IMF Working Paper

Private Sector Deleveraging and Growth Following Busts

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Abstract

Balance sheet recessions have been a drag on activity after the Global Financial Crisis, underscoring the important role of balance sheet adjustment for resuming sustained growth. In this paper we examine private sector deleveraging experiences across 36 advanced and emerging economies countries since 1960. We consider the common features and divergent experiences of deleveraging episodes across countries, and analyze empirically the impact of different aspects of deleveraging during the bust phase of leverage cycles on subsequent medium-term growth. The results suggest that larger and quicker unwinding of non-financial sector debt overhangs is associated with sizable medium-term output gains, and that policies should focus on facilitating up-front balance sheet adjustment.

I. INTRODUCTION

The recent financial crises in advanced economies and their subsequent sluggish recoveries have focused attention on the implications of high levels of leverage and slow balance sheet adjustments. Although many aspects of policy responses have been swift and large – substantial increases in key central bank balance sheets, large government spending to offset the decline in private demand, sizable bank recapitalization to preserve some level of credit supply, to name a few – growth recoveries have been sluggish. This reflects, in part, the tremendous macroeconomic costs of the disorderly unwinding of large private debt expansion during the bubble years. Contrary to normal recessions, balance sheet recessions are more damaging and typically require deleveraging to allow debt overhang to be reabsorbed into the economy. To the extent that stressed European economies have yet to delever sufficiently, debt overhangs may be holding back their recoveries. Against this backdrop, still-rising debt levels in emerging markets and select advanced economies suggest that were shocks to arise, recovery could be constrained by balance sheet concerns in many parts of the world.

History suggests that deleveraging following financial crises is typical and tends to be sizable. Tang and Upper (2010) found, in countries that suffered systemic banking crises, private sector debt-to-GDP ratios fall on average by 38 percentage points before returning to levels seen before the credit boom. McKinsey (2012), examining deleveraging episodes (including both private and public debt) across large emerging and advanced economies, found deleveraging lasts on average seven years and is associated with a decline in debt-to-GDP ratio of 25 percentage points. In a similar vein, IMF (April 2012) found that household deleveraging takes roughly seven years following busts associated with a large increase in household debt, with a decline in debt-to-income ratio of roughly 23 percentage points.

The historical experience is clear—deleveraging processes run their course eventually. But to the extent that demand is held back by debt overhang currently, policy responses to deal with this specific aspect have been more constrained, with policies in advanced economies to date focusing on shoring up aggregate demand and boosting credit supply. This in part reflects that household debt increases, a common feature in many advanced economies in the current leverage cycle, pose a particularly complex challenge from a policy perspective. Households are much smaller, scattered, less amenable to centralized solutions, and often politically sensitive as the major asset in such cases are homes. Moreover, bankruptcy and debt default proceedings across countries are idiosyncratic and complex. In the U.S. where the non-recourse mortgage framework and active government policies enabled larger household debt reductions, the output recovery is expected to be stronger than Europe, where it has proven harder to achieve substantial deleveraging.

A logical question then is to what extent has unfinished balance sheet adjustment held back recovery? Given the expected – and necessary – balance sheet adjustments following financial crises, does the modality of deleveraging – its magnitude and speed – matter for growth prospects going forward?

Prior research has mostly explored the impact of *levels* of debt and leverage on growth, but detailed assessments on the impact of *changes in* leverage (deleveraging) is limited. Of those

that address the impact of deleveraging on growth, most have focused on public sector balance sheet adjustments. Those that do address the issue of private sector deleveraging tend to be limited to the effect of deleveraging size on growth and focused on economies with rich, detailed data, such as the U.S. and other advanced economies. This paper aims to broaden our understanding of the dynamics of deleveraging on growth by analyzing a cross-country sample of episodes over the last 50 years and going beyond the experiences of advanced economies and the impact of deleveraging size. Specifically, this paper examines the modalities of deleveraging across both advanced and emerging economies and assesses the impact on growth from the size of total deleveraging, as well as the duration of these episodes and the intensity of deleveraging efforts over these intervening periods.

The paper is structured as follows: in section II, we review the literature on leverage, summarizing findings that connect leverage ratios and growth. In section III, we offer a close look at deleveraging episodes for a wide range of countries from 1960. We find a secular increase in leverage – defined as nominal debt to nominal income – across both advanced and emerging market economies, suggesting financial deepening and income growth may have played a role. We also find that peaks in these leverage cycles occur on average every 19 years; deleveraging experiences are not uncommon and tend to last approximately four to five years on average. In section IV, we offer a novel approach to assess the impact of deleveraging on medium-term growth. Here, given the complexities of deleveraging experiences – changes in nominal debt levels, the impact of changing interest rates, growth and inflation, and not the least of all, valuation effects – we focus on changes in leverage ratios and more specifically, the intensity and duration during which private borrowers adjust these ratios and the attendant impact on future output. We find that larger, more up-front deleveraging does boost medium-term growth, other things equal. Lastly, section V concludes.

II. LITERATURE REVIEW

Traditionally, economists have focused on private debt only to the extent that it affects household net worth and correspondingly, consumption (Benito and Zampolli, 2007; Dynan and Kohn, 2007). Recent work has shown that the accumulation of debt and subsequent retrenchment may have played a role in lowering demand in the U.S., Europe, and elsewhere (Eggertson and Krugman, 2010; Philippon and Midrigan, 2011). In particular, Mian, Rao and Sufi (2011) provided strong empirical evidence that household debt accumulation in the mid-2000s and subsequent busts contributed to the ensuing decline in consumption and economic crises. Along the same line, Meltzer (2010) found that households with negative equity – debt overhang – spent 30 percent less on home improvements and maintenances than those without debt overhang. Taken together, these recent works offer a theoretical justification for analyzing the dynamics of private sector leverage and their impact on economic growth.

There are several themes common in the current literature on debt and growth. First, there is a distinct credit cycle, characterized by changes in credit aggregates and asset values. In the post WWII era, these credit cycles have been increasingly characterized by rising credit and complex forms of leverage (Schularick and Taylor, 2010). Moreover, these credit cycles are driven by leverage, which determines asset values and affects economic cycles (Geanakoplos, 2010). Here, the literature on capital structure and its economic consequences has evolved over the years. Modigliani and Miller (1958) set the tone for a period, stressing that with perfect capital

markets, capital structure does not affect a firm's cost of capital and hence investment decisions. But since then a large literature has developed in finance, focusing on a wide range of frictions that insert wedges into the cost of finance depending on capital structure, thus affecting aggregate outcomes (Tirole, 2011).

Second, credit matters for growth. Intuitively one might expect a positive correlation between debt levels and output as debt allows for consumption and investment smoothing over uncertain income, and financial deepening and rising debt go hand in hand with output. In reality, roughly one in five growth recoveries occur in the absence of credit growth – the so called "creditless recoveries", but such recoveries tend to be shallow (Abiad, Dell'Ariccia, and Li, 2011). Specifically, negative real credit growth in the first three years following a recession is more likely if the downturn is preceded by credit booms or coincided with a banking crisis. Weak credit growth may reflect, in part, banks' increased risk aversion and more cautious lending activities. The policy prescription related to supply constraint as noted here is clear – boost bank capital and restore credit supply to avert a credit crunch, as demonstrated clearly in Laevan and Valencia (2011).

That said, the demand side of the equation also matters; the ability to borrow is not indefinite. Debt levels above a particular threshold may be associated with compromised medium-term growth prospects (Cecchetti et al., 2011; Kumar and Woo, 2010; Baum et al., 2013; Reinhart and Rogoff, 2010). The consensus here, however, is less clear. Existing literature generally suggest that high debt levels are negatively associated with growth performance, but the threshold at which debt levels begin to matter differs across studies. For OECD countries, the threshold for government debt is around 85 percent of GDP, corporate debt, 90 percent of GDP and households, 85 percent (Cecchetti et al., 2011). In another study, the government debt threshold is slightly higher across a wider range of countries, at around 90 percent (Reinhart and Rogoff, 2010). More generally, increases in debt levels – beyond a particular threshold – are often found to detract from future growth. Estimates range from a reduction in average annual growth rate of 2 to around 20 basis points for every 10 percentage point increase in the private sector debt-to-GDP ratio (Cecchetti et al., 2011; Randveer et al., 2011; Takats and Upper, 2013; Bech et al., 2012).

Third, movements in aggregate debt and asset ratios affect financial stability. Sharp increases in credit provision are seen as a key predictor of financial or banking crises (Friedman, 1986, Gourinchas and Obstfeld, 2012). In general, credit growth tends to be elevated and natural interest rates depressed in the run-up to financial crises, with credit growth seen as the single best predictor of financial instability (Jorda et al., 2010).

Along the same line, there is some evidence that the trajectory of debt may be more important than the level of debt, that is, countries with high, but declining levels of debt have historically grown just as fast as their peers (Pescatori et al, 2014). That said, deleveraging comes with a tradeoff. The process of deleveraging from high debt levels is generally seen as costly. Historic experiences suggest that deleveraging episodes are associated with contracting outputs during the first several years (McKinsey, 2012). Financial crises, in particular, tend to be followed by a prolonged period of deleveraging in the corporate sector (Tang and Upper, 2010). Recent analysis of U.S. household balance sheet adjustment suggests that the magnitude of

deleveraging is correlated with economic performance – higher deleveraging is associated with sharper swings in housing markets, larger increases in mortgage delinquencies and worse labor market performance (Albuquerque et al., 2014). Moreover, private sector debt deleveraging may be more detrimental to growth than public sector debt (IMF 2013).

That said, detailed empirical analysis on the nature and composition of private debt dynamics is scarce, in part because changes in private balance sheets are often microeconomic in nature. Public sector debt typically involves a single, well-understood borrower and good data on the debt portfolio by maturity and interest rates, primary balances, and debt forgiveness. While the burden of public debt deleveraging falls on fiscal consolidation, private sector deleveraging operates through diverse channels and agents– consumption and investment, households and corporates. Moreover, factors that underlie changes in private leverage – the composition of borrowers, evolution of risk premia and loan terms, write-offs, refinancing, and new borrowing – can have varying effects on growth. It is then perhaps unsurprising that given such complexities, the literature on private sector deleveraging has much scope for development. Our analysis is the first effort to our knowledge to relate changes in the level of private leverage after a peak to subsequent medium-term growth. More specifically, it contributes to the analytical discussion on two fronts: first, we find that the size of deleveraging, all else equal, affects subsequent growth. Second, the modality of deleveraging matters – sizable subsequent growth is best achieved via more intense, upfront deleveraging where the length of deleveraging is limited.

III. A CLOSER LOOK AT PRIVATE SECTOR DELEVERAGING -- STYLIZED FACTS

Sustained increases in the leverage of households and firms have magnified the role of credit cycles in macroeconomic developments, as noted by Kiyotaki and Moore (1997) and more recently, Claessens et al. (2011). Taking periods of deleveraging episode by episode, this section looks at when and how these events occur and the consequences on the economy more generally.

In identifying relevant variables, we rely on *nominal debt-to-nominal GDP ratios* to measure private-sector leverage. Specifically, we measure leverage from an affordability perspective, using income as a proxy for the underlying pool of resources available to service the debt. For the numerator, the rationale for using total debt stock is twofold: Debt service figures do not accurately reflect the associated long-term obligations such as the number of years of the payment commitment or the term structure of interest rates that could improve affordability in the short term but raise payments later. Second, debt contracts are written in nominal terms, and the ability to repay is therefore based on nominal income; here, we rely on GDP – given limited sectoral data – as a proxy. This use of debt stock-to-income ratios is in line with credit rating agencies' methodology of comparing debt burdens across different countries and states (Boston Fed, 2013). That said, we recognize that debt-to-income is not a comprehensive measure of balance sheet stress. Assessing the total stock of debt relative to the composition of assets – the extent of liquid holdings, for example – and equity buffers could also offer useful insights into debt sustainability.

A. Broad Trends in Private Sector Debt

Using BIS data on household and non-financial corporate gross debt, we constructed a sample of 36 countries with data ranging from 1960 to 2013. Private sector debt as a fraction of GDP has been on the rise across countries since as far back as the 1960s, growing from an average of 62 percent of GDP 1960 to 157 percent in 2012 across the countries in our sample (chart below). While leverage growth has been steady for advanced economies and emerging markets, it has occurred in different ways.

Credit to the Private Sector around peaks (%GDP)
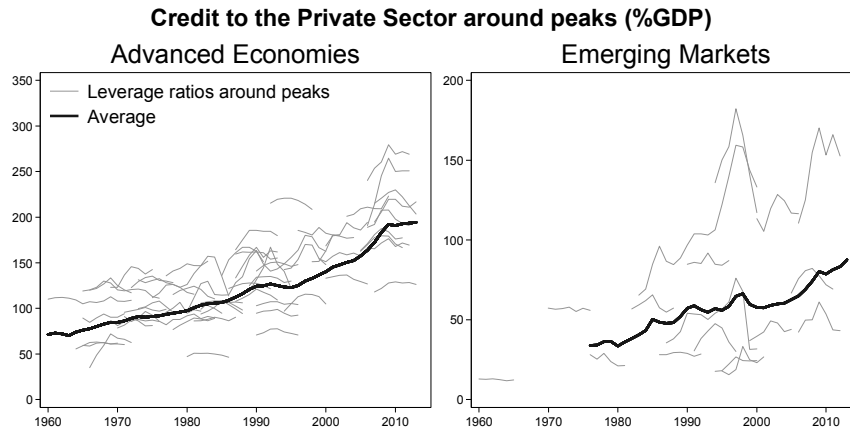
Leverage ratios in advanced economies, with greater financial depth, grew steadily from 71 percent to 193 percent of GDP between 1960 and 2013.[1] Advanced economies saw strong nominal debt growth offset by high output growth in the 1960s and high inflation in the 1970s. Inflation moderated by the 1990s, and leverage saw its longest period of sustained growth from the 90s through the crisis (right-hand side text chart below).

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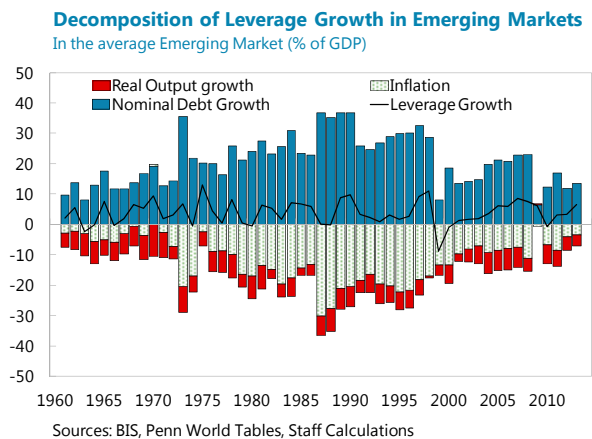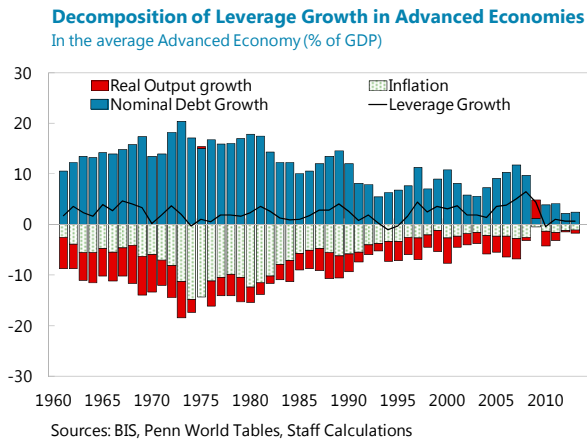
[2] *Advanced economies:* Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Singapore, South Korea, Spain, Sweden, Switzerland, United Kingdom, United States. *Emerging economies:* China, Hungary, India, Indonesia, Malaysia, Mexico, Poland, Russia, Saudi Arabia, South Africa, Thailand, Turkey.

Emerging markets, starting from a lower base, also increased their leverage, growing from 13 percent to 83 percent in the same period. Average leverage growth was more volatile than in AEs with greater leverage growth peaks and deeper troughs (left-hand side text chart previous page). Strong real output growth tempered leverage growth throughout the sample. High inflation in the late 1980s and 1990s coincided with rising nominal GDP and reduced leverage; but this decline in leverage ratio was largely offset by increases in nominal interest rates. The Asian Financial Crisis is the largest aggregate event for emerging markets in the series, while the Global Financial Crisis and its growth consequences are particularly noteworthy for advanced economies.

Along with financial sector deepening there has been a change in the composition of gross debt, particularly in emerging markets. In spite of dramatic growth in corporate debt in the past few decades, household debt has grown even faster, rising from 15 percent of total debt in 1989 to 34 percent in 2012 and rapidly approaching advanced market levels of 40 percent and higher. The growth of household debt as a share of total private sector debt is consistent with higher levels of economic development. We find in our sample that it rises with income per capita, converging to similar levels as corporate debt once income approaches US$50,000 on a GDP-per-capita basis (text charts). The rising share of household debt with income levels likely reflects higher levels of financial development which increase the ease of borrowing for households, though this is not our focus.

Household Share of Private Sector Debt
percent of GDP

Sources: BIS, Penn World Tables,

Household Debt Share and Income
Household Debt as percent of Total Debt; GDP per capita in PPP

Sources: BIS, Penn World Tables, Staff Calculations
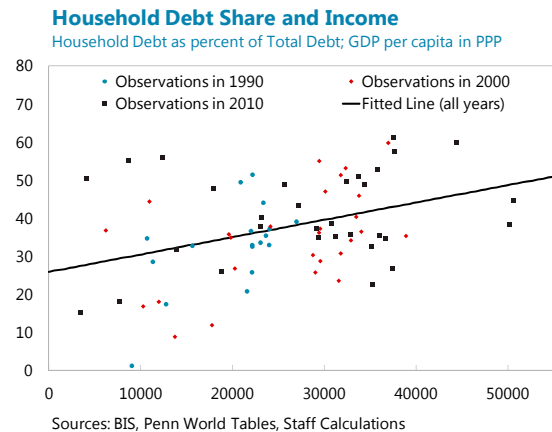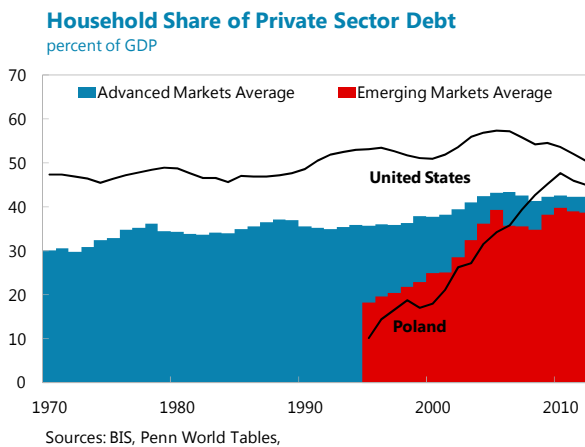
B. Deleveraging Episodes

To more closely examine the relationship between deleveraging and subsequent growth, we identify episodes of deleveraging across private sectors – both in aggregate as well as looking at households and nonfinancial corporate separately. In the process, we consider a number of features of these episodes, including the total size of deleveraging, the length of time spent deleveraging and the intensity of deleveraging – size of deleveraging per annum over the deleveraging period – and the effect of these features on growth outcomes[2].

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[2] The number of household deleveraging episodes – after stripping out those affiliated with the GFC – was too few for meaningful regression results.

 We identify deleveraging episodes with the dating algorithm introduced by Harding and Pagan (2002) to locate turning points in private debt-to-GDP ratios (Appendix I, Tables 1, 2, 3, and 4).
There is not yet a well-established approach to
financial cycle dating, but this algorithm is a
simple, well-defined approach that is robust to
the inclusion of new data. Using this turning
point methodology, we searched for maxima
(identified as "peaks") and minima ("troughs")
over a given period.[3] The difference between the
local peak and trough is the total amount of
deleveraging associated with a deleveraging
episode (text chart). In a similar vein, the number
of years that span the interim between peak and trough is the duration of the episode.

Deleveraging Episode Identification

Legend: Total Deleveraging, Peak, Leverage Ratio
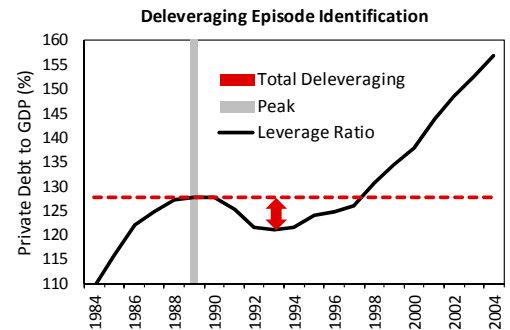
Our exercise identified 83 deleveraging episodes, 63 among advanced economies (AEs) and 20 among emerging economies (EMs), with the smaller number for EMs explained by fewer countries and shorter series in the data.[4]
Deleveraging episodes occur less frequently than
recessions, about once every 19 years on average
with AEs and EMs seeing similar frequencies.
Within these groups, episodes occurred for
countries at every level of financial depth.
Episodes were widely distributed across time as
well. Deleveraging episodes are largely
idiosyncratic through the mid-nineties but then
become somewhat more synchronized, with some
clustering around the Asian Financial Crisis, a lull
in the mid 2000s, and then wide-spread
deleveraging with the highest frequency during the Global Financial Crisis (text chart).

Deleveraging Episode Distribution
Frequency

Sources: BIS, Penn World Tables, Staff Calculations
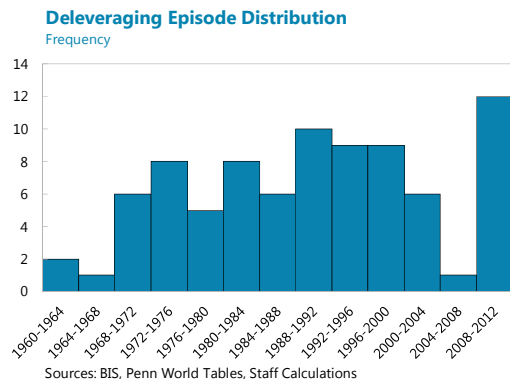
C. Length and Depth of Deleveraging Episodes

Deleveraging experiences varied widely across
economies and time periods, with some countries
re-levering swiftly after a deep retrenchment,
some experiencing only minor corrections, and
others experiencing protracted periods of slow
reductions in debt-to-GDP. Some events can even
herald a period of secular decline in debt-to-GDP,

Duration of Deleveraging Episodes in Years
Frequency (lhs); Change in Leverage Ratio (rhs)

Legend: Number of Epsidodes (lhs), Average Deleveraging (rhs)

Sources: BIS, Penn World Tables, Staff Calculations

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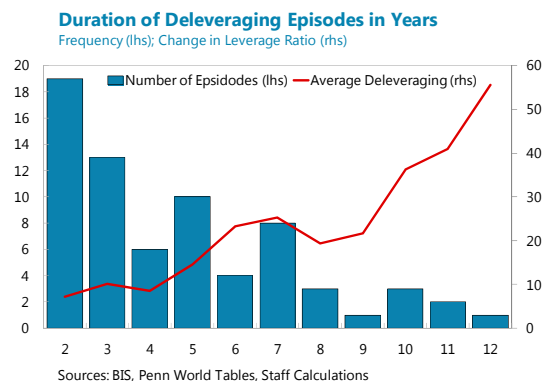
[3] The window is defined as two years, and a complete cycle is at least five years.

[4] Emerging markets represent 26 percent of annual observations on leverage and 24 percent of identified episodes, suggesting similar frequencies across levels of development.

as Japan (1995) and Germany (2003) appear to have transitioned to a period of sustained reductions in leverage. On average, deleveraging episodes last roughly 5 years,[5] with average debt-to-GDP levels falling by about 15 percentage points over this period. There is a wide range in the sample – some of the sharpest balance sheet adjustments took place within two or three years and some of the longest deleveraging spells were just as vigorous. That said, in general, the total size of adjustment increases with the amount of time spent deleveraging (text chart and table below).

	Average	Standard Deviation	AEs	EMs
Peak Leverage Ratio (% of GDP)	115.2	47.2	128.4	73.2
Deleveraging duration (years)	4.7	2.7	4.6	4.8
Change in Leverage Ratio (annual avg; ppts)				
Pre-deleveraging growth rate	4.9	4.3	3.9	8.1
Peak to trough	-3.6	3.5	-2.7	-6.6
Post-trough	4.2	3.1	3.5	6.4
Real GDP Growth (annual avg; %YoY)				
Pre-deleveraging	4.1	3.0	3.8	5.3
Peak to trough	3.8	2.7	3.3	5.5
Post-trough	3.7	2.3	3.3	5.3

1/ Based on available observations; pre-deleveraging and post-trough growth rates are 5 year averages.

D. How Countries Delever

To assess the mechanisms of deleveraging, we decompose the change in the private sector debt-to-GDP ratio into real growth, inflation, and nominal debt stock changes[6] during the deleveraging episode. In general, deleveraging tends to be triggered by a combination of growth downturns – particularly when a slowdown has been in train for some time – and extended, large increases in debt levels. To put it differently, leverage ratios typically peaked when income and, correspondingly, the capacity to service debt, have deteriorated sizably. Subsequent deleveraging can be seen as a response to an unsustainable debt overhang.

Countries in the Asian Financial Crisis stand out as having had the most sizable absolute reduction in leverage in our sample with a particularly large contribution coming from positive output growth (chart above). Indeed, they had not moved very far from peak debt-to-GDP ratios after four years, suggesting that increases in growth enabled speedier releveraging. Nordic countries in the late 1980s and early 1990s delevered on the back of a relatively high rate of inflation—perhaps reflecting currency depreciation in a context where most debt was domestic though they also did not see a sizable net releveraging. By contrast, countries experiencing

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5 Data on duration cover only episodes for which we can identify a trough thus excludes those with ongoing declines.

6 Ideally, debt stock changes should be decomposed into retiring loans, new borrowing, and any debt relief or renegotiation. Detailed data for the vast majority of our sample were unfortunately not available.

deleveraging episodes in the GFC period have seen far smaller movements in debt ratios and its components.

Contributions to Deleveraging
(percent of GDP)

Sources: BIS, Penn World Tables, Staff Calculations
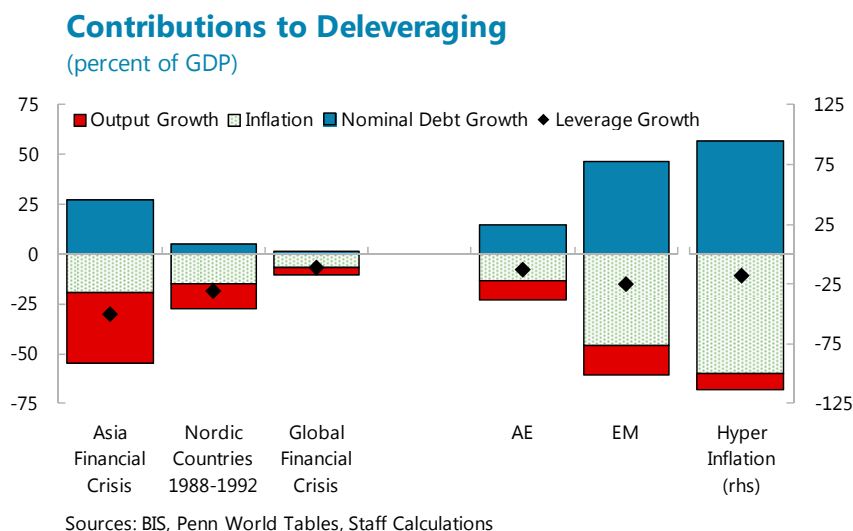
Cases of absolute reductions in nominal private sector debt over consecutive years are rare. The six episodes that saw absolute reductions in nominal debt levels—that is, end-of-period debt level was lower than that at the beginning of the episode—all occur in the 1990s in either Europe or East and Southeast Asia[7,8].

Instead, nominal debt accumulation generally remained positive in most cases, with deleveraging achieved primarily through higher income growth. On average the rate of nominal debt accumulation is about 3 percentage points lower than nominal GDP growth over the delveraging period (text chart). By comparison, debt accumulation was about 4 percentage points higher than nominal growth over five-year periods before and after these episodes.

Average Annual Growth Rates

Source: IMF staff estimates
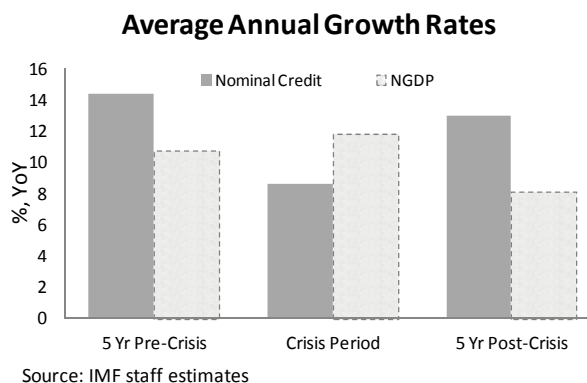
Deleveraging is observed mostly in the non-financial corporate sector (text chart). We compare household and corporate sector contributions to total deleveraging in the 37 cases for which we have a breakdown. Episodes with equal contributions from both sectors would fall on the 45

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[7] The six episodes are: Finland 1992 (6 years of deleveraging), Hong Kong 1997 (5 years), Indonesia 1997 (5 years), Japan 1995 (12 years), Poland 2002 (2 years), and Thailand 1997 (10 years).

[8] By contrast, declines on a *per year* basis (relative to episodes) are more common. Out of the entire sample, 18 episodes saw a decline in debt levels during some parts of the episodes, though on net, the aggregate average rate of credit growth was positive for most of these cases.

degree line, but only four episodes show equal or greater contributions from the household sector. In fact, 20 episodes show an increase in the household leverage ratios. This may reflect that the underlying increase in household leverage, a structural feature, is particularly strong, but it also highlights the challenges facing economies that experience housing busts, where it seems that household leverage typically adjusts much more slowly than that in other sectors. Indeed, the sector's apparent low cyclicality due to long debt maturity suggests that NFCs will remain the dominant drivers of private debt reduction.

Sectoral Contributions to Deleveraging
Change in leverage ratio (percent of GDP)

Sources: BIS, Penn World Tables, Staff Calculations
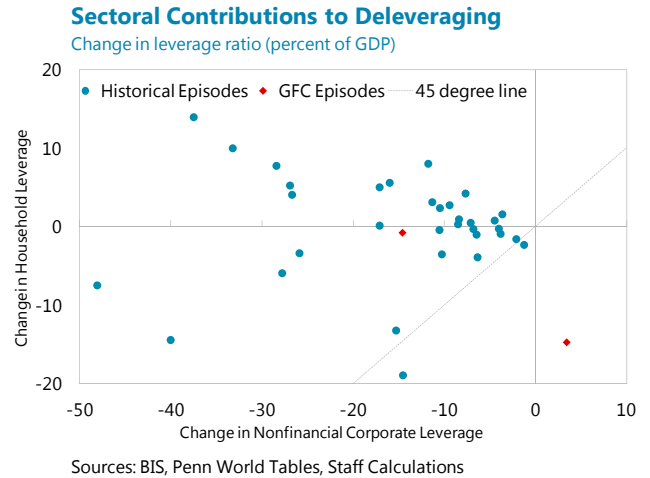
E.   Experience through the Global Financial Crisis

The Global Financial Crisis has seen a cluster of deleveraging events. These episodes occur under unusually difficult macroeconomic conditions, including negative growth and low inflation or deflation. Indeed, the current deleveraging cycle, particularly in European countries under stress finds very few historical analogs in terms of negative growth. The levering-up phase was very strong and lasted well into the recession. In the early phase of the recession, economic decline outpaced reductions in private sector debt, leading to an increase in leverage ratios through 2010-11. Thus we are currently less than four years from most identified peaks.

Leverage Ratio

Calculation:
Simple averages over series normalized at 2007 and 1997

Real GDP per Capita

United States
Stressed Economies
Asia Financial Crisis (top x-axis)
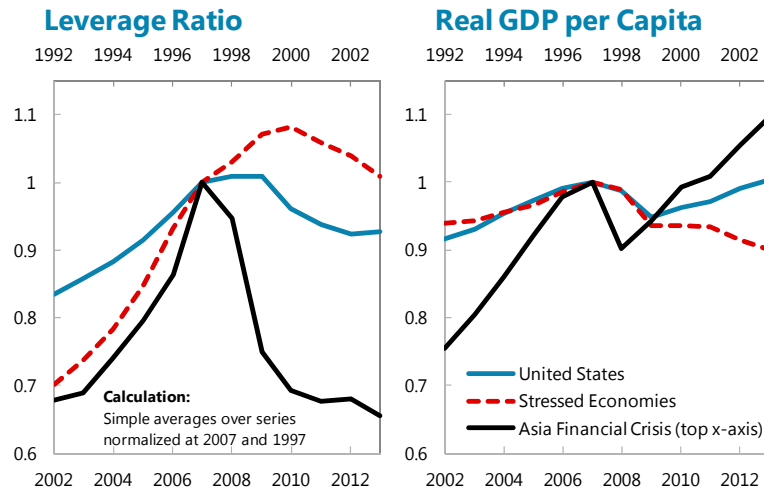
The chart above presents an average of stressed European economies' deleveraging experiences[9] against other countries. For these European economies, private debt rose rapidly in

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[9] Greece, Ireland, Italy, Portugal, and Spain

advance of the crisis but has transitioned to a period of modest decline. Significant reductions in the debt stock paled in comparison to losses in real output.

The difference is especially stark when compared with either the Asian Financial Crisis or the United States during the GFC. During the Asian Financial Crisis, affordability ratios peaked in 1997 and saw a very quick decline of over 30 percentage points in the ensuing four years at the expense of a sharp output contraction between 1997 and 1998. Meanwhile the U.S. has seen some gradual reduction in leverage combined with a relatively stronger output performance, a sharp contrast with the lingering challenges in the European economies.

The experience of those countries that saw rapid deleveraging through the present crisis, particularly the U.S. and the U.K., are suggestive. Getting bad debt off private sector balance sheets appears correlated with recovery, presumably as it helps free-up an economy to invest and consume. These experiences are in line with the deep deleveraging and rapid recoveries in East Asia in the late 1990s. For a broader perspective, our sample provides an opportunity to compare this narrative against a large sample of deleveraging episodes over more than five decades across all types of countries.

That said, as with any set of cross-country growth correlations, there are many factors that may be behind this relationship, and a variety of confounding factors which may play a role. Indeed, a key challenge with this examination of deleveraging episodes is the lack of systematic data on private sector debt reduction operations—relief offered by the financial system to the real economy, whether through write-offs or net present value reduction of debt in debt restructuring. Without this, it is difficult to assess the impact of specific actions to promote deleveraging on subsequent output dynamics. In the next section we control for various factors that can be identified to isolate the role of deleveraging.

IV. Deleveraging Modality and Growth – An Empirical Analysis

A. Analytical Considerations

We next examine empirically the extent to which greater private sector deleveraging is associated with higher subsequent growth. One consideration – as suggested by the literature –is the tradeoff between swift deleveraging and growth. Delay in balance sheet repair following an excessive credit boom could suppress demand and impair economic efficiency by locking up resources in unproductive sectors. At the same time, however, deleveraging could weigh on output growth as households and non-financial corporates undergo balance sheet adjustments. The net benefit of this trade-off is not obvious without taking a close look at the data.

We find in our sample that although a fall in debt level is associated with weaker growth, output losses associated with a decline in *leverage ratios* are rare. In part, as we showed in section III, deleveraging was largely achieved through more moderate debt accumulation relative to income growth. Out of the sample of 83 episodes, only one saw a negative annual real growth rate during the deleveraging period. A larger share—about 65 percent of the cases—saw weaker, but positive real annual growth relative to the five years before the onset of balance sheet adjustment. Still, given the unconditional correlation between debt accumulation and growth, it

is possible that slower leverage growth could have dampened growth recovery. We explore this trade-off between deleveraging and growth in a robustness test.

Another consideration is the channels through which deleveraging takes place. If deleveraging is done through increased savings from households, the process could result in a sizable downturn in consumption[10]. Alternatively, if the process is achieved through default or loan forgiveness, the problem is shifted from consumers (who may still shoulder tax liabilities, legal fees and lower credit scores) to banks. Banks, in return, might have to curtail lending. Still, a third option could involve corporates, whose deleveraging could result in reduced investment. The question of who bears the burden can affect growth and the policy prescription. We explore the varying effects of different deleveraging agents in our robustness test, though granular data on sectoral breakdowns are few, thus limiting the generality of the results.

A third important consideration is the issue of reverse causality: sluggish growth may contribute to high debt ratios, or debt service burdens may constrain growth through limited consumption and investment. Other omitted factors may simultaneously reduce growth and increase debt.[11] Our analysis does not formally establish a firm causality. Instead, given limited data, we allow for non-overlapping episodes – that is, we look at real growth per capita over *n* years following deleveraging. We thus take the notable approach of a temporal separation between the growth variable (dependent) and the deleveraging variable (regressor). By focusing on the relationship between deleveraging and the subsequent medium-term growth, we seek to mitigate the problem associated with the direction of causality between leverage and growth. Finally, we analyze the impact of extreme deleveraging events that were not associated with a decline in growth, the associated changes in interest rates or with the occurrence of financial crises as another robustness check for assessing the link between deleveraging and subsequent growth.

Lastly, the extent to which a decline in credit is due to supply or demand factors affects growth prospects and policy responses. If limited credit is a result of reduced investment opportunities, leading to a fall in demand for credit, the attendant growth prospect could well be different from a supply shock, driven by, say, a tightening in bank lending standards. One study finds that in general, demand shocks to credit[12] have longer lasting and stronger effects on real GDP than supply shocks (Chen et al., 2012). A novel approach may be to proxy supply shocks using bank loan write-offs. We do not make the distinction between supply and demand shocks in our study, however, as consistent, reliable data are lacking on a cross-country basis.

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[10] In a sample of OECD countries from 1980 to 2012, Bouis (2014) found that the negative relationship between household savings rate and debt ratios is only significant during debt build-ups. The rise of savings rates during deleveraging period may reflect primarily an increase in precautionary saving, with little direct connection to changes in debt.

[11] In a study on U.S. households, consumption and employment fell more in those states that suffered larger housing busts (Mian & Sufi, 2014). In another study on Spain, weakened employment prospects and reduced financing are associated with a decline in household savings (Sastre and Fernandez-Sanchez, 2011).

[12] Credit, in the study, is defined more broadly as a combination of bank credit and collateral-based funding; negative demand shock is identified as a decline in quantity and a corresponding decline in price.

B. Data

We rely primarily on BIS data on credit to private non-financial sectors for our analysis. Although our policy discussion is mainly focused on the actual debt burden facing households and non-financial corporates, historical sectoral data collected from these entities are not available for most of our sample countries and are not fully comparable internationally even when available.[13] In all, there are 36 countries in our sample, with annual data generally ranging from 1960 to 2013.

C. Model Setup

For our benchmark results, we estimate the following regression equation:

$$\bar{y}_{i,Tq+1-Tq+5} = \beta_0 + \beta_1 \Delta d_{i,T0-Tq} + \sum \beta_m X_{i,m} + \varepsilon_i , \qquad (1)$$

where $\bar{y}_{i,Tq+1-Tq+5}$ refers to the 5-year forward average output per capita growth rate on an annual basis (measured as log-difference) starting $q+1$ years after the end of a leverage cycle.[14] The deleveraging variable $\Delta d_{i,T0-Tq}$ is analyzed from two perspectives: first, in a "fixed window" approach, we assess the impact of deleveraging over a five year horizon – based on the average duration of deleveraging – on subsequent growth over the next five years, that is, year 6 to year 10. This relatively simple approach allows us to estimate the impact of the size of deleveraging on growth. A second, more nuanced approach decomposes deleveraging into two components: the average deleveraging per year, that is, the intensity of deleveraging, measured as the percentage point change in the private sector debt-to-GDP ratio over the deleveraging period where a negative value denotes reduction in the debt ratio (i.e. "deleveraging"); and the total number of years spent delevering, where a positive number denotes increases in deleveraging duration.

We consider a number of regressors ($X_{i,m}$) to control for the initial economic conditions and the domestic policy stance over the first q years. For the former we consider: the per capita output growth rate from T0 to Tq to capture any potential rebound effect in the subsequent period, the change in the real effective exchange rate over T0 – Tq to control for possible gain/loss of external price competitiveness, the private/public debt-to-GDP ratio at T0 as a measure of initial debt burden in the private and the public sector, and GDP per capita relative to the United States at T0 to reflect various structural differences between advanced and emerging market economies.

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[13] Depending on the institutional arrangement of individual countries, this could potentially over-estimate the extent of actual debt reduction in household and corporate balance sheets in a leverage cycle downturn. For example, while mortgage loans in the United States are non-recourse, debt forgiveness policy is much stricter in Europe.

[14] As most countries in our sample have more than one deleveraging episode, we use the subscript i to denote a leverage cycle and not a specific country.

Having the output growth during the corresponding deleveraging years as a regressor is particularly important in this setup. Not only does this variable capture potential rebound effect following a deleveraging spell, but more importantly, it accounts for the positive correlation that exists between the average output growth rates in the two non-overlapping windows: countries with relatively high output growth over the deleveraging years tend to experience high growth over the subsequent years, and *vice versa*. This implies that, for a given average nominal debt stock over T0 – Tq, a country with relatively high trend output growth would exhibit greater deleveraging (denominator effect) and faster subsequent recovery. In light of this output dynamics effect, we attempt to isolate the impact of deleveraging by including the average output growth during the initial deleveraging years and the relative level of GDP per capita as explanatory variables.

As for the policy variables, we consider the change in the short-term real interest rate and the government primary balance from T0 to Tq to account for the extent of monetary and the fiscal policy stimulus, respectively.

Finally before turning to the results, we recognize that deleveraging does not occur in a vacuum but reacts to macroeconomic conditions; we therefore note a few important caveats in our analysis. First, although we use non-overlapping windows and control for the output growth in the initial deleveraging period, interpreting the results as a causal link between deleveraging and growth still warrants caution. Second, the small number of pre-GFC episodes (73) constrains the number of control variables that can be considered, such that potential omitted variable bias, and associated limitations on inference, cannot be excluded.

D.   Regression Results

We present our benchmark regression results in Appendix 2, Table 1. Regressions for output use the ordinary least squares estimator and the Newey-West method for estimating robust standard errors of the coefficients.

In the fixed-window approach from the benchmark regression, the estimated coefficient for the deleveraging variable is negative and statistically significant, implying greater deleveraging tends to be followed by higher future growth in output. Furthermore, the size of the impact is also economically significant: a 10 percentage point decline in the private debt ratio over T0 – T5 is related to about 30 – 42 basis points higher average annual growth rate over the following 5 years (T6 – T10), which amounts to about 1.5 to 2 percentage point higher output level on a cumulative basis. Considering that the average decline in the debt ratio for the pre-GFC sample is about 15 percentage points, the average impact on the subsequent annual output growth would be about 45 basis points, which is not trivial especially when one considers that potential output growth rates for advanced economies are currently estimated at about 2 percent.

For a more disaggregated analysis of deleveraging, the efforts are decomposed into intensity – the size of deleveraging per year over the episode – and duration – the length of deleveraging. The results are qualitatively the same as the benchmark regression for most of the regressors. The estimated coefficient for deleveraging intensity is negative and statistically significant, implying greater deleveraging intensity tends to be followed by higher future growth in output (Table 2). Furthermore, the size of the impact is also economically significant: a 1 percentage

point decline in the private debt ratio per year over the deleveraging period is related to about 13 – 24 basis points higher average annual growth rate over the following 5 years. As the average change in deleveraging intensity is a decline of about 3 percentage points per year, the cumulative boost to subsequent growth would amount to about 2 to 3 percentage points.

Meanwhile, the estimated coefficient for the length of deleveraging is negative, suggesting longer deleveraging is associated with lower output over the subsequent years. Though not statistically significant, the effect of long deleveraging duration is sizable economically: every year of deleveraging is associated with a subsequent output loss of 5 to as much as 12 basis points per year. Such a relationship between output and deleveraging duration supports the widely-held notion that deleveraging comes with a tradeoff; extended periods of deleveraging, either a result of institutional constraints or borrower inertia or both, prolongs the process needed to cleanse balance sheets, affects the allocation of capital and labor and correspondingly, the prospects for output. To the extent that deleveraging reflects active efforts to tackle the private sector debt burden, these results provide insights to the modality of deleveraging and empirical support to the argument that faster and more aggressive balance sheet repairs are needed to boost growth following a credit bust.[15]

As for other control variables, the coefficient for the average output growth over the corresponding deleveraging period is positive and highly significantly, accounting for most of the equation's explanatory power. The level of GDP per capita relative to the U.S. does not seem to have a significant impact on total private debt. This is possibly because the initial period output growth and the debt-to-GDP ratio already capture structural differences between advanced and emerging market economies, as both variables are higher for advanced economies. Meanwhile, real effective exchange rate depreciation has the expected negative sign, implying that depreciation over the deleveraging years is associated with higher output growth in the subsequent 5 years.

Moreover, the results show that a *loosening* in fiscal and monetary policy over the deleveraging period has a sizable *positive* economic impact on future growth: a 1 percentage point increase in the government primary balance as percent of GDP is associated with a 20 to 30 basis points increase in the average annual investment growth. Meanwhile, every 1 percent point decline in monetary policy rate is related to roughly 5 basis points in annual subsequent growth (Table 2).

Lastly, to assess the extent to which the length of deleveraging could affect the impact of deleveraging intensity on subsequent growth (based on the episode approach), we created an interaction term between intensity and length; these two variables are now measured as deviation from the average deleveraging intensity and duration, respectively. Coefficients for the interaction term correspond to the effect of deleveraging intensity on subsequent growth when deleveraging duration is above or below the mean. The results are in line with those from the baseline regression and confirm the notion that slower deleveraging is associated with weaker subsequent growth. The coefficients for deleveraging intensity remain consistently

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[15] A study by Bech, Gambacorta, and Kharroubi (2012) also find evidence that a 10 percentage point decline in the debt-to-GDP ratio during a business cycle downswing accompanied by a financial crisis is associated with a 60 basis point increase in average output growth in the recovery phase.

negative and statistically significant, and are largely in the same ballpark as the baseline regression. Specifically, every extra percentage point of deleveraging above the sample average is associated with an additional gain of about 14 to 28 basis points of real growth per year. Meanwhile, each extra year spent deleveraging beyond the sample average of 5 years is associated with an annual output loss of about 6 to 18 basis points. And, for those that delever at average speed, but spend more time deleveraging, each additional year of deleveraging *above* the mean of 5 years is associated with subsequent output loss of roughly 5 basis points per year (Appendix 2, Table 3).

E. Robustness

In light of the small sample size and the identification challenges, we conduct a number of checks to confirm the robustness of our benchmark results.

Length of Post Deleveraging Period. We examine the sensitivity of the results with respect to the choice of the period window following deleveraging, and compare results from the

benchmark 5 year model to periods of 3, 4, 6, and 7 years, respectively. The coefficient for deleveraging intensity remains negative and significant regardless of the window chosen, though the size of the impact seems to peak over a 5 year window and moderates over a longer period (text chart[16]). Interestingly, the coefficients for the length of deleveraging suggest more negative growth impacts over shorter horizons, with the estimated coefficients stabilizing over a longer period. The results suggest that growth following deleveraging could take

Estimated Average Impacts of Deleveraging on Subsequent Annual Growth

some time to recover, and confirm that on net, more aggressive and shorter deleveraging remains beneficial for subsequent growth.
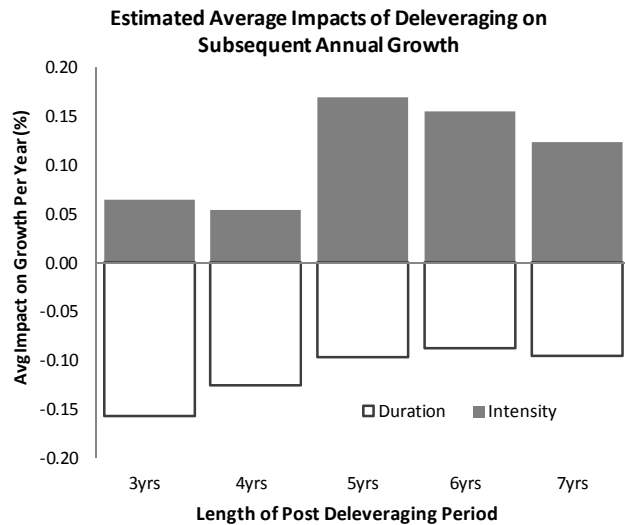
Credit Gap. As an alternative to the private sector debt-to-GDP ratio, we consider the impact of the cyclical deviation in leverage ratios– measured as the percentage deviation of the ratio from trend. The motivation is to see whether, after accounting for the varying degrees of financial deepening – hence different trends – in our sample, the degrees of disequilibrium affects the modalities of deleveraging and correspondingly, subsequent growth. Put differently, increased financial market deepening is often thought to have promoted more efficient allocation of resources, accompanied by higher debt-to-asset levels; there is little evidence that the severity and length of recessions are correlated with the *level* of private sector debt – otherwise recessions would have shown increasing magnitude and duration, in line with the secular

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[16] Coefficient signs for intensity are reversed to show positive impact on subsequent growth.

increases in debt levels. But cyclical deviations in debt-to-asset levels relative to trend may heighten default probabilities through reduced collateral values at downturns and correspondingly, limited access to credit markets. The data on cyclical deviations suggest a positive relationship between the credit gap (i.e. higher leverage) at time of leverage cycle peak and total size of deleveraging. The equilibrium debt-to-income ratios may therefore be time-varying and dependent on economic fundamentals; the role of cyclical leverage relative to trend could be considered when assessing the impact of deleveraging on subsequent growth.

In this context, to more closely examine the role of cyclical fluctuations in leverage, we identify new deleveraging episodes using cyclical movements in leverage, where leverage ratios are detrended using the Christiano-Fitzgerald filter (Christiano & Fitzgerald, 2001)[17]. The number of deleveraging episodes increased from 83 to 135 (Appendix I, Table 2). The episodes generally overlap with those from the benchmark model, though starting dates shifted somewhat. The length of deleveraging episodes increased slightly, from 4.7 years on average to 5.3 years, while the intensity of deleveraging fell slightly from an average of 3.6 percentage points to 2.9 percentage points. The regression results are qualitatively the same as the benchmark model. The impact of closing the credit gap on subsequent growth is sizable, ranging from 8 to about 20 basis points for every percentage points of narrowing in credit gap. Notably, the length of time spent deleveraging became statistically significant and the economic impact, larger. Each additional year spent closing the credit-gap is associated with subsequent output loss of 8 to slightly over 20 basis points per year (Appendix 2, Table 4).

Channels of deleveraging – households vs. nonfinancial corporate. To assess the sensitivity of investment and consumption to private sector deleveraging, we drilled down into the sectoral components of leverage cycles, decomposing them into changes in non-financial corporate and household leverage ratios, focusing on non-financial corporate debt to profit and household debt to gross deposable income (Appendix 1, Table 3 and 4, respectively). Given limited data, the number of deleveraging episodes falls considerably; for corporates, 40 episodes and for households, 17 episodes— compared to 83 episodes for total private debt. Excluding the Global Financial Crisis, the number of episodes falls to 33 and 12, respectively. The very limited number of household deleveraging episodes excludes empirical analysis. In the small sample of specifically corporate deleveraging episodes, there is little relationship between deleveraging and growth over the subsequent 5 years, in part, because investment dipped sizably within that window for a number of countries. If we shrink the post deleveraging window to three years, the relationship between deleveraging and growth became somewhat clearer. We found that the impact of deleveraging length has a dominant impact on future real investment growth, with consistently negative coefficients that are economically significant (Appendix 2, Table 5). Specifically, every year of deleveraging is associated with subsequent output loss of about, on average, 50 basis points per year. By contrast, the impact of deleveraging intensity is found to have little relationship with post deleveraging growth. A specific challenge with identification here may be that a large part of investment growth at cyclical frequencies may be explained by prospects for future aggregate growth.

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[17] The filter cycles last between 5 and 32 quarters.

Extreme deleveraging events. To address the potential issue of endogeneity between growth during the deleveraging period and the subsequent years as well as the issue of reverse causality between growth and leverage ratios, we also use an additional two-step approach focused on extreme shocks. The first step consists of estimating the drivers of episodes of private sector deleveraging using various explanatory variables, such as: contemporaneous and lagged GDP growth, changes in interest rates, inflation, or other structural features. As financial crises are also likely to affect private sector deleveraging, crisis dummies are also included among the explanatory variables. Extreme deleveraging events are then indicated using the residuals below the 5th percentile. In all, there are 52 identified extreme deleveraging events, of which 20 in the household sector and 17 in the corporate sector (Appendix 3, Table 1). The second step focuses on deriving the impulse response functions of real (per capita) output to extreme deleveraging events. The results, attributable to *sharp* leverage reductions, are larger relative to the benchmark model and confirm that a reduction in the private sector debt has a significant and persistently positive effect on output. In particular, the occurrence of an extreme deleveraging episode increases real output by 0.6 percentage points after one year, or, a cumulative increase in real output of about 2.8 percent after 5 years. Interestingly, the effect seems to be driven by the corporate sector deleveraging rather than household (see Appendix 3 for more details).

Advanced vs. Emerging Market Economies. To see whether economic development matter, we divide our analysis between advanced and emerging market economies. In particular, using a two-step approach, we identify 29 exogenous deleveraging episodes in advanced countries and 23 in emerging economies. It appears that a sharp decrease in the private sector leverage has mostly a significant effect on output in emerging markets. In particular, an extreme deleveraging episode increases real output by 1.4 percent after one year with a 3-year cumulative impact of about 3.6 percent (text charts, Appendix 3).

Banking/Financial Crises. We examine whether the impact of deleveraging depends on the existence of a banking crisis using the dataset constructed by Laeven and Valencia (2012). It seems that the impact of a sharp reduction in private sector deleveraging on output is larger—with a 5-year cumulative increase of about 3.5 percent—when associated with bank restructuring, likely underscoring the important role of credit intermediation from banks. The effect, however, seems to be driven by advanced countries. In fact, private sector deleveraging has no significant impact on output when it is associated with banking crises in emerging markets. The striking difference between advanced economies and emerging economies suggests that the degree of financial deepening seems to play a role in the propagation of financial crises to the real economy.

Deleveraging/Growth Trade-off. Lastly, we return to the trade-off between deleveraging's potential short-term costs and long-run benefits for growth. In our benchmark regressions we seek to gauge causality by measuring output growth after the deleveraging episode concludes. For potential output losses *concurrent* with deleveraging we cannot establish causality. By assuming that the causality runs exclusively from deleveraging to growth, however, we can establish an upper bound on the potential short-run costs of deleveraging. To do so we simply rerun our benchmark regression with in-episode growth as the dependent variable and compare these results with those of the benchmark. The estimated effect of deleveraging intensity is highly unstable across regression specifications in the in-episode estimate, compared to positive and significant effects seen in the post-episode exercise across all specifications. This, in part,

could be related to findings from Section III, which noted that in practice, deleveraging is brought on largely through lower borrowing and higher income growth. The net effect of deleveraging—the difference in coefficients between the two exercises—does confirm that that deleveraging, though likely to dampen growth in the short run, is associated with output gains overall (left-hand side text chart). Meanwhile, the effect of time spent deleveraging is unequivocally associated with output losses, though the in-episode impact is larger (right-hand side text chart).

Range of Intensity Coefficient Estimates

Range of Duration Coefficient Estimates

Effect on the annual GDP growth rate of an increase of the intensity of deleveraging by 1 percent of GDP.

Effect on the annual GDP growth rate of an increase of the duration of deleveragign episode by 1 year.
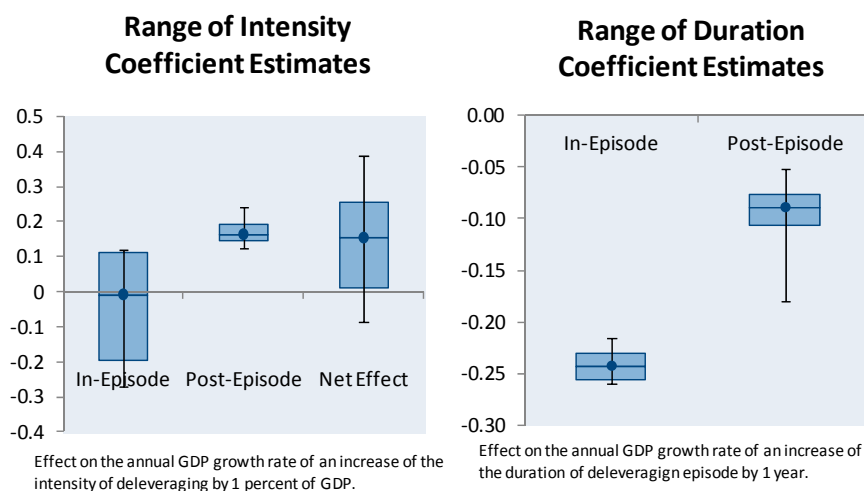
V. CONCLUSION

In this paper we have looked at the experience with private-sector leverage cycles across 36 countries over a span of 50 years and sought to assess how the modalities of deleveraging in the bust-phase of cycles affects subsequent economic growth.

Private sector debt has been rising on a secular basis, reflecting growing income levels and financial development. But this trend belies slow moving leverage cycles where leverage ratios tend to peak about every 19 years. Deleveraging experiences are therefore not uncommon and indeed most deleveraging episodes end within 5 years. Meanwhile, although total deleveraging size tends to increase with the length of adjustment, there does not appear to be a relationship between the intensity of deleveraging per year and the length of time spent deleveraging. Specifically, some of the sharpest reductions in leverage took place within two or three years, and some of the longest deleveraging spells were just as vigorous. Further, although deleveraging episodes were widely distributed across time, they became more synchronized around the late 1990s and most recently, during the Global Financial Crisis.

Looking at the impact of deleveraging, we find that larger deleveraging is positively associated with subsequent growth. Specifically, a 10 percentage point reduction in the leverage ratio over the 5 years of the typical episode is associated with an increase in annual growth of about 0.4 percentage points, such that the level of output would be about 2 percentage points higher over the subsequent 5-year period. In the more granular episode-based approach, the interpretation is more complex, but also intuitive. Greater intensity in deleveraging—i.e. higher per annum reduction in leverage—is associated with faster subsequent growth. But there is a trade-off

against the time spent deleveraging—the more stretched out the time spent deleveraging is, the lower the subsequent growth. More specifically, a 1 percentage point decline in private sector debt ratio per year during the episode is associated with 13 – 24 basis points increase in average annual real growth rate in the 5 years following the end of the episode. Considering that the average decline in the debt ratio per year for the sample pre-Global Financial Crisis (73 episodes spanning 36 countries) is about 3 percentage points, the average impact on the subsequent annual output growth would be about 30 to 70 basis points per year, hardly trivial. On the other hand, every year spent deleveraging is expected to trim as much as 12 basis points from subsequent growth per year. In this context, those that experienced shorter deleveraging episodes—relative to the average duration of 5 years—saw a boost to subsequent annual growth of about 5 basis points for every year below average duration.

A key challenge that we leave for future work is seeking to identify how much of the reduction in leverage observed in the episodes considered reflects the outcome of active efforts or policies to reduce firms and household debt burdens. To assess this we would need to have comprehensive data on the dynamics of debt related to real growth – interest differentials, savings, and then overlaid with data on debt reduction operations. In practice, non-financial sector nominal debt stock reduction is observed through internal savings, explicit write-downs of debt,[18] NPV reductions delivered through debt restructuring, and other modalities that could involve structured finance operations. In the Euro Area, for example, recent private sector deleveraging has been assisted, in part, by moving debt to the public sector's balance sheet through banking sector recapitalization, or debt-financed fiscal demand support (IMF 2013).

In the current context in advanced economies, this paper has documented that private sector balance sheet restructuring has been limited, albeit larger gains have been realized in the U.S. and the U.K. This may reflect the inherent difficulty of adjusting private debt stocks—restructuring requires the complex coordination between disparate stakeholders. And, it often calls for the substitution of private for public debt, a difficult task given the outlook for many sovereign balance sheets. But this paper has provided suggestive evidence of the gains that could be achieved by policies aimed at facilitating faster balance sheet realignments. Specifically, research has highlighted the importance of easing liquidity constraints and facilitating debt restructuring (Andritzky, 2014; IMF 2015), including strengthening incentives for decentralized debt resolution by bolstering the legal and institutional framework and market infrastructures for NPL resolutions (IMF 2013; Jassaud and Kang, forthcoming). These will remain important policy objectives and likely key to facilitating higher growth in advanced economies going forward.

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[18] For example McKinsey (2012) note that of the 15 percentage point reduction of debt relative to disposable income in U.S. households after the GFC, about two-thirds of which was a result of households walking away from foreclosed mortgages and other consumer debt. This reflects that mortgages in many U.S. jurisdictions are non-recourse in nature, such that under-water households may vacate the property and see their debt effectively written down by their financiers.

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VI. APPENDIX 1: LEVERAGE EPISODES

Table 1. Episode List – Changes in Private Debt/Nominal GDP

#	Country	Year	Group	Total Deleverage Size (ppt)	Duration (Yrs)	#	Country	Year	Group	Total Deleverage Size (ppt)	Duration (Yrs)
1	Australia	1968	AE	-2.70	4	43	Malaysia	1986	EM	-11.42	2
2	Australia	1990	AE	-12.10	4	44	Malaysia	1991	EM	-0.78	2
3	Australia	2008	AE	-11.32	2	45	Malaysia	1997	EM	-48.09	11
4	Austria	1981	AE	-3.01	2	46	Mexico	1994	EM	-29.27	7
5	Belgium	1979	AE	-20.60	7	47	Netherlands	2006	AE	-2.07	2
6	Belgium	2003	AE	-8.21	2	48	Norway	1962	AE	-6.85	3
7	Canada	1968	AE	-3.50	2	49	Norway	1969	AE	-7.80	5
8	Canada	1981	AE	-13.81	3	50	Norway	1978	AE	-10.96	3
9	Canada	1993	AE	-4.75	2	51	Norway	1988	AE	-33.47	8
10	Canada	2002	AE	-3.77	3	52	Norway	2010	AE	--	--
11	China	1993	EM	-7.68	2	53	Poland	2002	EM	-6.62	2
12	China	2003	EM	-12.08	3	54	Portugal	1976	AE	-9.45	3
13	Denmark	1975	AE	-17.56	7	55	Portugal	1983	AE	-69.44	7
14	Denmark	1990	AE	-16.34	4	56	Russia	1998	EM	-10.07	2
15	Denmark	2009	AE	--	--	57	Saudi Arabia	2009	EM	--	--
16	Finland	1992	AE	-54.46	6	58	Singapore	1985	AE	-14.23	3
17	France	1973	AE	-2.80	6	59	Singapore	1997	AE	-21.70	9
18	France	1984	AE	-3.71	2	60	South Africa	1973	EM	-8.32	7
19	France	1993	AE	-3.69	5	61	South Africa	1985	EM	-13.98	8
20	Germany	1985	AE	-3.57	5	62	South Africa	2008	EM	--	--
21	Germany	2003	AE	--	--	63	Spain	1976	AE	-12.81	3
22	Greece	1983	AE	-14.56	10	64	Spain	1982	AE	-16.97	5
23	Hong Kong SAR	1983	AE	-15.14	2	65	Spain	1993	AE	-7.12	2
24	Hong Kong SAR	1990	AE	-22.65	2	66	Spain	2010	AE	--	--
25	Hong Kong SAR	1997	AE	-23.25	5	67	Sweden	1968	AE	-10.70	3
26	Hungary	2009	EM	--	--	68	Sweden	1973	AE	-13.04	7
27	India	1962	EM	-1.63	5	69	Sweden	1990	AE	-28.52	6
28	India	1989	EM	-3.15	5	70	Sweden	2001	AE	-3.46	2
29	Indonesia	1978	EM	-7.75	2	71	Sweden	2009	AE	--	--
30	Indonesia	1990	EM	-3.93	3	72	Switzerland	1969	AE	-24.89	5
31	Indonesia	1997	EM	-49.85	5	73	Switzerland	1980	AE	-2.27	2
32	Ireland	1974	AE	-14.32	3	74	Switzerland	1990	AE	-5.70	4
33	Ireland	1981	AE	-10.67	8	75	Switzerland	1999	AE	-8.19	3
34	Italy	1972	AE	-33.72	11	76	Thailand	1997	EM	-90.94	10
35	Italy	1993	AE	-7.49	4	77	Turkey	1997	EM	-7.45	6
36	Italy	2010	AE	--	--	78	United Kingdom	1967	AE	-3.17	10
37	Japan	1972	AE	-8.12	2	79	United Kingdom	1992	AE	-10.26	5
38	Japan	1995	AE	-55.55	12	80	United Kingdom	2009	AE	--	--
39	Japan	2009	AE	--	--	81	United States	1974	AE	-4.28	2
40	Korea	1969	AE	-20.69	7	82	United States	1989	AE	-6.70	4
41	Korea	1985	AE	-10.42	3	83	United States	2008	AE	-15.38	4
42	Korea	1997	AE	-23.55	7						

Table 2. Episode List – Cyclical Changes in Private Debt/Nominal GDP

#	Country	Year	Total Private Debt/NGDP (%) at T_0	Total deleveraging size (ppt)	Duration (years)	#	Country	Year	Total Private Debt/NGDP (%) at T_0	Total deleveraging size (ppt)	Duration (years)
1	Australia	1967	62	-7	5	53	United Kingdom	1990	134	-39	8
2	Australia	1975	67	-7	3	54	United Kingdom	2008	208	--	--
3	Australia	1989	115	-27	6	55	Greece	1971	42	-2	3
4	Australia	2008	187	--	--	56	Greece	1983	51	-4	15
5	Austria	1966	44	-2	2	57	Greece	2009	122	--	--
6	Austria	1971	56	-5	4	58	Hong Kong SAR	1982	127	-28	4
7	Austria	1980	86	-10	6	59	Hong Kong SAR	1990	163	-26	3
8	Austria	1990	106	-8	6	60	Hong Kong SAR	1997	180	-37	5
9	Austria	2001	139	-7	4	61	Hong Kong SAR	2005	172	-2	2
10	Austria	2010	164	--	--	62	Hungary	2009	170	--	--
11	Belgium	1972	86	-2	2	63	Indonesia	1991	54	-6	2
12	Belgium	1979	107	-23	7	64	Indonesia	1997	76	-42	4
13	Belgium	1991	104	-8	5	65	India	1971	14	-1	3
14	Belgium	2001	179	-20	5	66	India	1988	29	-6	10
15	Canada	1967	90	-4	3	67	India	2001	33	-1	2
16	Canada	1973	100	0	2	68	India	2008	55	--	--
17	Canada	1980	122	-24	5	69	Ireland	1974	96	-8	3
18	Canada	1992	150	-12	3	70	Ireland	1986	88	-11	3
19	Canada	1997	151	-17	8	71	Ireland	1992	100	-20	4
20	Canada	2010	191	--	--	72	Ireland	1999	150	-33	5
21	Switzerland	1969	134	-25	5	73	Ireland	2010	338	--	--
22	Switzerland	1979	144	-11	6	74	Italy	1973	86	-19	8
23	Switzerland	1990	186	-13	4	75	Italy	1992	77	-19	6
24	Switzerland	1996	186	-8	6	76	Italy	2001	86	1	2
25	Switzerland	2004	183	-6	3	77	Italy	2009	128	--	--
26	China	1987	77	-2	2	78	Japan	1966	123	-7	3
27	China	1992	85	-15	3	79	Japan	1972	146	-22	8
28	China	1998	104	-4	3	80	Japan	1983	162	-1	2
29	China	2003	128	-27	4	81	Japan	1994	221	-37	11
30	Czech Republic	1997	81	-15	7	82	Korea	1969	72	-40	8
31	Germany	1968	82	-2	3	83	Korea	1984	101	-21	4
32	Germany	1973	90	-3	4	84	Korea	1992	132	-4	2
33	Germany	1983	107	-12	8	85	Korea	1997	170	-44	8
34	Germany	2002	136	--	--	86	Korea	2009	193	--	--
35	Denmark	1968	115	-2	3	87	Mexico	1994	48	-27	9
36	Denmark	1974	134	-35	9	88	Malaysia	1970	22	-11	8
37	Denmark	1988	162	-32	10	89	Malaysia	1985	85	-23	8
38	Denmark	2008	261	--	--	90	Malaysia	1997	159	-49	9
39	Spain	1975	106	-13	4	91	Netherlands	1963	45	-8	8
40	Spain	1983	103	-14	4	92	Netherlands	1980	100	-17	6
41	Spain	1990	95	-22	7	93	Netherlands	1989	127	-14	7
42	Spain	2008	221	--	--	94	Netherlands	2004	203	-5	3
43	Finland	1977	90	-10	6	95	Netherlands	2010	222	--	--
44	Finland	1992	167	-47	9	96	Norway	1962	112	-6	3
45	Finland	2010	178	--	--	97	Norway	1967	106	-5	7
46	France	1973	88	-8	8	98	Norway	1977	126	-18	4
47	France	1983	88	-3	3	99	Norway	1988	167	-44	7
48	France	1991	105	-16	7	100	Norway	1998	159	-5	3
49	France	2001	124	-5	3	101	Norway	2009	219	--	--
50	France	2010	158	--	--	102	Poland	2001	42	-11	4
51	United Kingdom	1967	63	-5	3	103	Poland	2009	71	--	--
52	United Kingdom	1973	69	-20	7	104	Portugal	1964	82	-5	4

Table 2 – Cont'd. Episode List – Cyclical Changes in Private Debt/Nominal GDP (2)

#	Country	Year	Total Private Debt/NGDP (%) at T_0	Total deleveraging size (ppt)	Duration (years)
105	Portugal	1974	128	-15	5
106	Portugal	1983	157	-63	7
107	Portugal	2001	184	-16	4
108	Portugal	2009	251	--	--
109	Russia	1998	33	-7	3
110	Russia	2009	63	--	--
111	Saudi Arabia	1998	44	-8	4
112	Saudi Arabia	2009	61	--	--
113	Singapore	1973	73	-8	5
114	Singapore	1984	106	-27	9
115	Singapore	1997	116	-11	3
116	Singapore	2002	112	-24	4
117	Sweden	1968	130	-12	13
118	Sweden	1990	167	-44	7
119	Sweden	2001	180	-17	4
120	Sweden	2009	265	--	--
121	Thailand	1971	26	-2	11
122	Thailand	1984	61	-14	4
123	Thailand	1997	182	-74	5
124	Thailand	2004	102	-5	3
125	Turkey	1997	27	-15	7
126	United States	1964	89	-2	6
127	United States	1973	99	-7	4
128	United States	1979	103	-4	3
129	United States	1988	127	-18	10
130	United States	2008	179	--	--
131	South Africa	1971	57	-7	9
132	South Africa	1984	62	-8	4
133	South Africa	1990	57	-7	4
134	South Africa	1998	65	-8	5
135	South Africa	2007	81	--	--

Table 3. Episode List – Changes in NFC Debt/Profit

#	Country	Year	Debt/Profit (%) at T_0	Deleveraging Size (ppt)	Duration (years)
1	Australia	1982	191	-11	2
2	Australia	1990	252	-64	5
3	Australia	2001	207	-13	2
4	Australia	2008	246	--	--
5	Austria	2001	244	-26	5
6	Belgium	2003	422	-48	2
7	Canada	1992	456	-127	8
8	Canada	2002	362	-72	3
9	Canada	2009	381	--	--
10	China	2009	1228	-272	1
11	Germany	1993	162	-21	2
12	Germany	2003	173	-27	4
13	Germany	2009	163	--	--
14	Spain	1992	183	-41	3
15	Spain	2010	346	--	--
16	Finland	1977	197	-29	2
17	Finland	1992	377	-171	6
18	France	1983	185	-23	3
19	France	1992	194	-6	6
20	France	2002	235	-4	1
21	United Kingdom	1992	323	-83	5
22	United Kingdom	2002	421	-43	2
23	Italy	1988	119	-11	1
24	Italy	1993	133	-25	3
25	Japan	1975	3345	-1997	5
26	Japan	1986	1917	-461	3
27	Japan	1993	3394	-2543	14
28	Japan	2009	1767	--	--
29	Netherlands	1993	237	-20	4
30	Netherlands	2001	267	-36	7
31	Netherlands	2009	254	--	--
32	Norway	1988	498	-202	8
33	Norway	1998	464	-179	8
34	Norway	2009	472	--	--
35	Sweden	2001	441	-57	3
36	Sweden	2009	654	-101	1
37	United States	1974	152	-18	2
38	United States	1988	174	-29	6
39	United States	2001	181	-12	3
40	United States	2008	207	-16	2

Table 4. Episode List – Changes in HH Debt/GDI

#	Country	Date	HH debt/GDI (%) at T_0	Total deleveraging size (ppt)	Duration (Years)
1	Belgium	1999	64	-5	2
2	Canada	1999	104	-1	2
3	Switzerland	2005	185	-8	3
4	Germany	1986	90	-13	5
5	Germany	2000 [1]	108	Note 1	Note 1
6	Finland	1989	78	-23	8
7	France	1993	55	-2	2
8	United Kingdom	1990	104	-10	7
9	United Kingdom	2008	156	ongoing	ongoing
10	Hungary	2010	69	ongoing	ongoing
11	Italy	1993	26	-2	2
12	Japan	1990	111	-3	2
13	Japan	2000 [1]	116	Note 1	Note 1
14	United States	1965	65	-6	5
15	United States	1973	61	-2	2
16	United States	1979	69	-6	3
17	United States	2007	127	ongoing	ongoing

Note 1: German and Japanese household debt ratios have been on a secular downward trend since 2000, with the latest 2013 data suggesting ongoing declines.

VII. APPENDIX 2: REGRESSION RESULTS

Table 1. Impact of Deleveraging on Future Output Growth from Year 6 to Year 10 – (Nominal Private Debt/Nominal GDP)
Fixed-Window Approach

Dependent variable:

Average real GDP per capita growth over T_6 to T_{10}

	reg1	reg2	reg3	reg4	reg5	reg6	reg7	reg8	reg9	reg10
Change in Debt/GDP ratio (T_0 - T_5)	-0.019	-0.042***	-0.036***	-0.036***	-0.037***	-0.038***	-0.039***	-0.039***	-0.030*	-0.030*
(minus sign = "deleveraging")	(0.012)	(0.013)	(0.012)	(0.013)	(0.013)	(0.014)	(0.015)	(0.014)	(0.017)	(0.017)
Output growth (T_0 - T_5)		0.539***	0.540***	0.544***	0.540***	0.594***	0.588***	0.586***	0.618***	0.621***
		(0.113)	(0.118)	(0.117)	(0.121)	(0.113)	(0.117)	(0.127)	(0.100)	(0.106)
REER appreciation (T_0-T_5)			-0.034*	-0.034*	-0.033	-0.021	-0.019	-0.019	-0.032*	-0.032*
(minus sign = "appreciation")			(0.018)	(0.018)	(0.021)	(0.019)	(0.021)	(0.021)	(0.018)	(0.018)
GDP per capita relative to US at T_0				-0.595	-0.671	-0.248	-0.146	-0.159	-0.012	0.008
				(0.542)	(0.623)	(0.544)	(0.649)	(0.665)	(0.622)	(0.639)
Private Debt/GDP at T_0					-0.001		-0.002	-0.002	0.000	0.000
					(0.006)		(0.006)	(0.006)	(0.004)	(0.005)
Gov't Debt/GDP at T_0						-0.005	-0.004	-0.004	-0.005	-0.005
						(0.008)	(0.008)	(0.009)	(0.008)	(0.009)
Avg change in fiscal balance (T_0 - T_5)								-0.031		0.031
(minus sign = "expansion")								(0.399)		(0.391)
Change in policy rate (T_5-T_0)									-0.116***	-0.116***
(minus sign = "loosening")									(0.044)	(0.045)
Number of observations	71	71	71	71	71	67	67	67	67	67
Adjusted R^2	0.009	0.317	0.347	0.338	0.328	0.394	0.386	0.376	0.455	0.445

note: *** p<0.01, ** p<0.05, * p<0.1

Figures in parantheses are standard errors.

The symbols ***, ** , * denote significance at 1, 5 and 10 percent, respectively.

Table 2. Impact of Deleveraging on Future Output Growth 5 years Post Deleveraging – (Nominal Private Debt/Nominal GDP)
Episode-Based Approach

Dependent variable:

Average real GDP per capita growth over 5 years post deleveraging

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6	Reg 7	Reg 8	Reg 9	Reg 10	Reg 11
Change in Debt/GDP ratio per yr during Deleveraging	-0.200**	-0.201**	-0.146*	-0.144*	-0.128*	-0.162*	-0.126	-0.240**	-0.186*	-0.177*	-0.152
(minus sign = "deleveraging")	(0.096)	(0.094)	(0.078)	(0.075)	(0.076)	(0.088)	(0.080)	(0.094)	(0.096)	(0.101)	(0.103)
Length of deleveraging (yrs)		-0.179**	-0.076	-0.099	-0.113	-0.109	-0.092	-0.076	-0.051	-0.076	-0.086
(positive sign = longer deleveraging)		(0.084)	(0.071)	(0.070)	(0.070)	(0.070)	(0.065)	(0.064)	(0.063)	(0.067)	(0.067)
Output growth during deleveraging			0.443***	0.381***	0.339***	0.346***	0.402***	0.445***	0.430***	0.463***	0.447***
			(0.077)	(0.079)	(0.085)	(0.085)	(0.081)	(0.081)	(0.083)	(0.084)	(0.085)
REER appreciation during deleveraging				-0.126**	-0.107*	-0.099*	-0.102*	-0.063	-0.021	-0.087	-0.063
(minus sign = "appreciation")				(0.054)	(0.055)	(0.057)	(0.056)	(0.057)	(0.059)	(0.068)	(0.070)
Real GDP per capita relative to US at T_0					-0.649	-0.404	-0.197	0.569	0.619	0.703	0.600
					(0.480)	(0.579)	(0.467)	(0.576)	(0.571)	(0.595)	(0.597)
Private Debt/GDP at T_0						-0.004		-0.011**	-0.010*	-0.010*	-0.009*
						(0.005)		(0.005)	(0.005)	(0.005)	(0.005)
Gov't Debt/GDP at T_0							-0.006	-0.003	-0.011	-0.012	-0.013
							(0.007)	(0.007)	(0.007)	(0.008)	(0.008)
Avg annual change in fiscal balance (T_0 - T_5)									-0.183		-0.315
(minus sign = "expansion")									(0.199)		(0.253)
Change in policy rate (T_0 - T_5)										-0.050*	-0.049*
(minus sign = "loosening")										(0.027)	(0.027)
Number of observations	71	71	71	71	71	71	67	67	65	56	56
Adjusted R^2	0.046	0.093	0.385	0.423	0.431	0.427	0.487	0.516	0.504	0.530	0.536

Figures in parantheses are standard errors.

The symbols ***, ** , * denote significance at 1, 5 and 10 percent, respectively.

Table 3. Impact of Deleveraging on Future Output Growth – (Interaction between intensity and duration)

Dependent variable:
Avg. real GDP per capita growth post deleveraging

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6	Reg 7	Reg 8	Reg 9	Reg 10	Reg 11	Reg 12
Change in Debt/GDP ratio per year relative to average during deleveraging	-0.200**	-0.201**	-0.216**	-0.160**	-0.158**	-0.142*	-0.150*	-0.220**	-0.279***	-0.220**	-0.216**	-0.191*
(*negative* sign = "deleveraging")	(0.096)	(0.094)	(0.093)	(0.077)	(0.074)	(0.075)	(0.087)	(0.086)	(0.095)	(0.099)	(0.104)	(0.106)
Length of deleveraging relative to average (yrs)		-0.179**	-0.166**	-0.064	-0.086	-0.100	-0.100	-0.087	-0.078	-0.056	-0.078	-0.088
(positive sign = longer than average)		(0.084)	(0.083)	(0.070)	(0.069)	(0.069)	(0.070)	(0.062)	(0.062)	(0.062)	(0.067)	(0.067)
Interaction: Deleveraging intensity & duration relative to avg.			0.054	0.050*	0.049*	0.048*	0.046	0.078**	0.062*	0.046	0.047	0.045
(positive = deleveraging *above* avg of 3.6% of GDP & duration *below* avg of 4.7 yrs)			(0.035)	(0.029)	(0.028)	(0.028)	(0.030)	(0.031)	(0.033)	(0.033)	(0.034)	(0.034)
Output growth during deleveraging				0.441***	0.379***	0.339***	0.341***	0.420***	0.446***	0.430***	0.462***	0.447***
				(0.076)	(0.078)	(0.083)	(0.084)	(0.078)	(0.080)	(0.082)	(0.084)	(0.084)
REER appreciation during deleveraging					-0.125**	-0.106*	-0.104*	-0.069	-0.049	-0.015	-0.088	-0.066
(minus sign = "appreciation")					(0.053)	(0.055)	(0.056)	(0.055)	(0.056)	(0.059)	(0.067)	(0.070)
Real GDP per capita relative to US at T_0						-0.622	-0.561	-0.157	0.357	0.446	0.582	0.487
						(0.473)	(0.581)	(0.448)	(0.575)	(0.580)	(0.596)	(0.598)
Private Debt/GDP at T_0								-0.001		-0.007	-0.007	-0.008	-0.007
								(0.005)		(0.005)	(0.005)	(0.006)	(0.006)
Gov't Debt/GDP at T_0								-0.006	-0.004	-0.011	-0.012	-0.013
								(0.007)	(0.007)	(0.007)	(0.008)	(0.008)
Change in fiscal balance per year during deleveraging										-0.170		-0.301
(minus sign = "expansion")										(0.198)		(0.251)
Change in policy rate during deleveraging											-0.051*	-0.050*
(minus sign = "loosening")											(0.027)	(0.027)
Number of observations	71	71	71	71	71	71	71	67	67	65	56	56
Adjusted R2	0.046	0.093	0.111	0.403	0.442	0.448	0.439	0.529	0.537	0.513	0.539	0.543

Figures in parantheses are standard errors.
The symbols ***, ** , * denote significance at 1, 5 and 10 percent, respectively.

Table 4. Impact of Deleveraging on Future Output Growth – (Cyclical deviation in Debt/NGDP)

Dependent variable:
Avg. real GDP per capita growth 5 yrs post deleveraging

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6	Reg 7	Reg 8	Reg 9	Reg 10	Reg 11
Change in cyclical PV/GDP ratio per year during deleveraging	-0.110	-0.127	-0.093	-0.076	-0.057	-0.128	-0.081	-0.182**	-0.188**	-0.198**	-0.189**
(minus sign = "deleveraging")	(0.092)	(0.091)	(0.070)	(0.071)	(0.069)	(0.083)	(0.070)	(0.082)	(0.078)	(0.084)	(0.085)
Length of deleveraging (yrs)		-0.203**	-0.116*	-0.127*	-0.122*	-0.118*	-0.120**	-0.114*	-0.098*	-0.076	-0.091
(positive sign = longer deleveraging)		(0.086)	(0.067)	(0.067)	(0.065)	(0.064)	(0.061)	(0.060)	(0.058)	(0.069)	(0.071)
Output growth during deleveraging			0.551***	0.554***	0.491***	0.501***	0.531***	0.551***	0.571***	0.559***	0.582***
			(0.063)	(0.063)	(0.065)	(0.065)	(0.063)	(0.062)	(0.064)	(0.067)	(0.071)
REER appreciation during deleveraging				-0.075	-0.056	-0.049	-0.037	-0.022	-0.120*	-0.074	-0.101
(minus sign = "appreciation")				(0.057)	(0.056)	(0.056)	(0.057)	(0.057)	(0.064)	(0.067)	(0.074)
Real GDP per capita relative to US at T_0					-1.129***	-0.674	-0.903**	-0.238	0.114	0.094	0.188
					(0.404)	(0.500)	(0.391)	(0.486)	(0.470)	(0.494)	(0.505)
Private Debt/GDP at T_0						-0.007		-0.010**	-0.011***	-0.011**	-0.011**
						(0.005)		(0.005)	(0.004)	(0.005)	(0.005)
Gov't Debt/GDP at T_0							-0.006	-0.005	-0.003	-0.004	-0.003
							(0.006)	(0.006)	(0.005)	(0.006)	(0.006)
Change in fiscal balance per year during deleveraging									0.135		0.190
(minus sign = "expansion")									(0.181)		(0.209)
Change in policy rate during deleveraging										0.004	-0.003
(minus sign = "loosening")										(0.025)	(0.026)
Number of observations	110	110	110	110	110	110	105	105	102	89	89
Adjusted R2	0.004	0.045	0.438	0.442	0.476	0.482	0.541	0.559	0.569	0.550	0.549

Figures in parantheses are standard errors.
The symbols ***, ** , * denote significance at 1, 5 and 10 percent, respectively.

Table 5. Impact of Deleveraging on Future Investment Growth – (Corporate Debt/Profits)

Dependent variable:
Avg. real investment per capita growth for 3 years post deleveraging

	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6	Reg 7	Reg 8	Reg 9	Reg 10	Reg 11
Change in NFC debt/Profit ratio per year during deleveraging	0.005	0.004	0.002	0.002	0.006	0.003	0.008	0.012	0.014	0.017	0.020
(minus sign = "deleveraging")	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.020)	(0.008)	(0.022)	(0.023)	(0.022)	(0.024)
Length of deleveraging (yrs)		-0.415*	-0.465**	-0.520**	-0.371	-0.338	-0.311	-0.349	-0.425	-0.556	-0.665
(positive sign = longer deleveraging)		(0.213)	(0.230)	(0.240)	(0.282)	(0.348)	(0.287)	(0.347)	(0.457)	(0.390)	(0.502)
Real investment growth during deleveraging			-0.082	-0.050	-0.071	-0.074	-0.083	-0.080	-0.105	-0.092	-0.127
			(0.133)	(0.139)	(0.140)	(0.144)	(0.140)	(0.144)	(0.174)	(0.149)	(0.181)
REER appreciation during deleveraging				-0.188	-0.112	-0.108	-0.072	-0.075	-0.084	0.023	0.013
(minus sign = "appreciation")				(0.216)	(0.229)	(0.234)	(0.231)	(0.236)	(0.243)	(0.256)	(0.262)
Real GDP per capita relative to US at T_0					-3.396	-3.296	-4.003	-4.175	-4.169	-5.230	-5.263
					(3.387)	(3.501)	(3.425)	(3.591)	(3.660)	(3.827)	(3.906)
Total NFC Debt/Profit at T_0						-0.000		0.000	0.001	0.002	0.002
						(0.002)		(0.002)	(0.003)	(0.003)	(0.003)
Gov't Debt/GDP at T_0							-0.025	-0.027	-0.027	-0.018	-0.018
							(0.023)	(0.025)	(0.026)	(0.028)	(0.028)
Change in fiscal balance per year during deleveraging									-0.222		-0.308
(minus sign = "expansion")									(0.846)		(0.869)
Change in policy rate during deleveraging										-0.456	-0.468
(minus sign = "loosening")										(0.377)	(0.386)
Number of observations	33	33	33	33	33	33	33	33	33	31	31
Adjusted R2	-0.013	0.070	0.050	0.043	0.043	0.007	0.048	0.011	-0.027	0.022	-0.019

Figures in parantheses are standard errors.
The symbols ***, ** , * denote significance at 1, 5 and 10 percent, respectively.

VIII. APPENDIX 3: TWO-STEP APPROACH TO ISOLATE EXTREME EXOGENOUS DELEVERAGING SHOCKS

This appendix describes an alternative empirical methodology to assess the impact of private sector deleveraging on real (per capita) output in a group of 36 emerging and advanced economies over the period 1960 and 2013.

A. *Exogenous* episodes of private sector deleveraging

To address reverse causality from growth to deleveraging, the first step consists of estimating private sector deleveraging episodes using various explanatory variables:

$$\Delta PSD_{i,t} = \alpha_{i+}\tau_{i,t} + \sum_{j=1}^{l} \beta_j \Delta y_{i,t-j} + \sum_{j=1}^{l} \gamma_j x_{i,t-j} + \varepsilon i, t$$
(1),

where PSD is a change in private sector credit-to-GDP, household credit-to-GDI, or corporate debt-to-profit ratio; β_j captures the impact of contemporaneous and lagged output growth; and x is a vector of control variables, including changes in monetary policy interest rates, trade openness, and a banking crisis dummy. The residuals $-\varepsilon_{i,t}$ –are then used to construct extreme *exogenous* events of private sector deleveraging $(D_{i,t})$ as

$$\begin{cases} D_{i,t} = 1 & if \ \varepsilon_{i,t} < a \\ \\ D_{i,t} = 0, & otherwise \end{cases}$$

where a corresponds to the value of the 5th percentile of the distribution. The number of indentified *exogenous* deleveraging episodes is listed in the table below.

Table 1: Number of deleveraging episodes (1965-2012)

|	AEs	EMs
Credit-to-GDP	29	23
Corporate debt-to-Profit	16	1
Household debt-to-GDI	16	4

B. Impulse response functions of output

The second step consists of deriving the impulse response functions of real (per capita) output to *extreme exogenous* deleveraging events using *local projections* (Jorda, 2005) by estimating a set of k (with k=1,…, 5) independent equations:

$$y_{i,t+k} - y_{i,t} = \alpha_i^k + \sum_{j=1}^{l} \beta_j^k \Delta y_{i,t-j} + \sum_{j=1}^{l} \gamma_j^k \Delta x_{i,t-j} + \varphi_k D_{i,t} + \varepsilon_{i,t}^k$$
(2),

where $y_{i,t}$ is the log of real GDP per capita, φ_k captures the impact of deleveraging episodes on output, β_j^k – the effect of persistence in output growth; and $\Delta x_{i,t-j}$ is a set of variables influencing output in the short and medium term. The results (Figure 1-6) obtained with this two-step approach confirm that a

sharp reduction in the private sector debt has a significant and persistent effect on output. In particular, the occurrence of an *exogenous* deleveraging episode increases real output by 0.6 percent in the short term, with the 5-year cumulative effect of about 2.8 percent. The effect seems to be driven by the corporate sector deleveraging rather than the household sector. The impact on real output is also larger – about 3.5 percent after 5 year—when private sector deleveraging is associated with bank restructuring , especially in advanced economies.

1. Impact of deleveraging on real output per capita
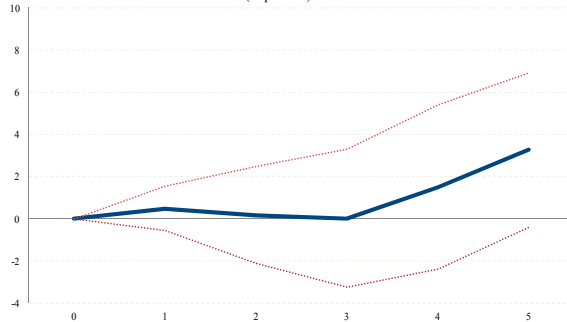(in percent)
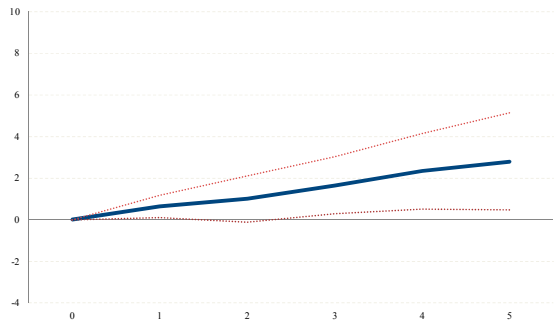
2. Impact of corporate deleveraging on real output per capita
(in percent)
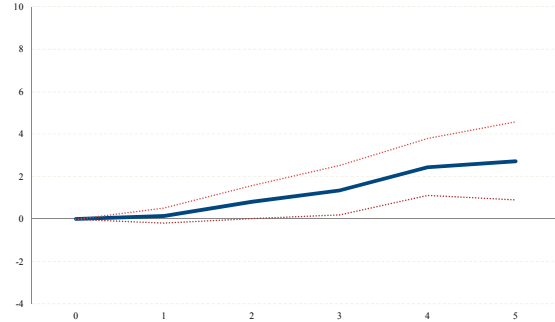
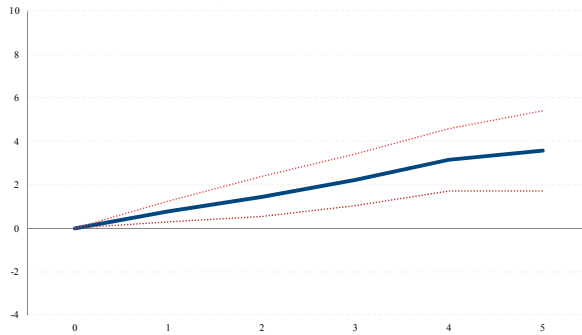**3. Emerging markets: Impact of deleveraging on real output per capita**
(in percent)
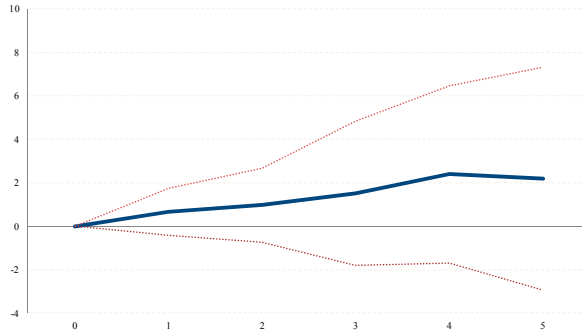
4. Impact of household deleveraging on real output per capital
(in percent)

5. Impact of deleveraging on real output per capita
(in percent, with bank restructuring)

6. Advanced economies: Impact of deleveraging on real output per capita
(in percent, with bank restructuring)