*** **	0.0106	**0.0142** **	**0.0117*** **	**0.00972*** **	**0.0130** **	**0.0132*** **
	(0.00257)	(0.00241)	(0.00832)	(0.00638)	(0.00325)	(0.00353)	(0.00527)	(0.00404)
Log trade openess (10y, lag)	-5.50e-06		-0.000673		-0.000241		0.000673	
	(0.000329)		(0.00116)		(0.000391)		(0.00104)	
CPI inflation (lag)	**-0.000276***	**-0.000346*** **	**-0.00180** **	**-0.00184*** **	**-0.000351***	**-0.000430** **	0.00	
	(0.000150)	(0.000124)	(0.000692)	(0.000599)	(0.000192)	(0.000184)	(0.000330)	
Log government spending (lag)	**-0.00765*** **	**-0.00885*** **	**-0.0172** **	**-0.0189*** **	-0.00690*	**-0.00855*** **	0.00145	
	(0.00270)	(0.00248)	(0.00754)	(0.00327)	(0.00395)	(0.00313)	(0.00773)	
Log secondary edu. enroll. rate (lag)	**0.00737*** **		0.00995		-0.00489			
	(0.00275)		(0.00704)		(0.00505)			
Log Private debt ratio (lag)	**-0.00408***	**-0.00448*** **	**-0.00725** **	**-0.00571** **	-0.00510	**-0.00660** **	-0.00733	
	(0.00236)	(0.00124)	(0.00271)	(0.00273)	(0.00313)	(0.00265)	(0.00513)	
Cum. growth private debt (past 3yrs)	**-0.000223*** **	**-0.000162** **	**-0.000196** **	**-0.000204** **	**-0.000253** **	**-0.000195** **	**0.000830***	**0.000317***
	(6.21e-05)	(6.29e-05)	(7.69e-05)	(8.85e-05)	(9.69e-05)	(7.42e-05)	(0.000469)	(0.000164)
Cum. growth public debt (past 3yrs)	6.39e-05	4.63e-05	**-0.000303***		7.94e-05		0.000132	
	(6.57e-05)	(3.92e-05)	(0.000152)		(9.34e-05)		(9.58e-05)	
Log primary edu. enroll. rate (lag)							0.00394	**0.0105***
							(0.00658)	(0.00534)
Constant	**0.0309*** **	**0.0621*** **	**0.122** **	**0.159*** **	**0.0577*** **	**0.0550*** **	0.0462	-0.0277
	(0.0113)	(0.00822)	(0.0468)	(0.0303)	(0.0194)	(0.0150)	(0.0298)	(0.0222)
Akaike's information criterion (AIC)	-7699	-9845	-3501	-3941	-3132	-4060	-1801	-2752
Bayesian information criterion (BIC)	-7610	-9792	-3426	-3893	-3056	-4009	-1733	-2720
R-squared	0.240	0.209	0.370	0.352	0.197	0.222	0.121	0.150
Observations	1,972	2,574	776	885	853	1,107	496	792

Robust standard errors clustered by countries in parentheses. *, **, *** respectively stands for statistical significance at the 10%, 5%, and 1% threshold.

Table A.4.3. Testing "Selection-on-Observables": Impact of Private Deleveraging on Past Growth and Public Debt

	Full Sample		Advanced Economies			Emerging Market Economies		Low-Income Developing Countries	
	Fixed-effects	IPWRA	Fixed-effects	IPWRA	IPWRA (incl. housig and stock prices)	Fixed-effects	IPWRA	Fixed-effects	IPWRA
	X.1	X.2	X.3	X.4	X.5	X.6	X.7	X.8	X.9
Cumulative change in GDP									
(t-2, t-1)	**-0.0116*** **	0.000296	**-0.0184*** **	0.00255	0.00419	**-0.0117*** **	0.00172	**-0.00802*** **	-0.000710
	(0.00206)	(0.000903)	(0.00430)	(0.00342)	(0.00353)	(0.00376)	(0.00242)	(0.00298)	(0.00131)
(t-3, t-1)	**-0.0114*** **	0.000116	**-0.0203*** **	0.00197	0.00423	**-0.0151** **	0.00118	-0.00409	0.00227
	(0.00345)	(0.000954)	(0.00598)	(0.00353)	(0.00359)	(0.00606)	(0.00263)	(0.00554)	(0.00588)
(t-4, t-1)	**-0.0159*** **	0.000190	**-0.0242*** **	-0.00249	0.00166	**-0.0213** **	0.00154	-0.00757	-0.00569
	(0.00439)	(0.00111)	(0.00795)	(0.00405)	(0.00401)	(0.00837)	(0.00303)	(0.00647)	(0.00884)
(t-5, t-1)	**-0.0106***	0.00165	**-0.0253** **	-0.00308	0.000855	**-0.0174***	0.000256	0.00225	-0.00297
	(0.00623)	(0.00330)	(0.0105)	(0.00596)	(0.00560)	(0.00941)	(0.00704)	(0.0108)	(0.0125)
Cumulative change in public debt									
(t-2, t-1)	**0.0459*** **	0.00520	**0.0618*** **	-0.000803	-0.00423	**0.0697*** **	-0.00285	**0.0190***	0.00794
	(0.00991)	(0.00414)	(0.0184)	(0.00370)	(0.00428)	(0.0199)	(0.00392)	(0.0137)	(0.0135)
(t-3, t-1)	**0.0537*** **	-0.00844	**0.0767*** **	-0.00215	0.00885	**0.0899*** **	-0.0114	0.0132	0.00408
	(0.0145)	(0.00631)	(0.0217)	(0.0161)	(0.0247)	(0.0334)	(0.0173)	(0.0178)	(0.0191)
(t-4, t-1)	**0.0530*** **	-0.00841	**0.0644** **	-0.00554	-0.0195	**0.109** **	-0.0157	0.00385	0.00296
	(0.0197)	(0.0128)	(0.0272)	(0.0220)	(0.0325)	(0.0425)	(0.0235)	(0.0281)	(0.0351)
(t-5, t-1)	0.0221	-0.0270	0.0478	-0.0109	-0.0594	0.0353	-0.0369	-0.00250	0.0273
	(0.0281)	(0.0198)	(0.0353)	(0.0254)	(0.0386)	(0.0666)	(0.0289)	(0.0360)	(0.0487)

Each reported coefficient corresponds to the estimated impact of private deleveraging starting in t on GDP and public debt over different horizons. Robust standard errors clustered by countries are reported in parentheses. *, **, *** respectively stand for statistical significance at the 10%, 5%, and 1% threshold.

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