**EXECUTIVE BOARD MEETING**

EBS/22/16

March 18, 2022

To: Members of the Executive Board

From: The Secretary

Subject: **April 2022 World Economic Outlook—Analytical Chapter 2 and Online Annex**

| | |
|---|---|
| Board Action: | Executive Directors' **consideration** (Formal) |
| Tentative Board Date: | **Monday, April 11, 2022** |
| Publication: | Yes, it is intended that the full set of the World Economic Outlook documents will be released to the public at the time of the World Economic Outlook press conference, tentatively scheduled for **Tuesday, April 19, 2022**.<br><br>The analytical chapters will be made available to the public on the IMF website in advance of the publication of the full document. |
| Questions: | Mr. Natal, RES (ext. 35983) |
| Additional Information: | The paper will be revised for publication in light of the Executive Board discussion. If Executive Directors have comments, they should notify Mr. Natal by **5:30 p.m. on Friday, April 1, 2022**. |

CHAPTER 2

# PRIVATE SECTOR DEBT AND THE GLOBAL RECOVERY

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*During the pandemic, and in particular its most acute phase, government policies helped maintain private access to credit, staving off a deeper recession in 2020. This chapter examines whether the resulting increase in leverage may affect the pace of the recovery. On average, the drag on future GDP growth is estimated at –0.9 percent over three years for advanced economies and at –1.3 percent for emerging markets. However, analyzes based on micro-level data show that the recovery is likely to be slower in countries where (1) leverage is concentrated among vulnerable firms and low-income households, (2) insolvency procedures are inefficient, (3) public and private deleveraging coincide and (4) monetary policy must be tightened rapidly. As countries prepare to normalize monetary policy, assessing how leverage is distributed and its interaction with countercyclical policies is key to forecasting the pace of the recovery and calibrating the unwinding of pandemic-time support. In some advanced economies where the recovery is well underway and private balance sheets are in good shape, fiscal support can be reduced faster, facilitating the work of central banks. Elsewhere, targeted fiscal support—within the limit of a credible medium-term fiscal framework—could be relied on to minimize the risk of disruptions and scarring.*

## Introduction[1]

Accommodative policies during the acute phase of the COVID-19 crisis mitigated its overall economic cost by providing ample and cheap liquidity to affected households and firms. But these policies also led to rapid debt buildup, extending a steady rise in overall leverage encouraged by supportive financial conditions since the global financial crisis of 2008. The surge in *global private* debt in 2020—of 13 percent of GDP—was widespread, faster than during the global financial crisis and almost as large as the rise in public debt (Figure 2.1, panel 1). Nonfinancial corporations which entered the pandemic with already elevated debt (*Global Financial Stability Report* [GFSR], April and October 2021) saw the largest increase, especially in advanced economies, partly thanks to extensive credit guarantees, concessional lending programs and moratoriums (Figure 2.1, panel 2).

Will these developments have a bearing on the nature of the recovery that lies ahead? After all, one person's debt is another person's asset, so why should it matter?

Answers to these questions require delving deep into why private debt matters. *First*, it matters because debtors and creditors are not alike.[2] Borrowers are typically constrained financially, with the severity of the constraint depending on the financial resources at their command. High-net-worth, liquid households and firms can sustain large variations in indebtedness with minor consequences for spending; higher debt often finances the accumulation of assets that can later be drawn down to finance consumption or investment. Low-net-worth, illiquid households and firms, on the other hand, are more constrained. They are also more sensitive to leverage cycles and more reactive to changes in fiscal and monetary policies. Such distinction is particularly relevant if rising interest rates lead to financial instability and tighter financial conditions (April 2022 GFSR and WEO chapter 1).

*Second*, periods of rapidly increasing debt often become unsustainable and lead to periods of deleveraging accompanied by subpar growth. In a nutshell, loose financial conditions encourage debt

[1]The authors of this chapter are Silvia Albrizio, Sonali Das, Christoffer Koch, Jean-Marc Natal (lead), and Philippe Wingender, with support from Evgenia Pugacheva and Yarou Xu. They thank Ludwig Straub for helpful comments on an earlier draft.

[2] Tobin (1980) argued that "[…] the population is not distributed between debtors and creditors randomly. Debtors have borrowed for good reasons, most of which indicate a high marginal propensity to spend from wealth or from current income or from any other liquid resources they can command."

buildup, which boosts spending, growth, and asset prices and further incentivizes credit as collateral values increase. This eventually unwinds when returns disappoint or are too poor to justify further debt-financed investment, lenders become wary of rolling over credit and extending new loans, or when financial conditions tighten and rising debt-service costs crowd out other spending.

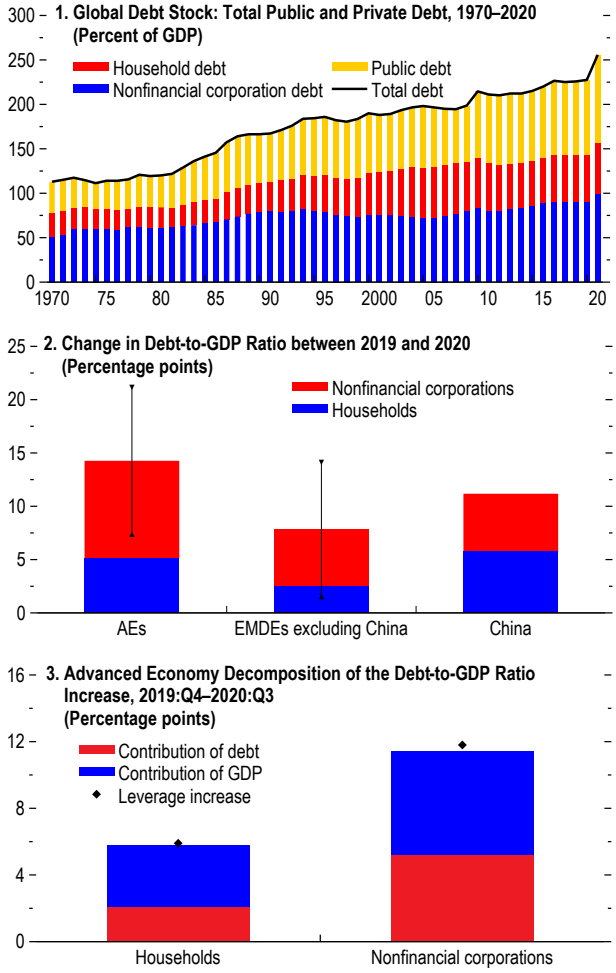
*Third,* national circumstances are also important. Countries with limited fiscal space may find it difficult to support domestic demand. Public and private sector deleveraging may occur simultaneously, compounding the drag on growth. In countries where debt restructuring or business liquidation is required, the efficiency of the insolvency framework may play an important role in reallocating capital to productive uses. The strength of the recovery will also critically hinge on the strength of financial intermediaries. Following monetary tightening, deleveraging pressures may be stronger where macroprudential instruments are ineffective, [3] and especially in countries where the health of the sovereign and banking sectors are closely intertwined (April 2022 GFSR, Chapter 2).

As governments are exiting pandemic-time emergency policies against the backdrop of rising inflation, the burden of debt is among the key challenges on the horizon. This chapter aims to answer two sets of questions:

- *Will the pandemic's private debt legacy affect the pace of the recovery*? How large a drag could there be on future private consumption and investment? Does it depend on the distribution of debt across households and firms? On available fiscal space? On the solvency framework?
- *What are the main implications for economic policy?* Does a high level of private debt, or its distribution across households and firms, affect the transmission and effectiveness of countercyclical policies? What does this imply for the pace of normalization and consolidation

**Figure 2.1. Rapidly Mounting Private Debt**

Private debt increased as much as public debt in 2020. The largest increases took place in advanced economies, with large variations across countries.




Sources: Gaspar, Medas, and Perrelli (2021); IMF, Global Debt Database; and IMF staff calculations.
Note: In panel 1, public debt refers to the largest category of debt available (non-financial public sector, general government, and central government, in decreasing order). Private debt (households and nonfinancial corporations) includes only loans and securities. Total debt (as a percent of GDP) is close but not exactly equal to the sum of the components of public and private debt. This is because of the difference in country coverage for the corresponding variables, which causes the corresponding country weights to differ. In panel 2, error bars show onestandard deviation for private debt. AEs = advanced economies; EMDEs = emerging market and developing economies.

[3] For an analysis of the implications of private sector leverage buildup on macro-financial stability risks and the role of macroprudential policy see Barajas and others (2021).

during the recovery, and what should the policy mix look like?

The main findings are summarized as follows:

*Pandemic debt buildup:* Nonfinancial corporate debt surged among vulnerable firms (high leverage, low liquidity, low profitability) in the worst-hit sectors (for example, those that are contact-intensive). Household debt accumulation, although more modest than that of nonfinancial corporations overall, was in some cases heavily concentrated among low-income households. Differences across countries are large with important implications for future growth.

*Leverage cycles, heterogeneity, and future growth:* Current levels of private leverage are expected to exert some drag on future GDP growth. Estimates based on cross-country aggregate data point to a slowdown of a cumulative –0.9 percent over three years for advanced economies and –1.3 percent for emerging markets. However, the post-pandemic drag on growth could be much larger in countries where (1) indebtedness is more concentrated among financially constrained households and vulnerable firms, (2) the insolvency regime is inefficient, (3) fiscal space is limited and (4) monetary policy needs to be tightened rapidly. For example, a surprise tightening of 100 basis points is estimated to slow investment at highly leveraged firms by a cumulative 6½ percentage points over two years, or 4 percentage points more than at those with little leverage. The effect could be larger if higher interest rates led to financial instability and tighter financial conditions (GFSR April 2021).

*Implications for policy:* Stronger emphasis on distributional considerations for macroeconomic forecasting and policymaking is needed. For example, where the recovery is well underway and private balance sheets are in good shape—mainly in advanced economies that benefited from generous government support during the pandemic—fiscal support can be reduced faster, facilitating the work of central banks. Elsewhere, the recovery may be weaker and targeted fiscal support could help lessen the risks of disruptions and scarring within credible medium-term fiscal frameworks (April 2022 *Fiscal Monitor*). Where targeting is difficult and fiscal space limited, countries may need to consider revenue enhancing measures to fund various priorities. Increasing tax compliance and other reforms to modernize business taxation are possible avenues; the latter could include temporary increases in corporate income tax designed to capture pandemic-related excess profits (IMF 2021c).

This chapter builds on earlier IMF work (April 2021 GFSR; April 2012, April 2020 *World Economic Outlook* [WEO]; IMF 2020a,b,c) and draws on two strands of literature that emphasize the importance of *heterogeneity* (Jappelli and Pistaferri 2014; Cloyne and others 2018; Kaplan, Moll, and Violante 2018; Ottonello and Winberry 2020) and *leverage* (Bernanke, Gertler, and Gilchrist 1999; Iacoviello 2005; Eggertsson and Krugman 2012; Jordà, Schularick, and Taylor 2011; Dell'Ariccia and others 2012; Mian, Sufi, and Verner 2017; Drehman and others 2020) in the transmission and amplification of economic shocks and policy.

The chapter starts by highlighting recent developments in households' and nonfinancial corporations' balance sheets, focusing on the distribution of debt. Cross-country panel regressions estimate the macroeconomic impact of leverage buildup on growth. Micro-level data on households and firms then help unpack the role of heterogeneity and the importance of countercyclical and structural policy.

# Private Sector Leverage during the Pandemic

This section sheds light on the historical development of household and corporate balance sheets, focusing on the COVID-19 recession and buildup of leverage among heterogeneous households and firms.

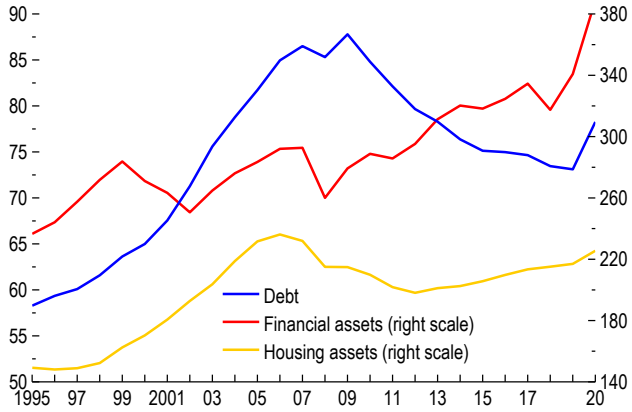
## Household Balance Sheets

### *A Global Cycle in Assets and Liabilities*

Household balance sheets have expanded almost continuously in recent decades, with net wealth increasing globally from an average 225 percent of GDP in 1995 to more than 360 percent of GDP in 2020, in purchasing-power-parity-weighted terms. Nevertheless, household debt went through two distinct phases over the past two decades. Among advanced economies, household leverage increased steadily in the years before the global financial crisis. Since debt was used primarily to finance housing investment, this resulted in assets growing in tandem with liabilities (Figure 2.2). In the decade after the global financial crisis, households gradually reduced debt relative to income, with housing assets also falling relative to income, driven by lower valuations and slower investment. Household debt jumped in 2020 because of increased borrowing and lower income as a result of the pandemic-induced recession. This rise in debt was accompanied by a large increase in financial assets. Looking ahead, net wealth could contract again as governments' cash transfers to households stop, and tighter financial conditions may increase debt-service costs and lead to declines in asset prices (see the April 2022 GFSR).

**Figure 2.2. Advanced Economies: Aggregate Household Balance Sheets**
*(Percent of GDP)*

Household indebtedness jumped in 2020, after a decade of consolidation following the global financial crisis.



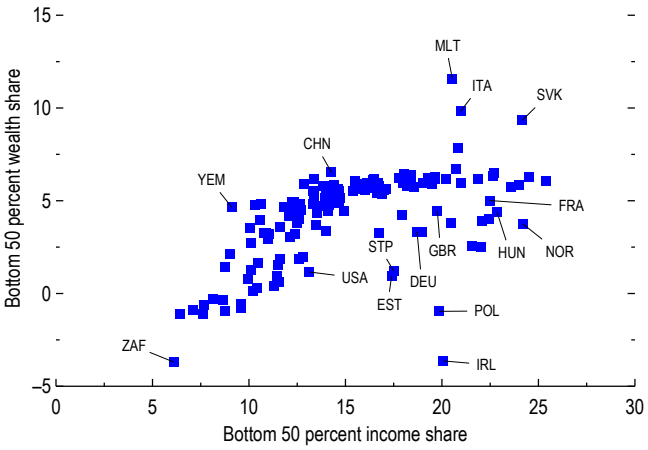

Sources: IMF, Global Debt Database; World Inequality Database; and IMF staff calculations.
Note: See Online Annex 2.1 for the list of countries included.

### *Household Debt across the Income Distribution*

It is important to look beyond aggregate figures as these can mask important heterogeneity, especially given the high degree of inequality in household income and wealth. How debt is distributed and changes over time has implications for liquidity constraints as well as for future saving rates. For instance, a debt buildup at the lower end of the income

**Figure 2.3. Correlation between Wealth and Income Inequality**
*(Percent)*

Countries where household incomes are more unequal also tend to have more wealth inequality.



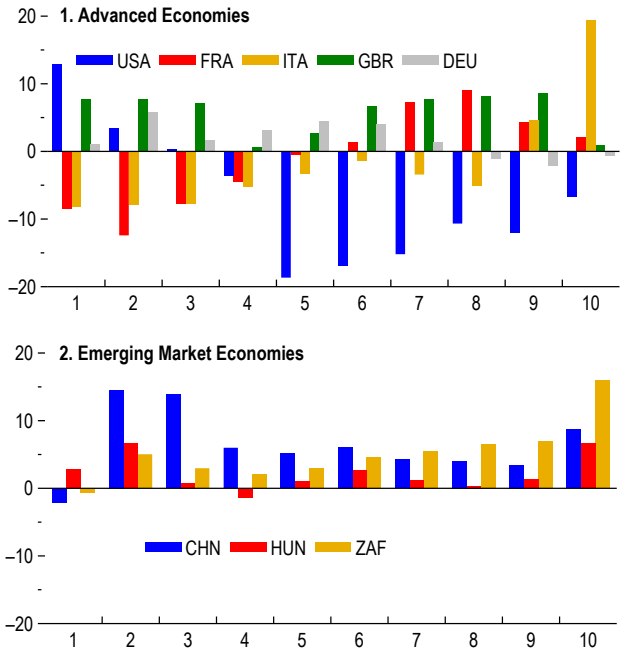

Sources: World Inequality Database; and IMF staff calculations.
Note: See Online Annex 2.1 for the list of countries included. Shares by country represent averages over the period from 2010 to 2020. Data labels in the figure use International Organization for Standardization (ISO) country codes.

distribution, where net wealth is typically lower, is more likely to slow future consumption when financial conditions are tightened, borrowing costs increase, and asset prices decline (Figure 2.3).

Measuring how debt varies across income groups is challenging as it requires household wealth surveys, which are available only in a handful of countries and relatively infrequently. To estimate the impact of the COVID-19 recession on household indebtedness, a "nowcasting" approach is used that relies on macroeconomic and financial variables to extrapolate microdata on income and debt. Regional and sectoral data for value added, wages, employment, unemployment, house prices and sales, and bank lending are used to estimate changes in income and debt for households. The algorithm also constrains the nowcast distributions to match published aggregate household income and debt for 2020.[4]

**Figure 2.4. Change in Debt-to-Income Ratio by Income Decile in 2020**
*(Share of income, percent)*

Household indebtedness has varied across countries and household income groups.




Source: IMF staff calculations.
Note: Income deciles on *x*-axes, except for the United States where households are grouped by fixed income bands. See Online Annex 2.1. CHN = China; DEU= Germany; FRA = France; GBR = United Kingdom; HUN = Hungary; ITA = Italy; USA = United States; ZAF = South Africa.

Changes in household indebtedness varied across countries and income levels during the first year of the pandemic. The bar charts in Figure 2.4 show that aggregate statistics conceal important dimensions of debt accumulation. Among selected countries, the nowcasting estimates show that China and South Africa have had the largest and broadest increases in debt ratios. The increases amounted to 5.7 percent of annual income on average for China and 4.5 percent for South Africa. Lower-income households saw larger increases in China, except those in the bottom decile. In South Africa, the richest households saw the largest relative surge in debt, amounting to 15 percent of their annual income.

Despite smaller aggregate increases in debt ratios in Germany, the United Kingdom, and Hungary, and even outright decline in the United States, low-income households saw comparatively larger increases in debt. The buildup exceeded 10 percent of income in the United States for the lowest income decile and about 7.5 percent for the lowest tercile in the United Kingdom. In contrast, France and Italy were able to support low- and middle-income households' balance sheets, as seen from the decline in debt ratios in both countries for the bottom 50 percent of incomes.

This exercise is possible only for the small number of countries that have conducted household wealth surveys. As attention to inequality and distributional issues increases, the expansion of data collection on household balance sheets will allow a better understanding of the impact of shocks and policies.

[4] The approach by DiNardo, Fortin, and Lemieux (1996) is used to nowcast joint distributions. This involves reweighting kernel densities and using regression adjustment to match changes in distributions over time. Income and debt distributions are nowcast for China, France, Germany, Hungary, Italy, South Africa, and the United Kingdom. For the United States, income and debt distributions are estimated using microdata from the 2019 and 2020 waves of the Consumer Expenditure Survey. See Online Annexes 2.1 and 2.2.

## Firms' Balance Sheets

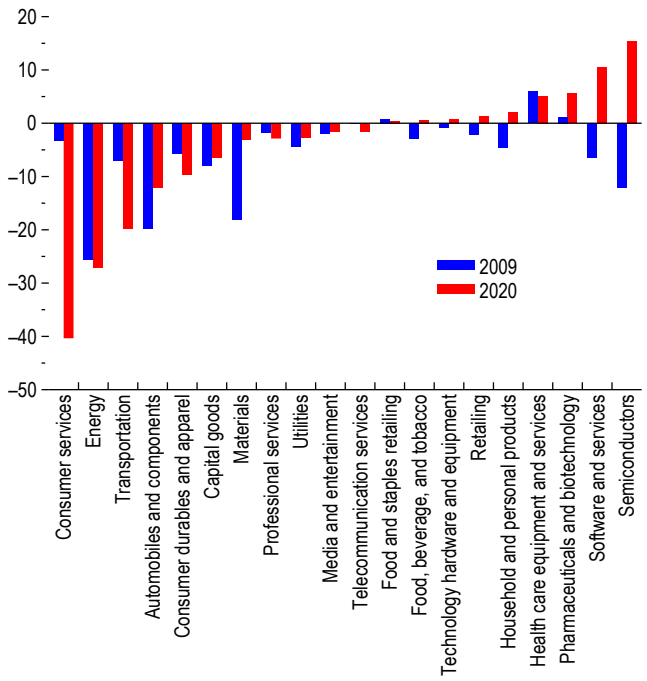
### *Nonfinancial Corporate Sector Vulnerabilities Are Concentrated*

Abundant liquidity support through loans, credit guarantees, and moratoriums on debt repayment contributed to debt buildup and were pivotal in preventing widespread corporate failures and related employment and output losses, especially among small and medium enterprises. The analysis here takes stock of balance sheet developments since the pandemic began, with a focus on the distribution of leverage and vulnerabilities across firms, sectors, and countries.

Figure 2.5 uses listed firms' quarterly balance sheets[5] to present revenue growth by sector across 71 advanced and emerging market economies in 2020 and compares this with 2009, at the height of the global financial crisis. A clear sectoral contrast emerges. Due to lockdowns (consumer services and transportation) or materials shortages (automobiles and components), the largest losses are concentrated in a few sectors. In contrast, at the other end of the distribution, some sectors gained from the structural pivot imposed by the pandemic (semiconductors, software and IT services, pharmaceuticals, health care equipment). This is different from the global financial crisis, when the shock hit almost all the sectors considered. Moreover, a significant part of the increase in leverage during the pandemic was covered by government guarantees.[6] Therefore, the risk of an adverse feedback loop in which corporate distress puts stress on the financial system—and eventually the public purse—appears smaller, at least in countries where the government can absorb the shock (Chapter 2 in the April 2022 GFSR analyzes risks associated with the sovereign-bank nexus in emerging markets). Figure 2.6 suggests that the biggest commitments have been made in advanced economies, where fiscal space is the largest (see Box 2.1). However, it is worth noting that regulatory forbearance may have masked the real extent of losses.

**Figure 2.5. Uneven COVID-19 Impact on Nonfinancial Corporations' Revenue Growth**
*(Percent)*

For nonfinancial corporations, a clear sectoral divergence between winners and losers emerged, which was not so pronounced in the global financial crisis.



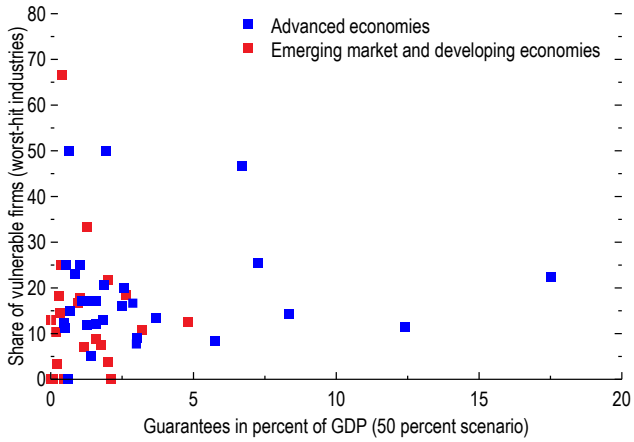

Sources: S&P Capital IQ; and IMF staff calculations.
Note: The sample consists of 71 countries, see Online Annex 2.1. The figure shows the annual revenue growth in 2009 (blue bars) and 2020 (red bars), asset-weighted median.

[5] The exercise uses S&P Capital IQ data. Because Capital IQ comprises listed firms only, the coverage in employment is only 7 percent of the total. This suggests the estimate of the share of firms in the worst-hit sectors should be considered a lower bound given that small and medium enterprises, which account for large labor and value-added shares in some of the economies, are not included in the sample. See Online Annex 2.1 for details.

[6] The share of those guarantees in total credit is highly variable, ranging from about 20 percent of all new credit in Germany to 100 percent (up to a certain limit) in Japan.

**Figure 2.6. Exposure to Contingent Liabilities Associated with Credit Guarantees ("50 percent scenario")**
*(Percent)*

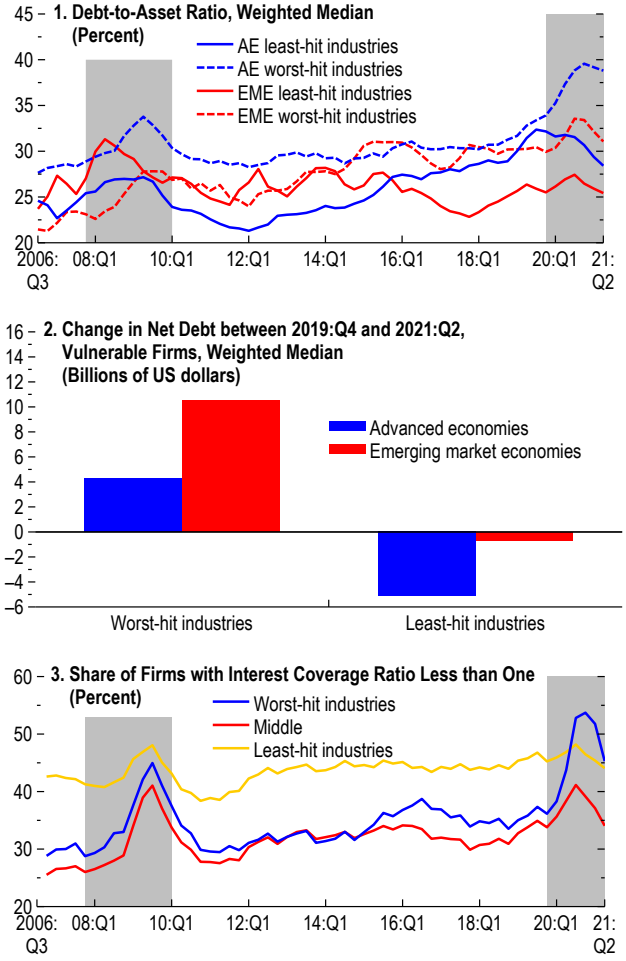
A combination of high vulnerabilities and generous announced guarantees is concentrated in advanced economies.




Source: IMF, COVID-19 Policy Tracker; S&P Capital IQ; and IMF staff calculations.
Note: The figure shows governments' potential exposure to contingent liabilities considering a scenario where 50 percent of the announced guaranteed loans are eventually used. The share of vulnerable firms refers to the mean share of firms in the top tercile of the debt-to-asset ratio, the bottom tercile of returns on assets, and with an interest coverage ratio of less than one in the worst-hit industries in 2021.

**Figure 2.7. Heterogeneous Effect on Nonfinancial Corporation Balance Sheets**

The pandemic exacerbated weak balance sheet positions only in the worst-hit industries.




Sources: S&P Capital IQ; and IMF staff calculations.
Note: Sample consists of 71 economies, see Online Annex 2.1. Panels 1 and 3 show a three-quarter moving average, shaded areas indicate the global financial crisis and COVID-19. Vulnerable firms are defined as firms in the top tercile of the debt-to-asset ratio distribution, the bottom tercile of return on assets distribution, and with an interest coverage ratio of less than one. Net debt = total liabilities net of cash and equivalents. AE = advanced economy; EME = emerging market economy.

### *Leverage Jumps for Vulnerable Firms, Especially in Worst-hit Sectors*

*Leverage by sector group:* Based on Figure 2.5, sectors can be grouped into three clusters: the worst-hit industries (the five sectors experiencing the strongest drop in revenue growth in 2020), the least-hit industries (symmetrically, the five sectors experiencing the highest revenue growth) and the middle ones as residual category. Leverage, which is defined as firms' debt-to-asset ratio, increased during the pandemic in the worst-hit industries and remained (in 2021:Q2, the latest available point) well above precrisis levels (Figure 2.7, panel 1). Net debt (gross debt net of cash holdings) has also increased significantly in vulnerable firms in the worst-hit sectors of various economies, especially those in emerging markets (Figure 2.7, panel 2). This is in stark contrast to other sectors that had essentially deleveraged during the pandemic already, reflecting both higher assets and lower liabilities.

*Assessing the debt burden:* Debt accumulation may not be detrimental in itself: a highly indebted firm might still have a healthy balance sheet—as reflected in ample liquid asset holdings and high profits. In contrast, a firm's capacity to invest, innovate, and grow may be compromised if high leverage is coupled with profitability so low that it cannot meet interest payments; in that case, the interest

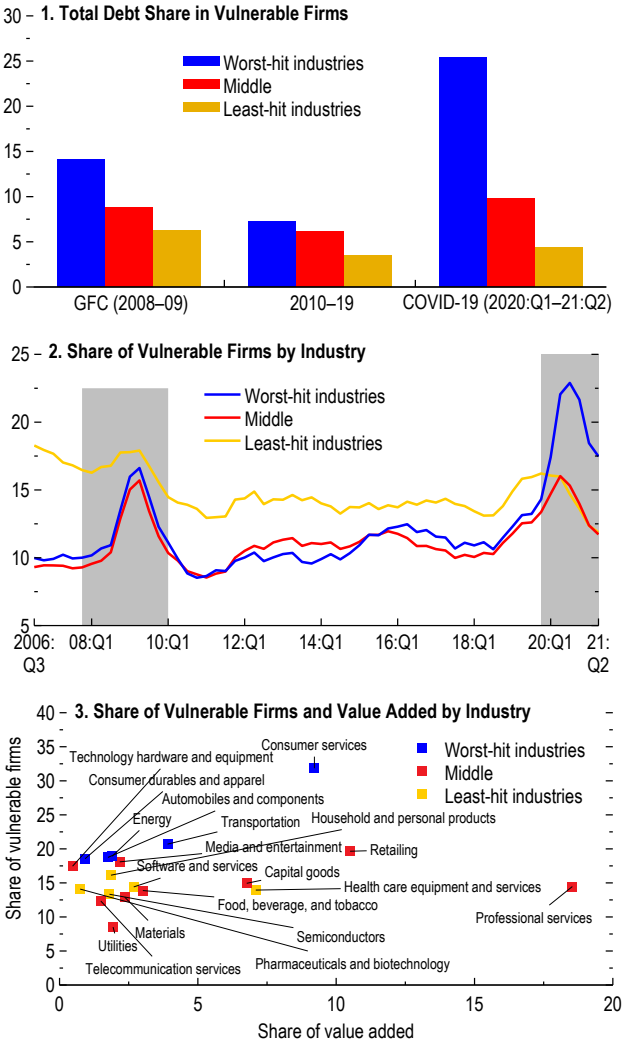
coverage ratio is less than 1. In the worst-hit industries, profitability has dropped to levels comparable to those during the global financial crisis and has not yet recovered completely. This reflects both earning losses (before interest and taxes) and higher interest rate payments. The share of firms with an interest coverage ratio of less than 1 in worst-hit sectors has yet to revert to its pre-pandemic level (Figure 2.7, panel 3).

*Vulnerable firms* are defined as nonfinancial corporations with high leverage, low profitability, and an interest coverage ratio less than 1.[7] Unprofitable, indebted firms with low liquidity are not only more exposed to potential asset repricing (Ding and others 2021) and the withdrawal of policy support, but they are also more likely to underinvest (Albuquerque 2021). At 18 months into the pandemic, the share of vulnerable firms remained higher than in the global financial crisis and concentrated in the worst-hit sectors, where indebtedness was also relatively higher (Figure 2.8, panels 1 and 2). The share has declined since its peak at the end of 2020, however, reflecting higher returns, better cash flows and lower debt.

How macroeconomically relevant is all this? Figure 2.8, panel 3, shows the 2020 share of vulnerable firms by sector with regard to their contribution to the country's value added. One of the worst-hit sectors, consumer services (including tourism, recreation, entertainment, education), accounts for almost 10 percent of value added and comprises about 30 percent of vulnerable firms. Both are sizable shares.[8] Overall, worst-

**Figure 2.8. Nonfinancial Corporation Vulnerabilities Are Concentrated in Worst-Hit Industries**
*(Percent)*

Vulnerable firms hold a higher share of debt, are concentrated in the hard-hit industries, and are macroeconomically relevant.




Sources: Organisation for Economic Co-operation and Development, STAN database; S&P Capital IQ; and IMF staff calculations.
Note: Sample consists of 71 economies in panels 1 and 2, and 14 economies for which an adequate sectoral breakdown of the value-added data is available in panel 3, see Online Annex 2.1. Vulnerable firms are defined as firms in the top tercile of the debt-to-asset ratio distribution, the bottom tercile of return on assets distribution, and with an interest coverage ratio of less than one. Panels 2 shows a three-quarter moving average, shaded areas indicate the global financial crisis and COVID-19. Panel 3 shows share of vulnerable firms in each sector in 2020 and value added corresponding to these sectors as a percent of total value added in these economies in 2019. GFC = global financial crisis.

[7] Since this analysis considers the distribution of leverage and return on assets by sector, high leverage is defined as above the average threshold of the top tercile across industries (35 percent) and low profitability as below the average of the bottom tercile of return on assets (0.2 percent).

[8] Note that these vulnerabilities may be underestimated since the presented stylized facts are based on data for listed firms, which are on average larger and less represented in worst-hit sectors than small and medium enterprises, as well as less likely to enter distress (Carletti and others 2020; Díez and others 2021).

hit industries represent 18 percent of value added and a quarter of the labor force. [9]

Extraordinary measures to cushion the impact of the pandemic on firms' cash flow have helped prevent corporate failures. Government credit guarantees have helped ensure broad access to credit and have protected bank balance sheets. Whether this extra leverage will affect investment remains uncertain. It will depend on (1) the strength of the recovery, especially in worst-hit sectors, and (2) the tightness of future financial conditions as monetary policy is normalized (Gourinchas and others 2020, 2021; Cros, Epaulard, and Martin 2021).

## Private Debt and the Business Cycle

The leverage buildup during the 2020 recession can be seen as an efficient reaction to the pandemic, perceived as a temporary shock. However, it led to large increases in private debt to GDP that is liable to affect future consumption and investment. This section quantifies the implications of leverage buildup for growth. In line with recent literature, it shows the quantitative importance of leverage cycles for growth forecasting.[10] It first documents empirical regularities based on cross-country aggregate data and then digs deeper into the mechanism, highlighting the importance of heterogeneity in the financial situations of households and firms.

### Output Responses to Deleveraging Pressures

#### *Cross-Country Evidence*

Following a buildup of private debt over and beyond what a smooth trend would predict—defined as *excess credit*—output growth typically slows as firms and households reduce debt. Local projections, as in Jordà (2005), depict the dynamic responses of output, keeping all else constant. The empirical approach relies on a panel of macroeconomic data for 43 countries (27 advanced economies and 16 emerging market and developing economies) over 51 years from 1969 to 2020 (see Online Annex 2.4).[11] For households, a 1 percentage point change in excess credit to GDP results in a persistent decline in private consumption of 0.5 percent in advanced economies and 2 percent in emerging market and developing economies five years later. Nonfinancial corporate credit swings induce a similar investment response.[12] Both consumption (following excess household credit) and investment (following excess nonfinancial corporate credit) decline substantially more in emerging market and developing economies (Figure 2.9).

[9] Value-added and employment figures are based on the Organisation for Economic Co-operation and Development (OECD) STAN database and are available with a detailed sector breakdown only for the following countries: Austria, Colombia, the Czech Republic, Finland, Greece, Iceland, Mexico, The Netherlands, New Zealand, the Slovak Republic, South Korea, Sweden, Turkey, and the United States.

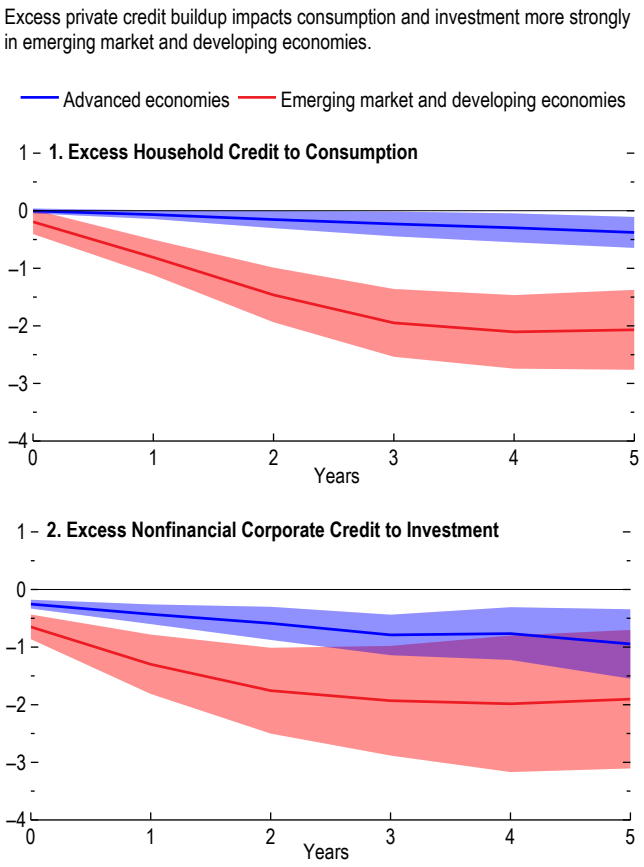
[10] Mian and others (2017) show that professional economic forecasters systematically overpredict GDP growth at the end of household debt buildup cycles. A rise in household debt over the three years preceding a forecast helps predict growth forecasting errors.

[11] Because the impact of leverage buildup on future growth might be different in different parts of the cycle, the local projection introduces time fixed effects. These make it possible to control for business cycle influences and other time-varying influences common to all countries in the sample. Country fixed effects control for country-specific factors. Potential idiosyncratic effects related to the presence of public guarantees are not taken into account. The implication for future growth are uncertain and depend on governments' propensity and capacity to forgive those liabilities in case guarantees are activated. In the worst-case scenario of limited fiscal and monetary space and large bank-sovereign nexus, activating public guarantees could even lead to doom loops (April 2022 GFSR).

[12] The total effect on output will be smaller because the share of investment is smaller than the share of consumption in output and because of the generally larger share of imported input in investment.

Wide heterogeneity is seen across different economies, but at face value these estimates would imply a slower recovery by a cumulative 0.9 percent of GDP over the next three years for advanced economies and 1.3 percent for emerging market economies (excluding China) as households and nonfinancial corporations reduce debt following the recent surge.[13] These are average estimates based on cross-country aggregate data.[14] The forces of deleveraging and the impact on growth could be stronger for countries with debt more concentrated among financially constrained households and vulnerable firms, where fiscal space is limited, the insolvency regime is inefficient, and inflation is high (requiring tighter financial conditions). The mechanisms in play are unpacked in the following subsections; they may explain some of the differences between emerging markets and advanced economies.[15]

**Figure 2.9. Consumption and Investment Responses to Household and Nonfinancial Corporate Excess Credit**
*(Cumulative percentage points)*




Sources: Bank for International Settlements; and IMF staff calculations.
Note: Panel 1 shows the impact of a one percentage point increase in the three-year trailing average excess household credit-to-GDP ratio on cumulative consumption growth. Panel 2 shows the impact of a one percentage point increase in the three-year trailing average excess nonfinancial corporate-credit-to-GDP ratio on cumulative investment. Jordà (2005) impulse response functions. Shaded areas represent 90 percent confidence intervals.

### *Private and Public Debt Interactions*

The rise in private debt during the COVID-19 pandemic was accompanied by a substantial increase in public debt. Public debt rose by almost 15 percent of GDP in 2020, and uncertainties remain about contingent claims and the ultimate guarantor of much of the private debt buildup (see the April 2022 *Fiscal Monitor* for more details).

[13] China is left out of this estimate because it is not in the same cyclical position. Deleveraging of nonfinancial corporations started a few years ago, likely already dampening growth.

[14] Note that these estimates are not driven by boom-bust episodes. The dynamic responses are unaltered by the exclusion from the sample of the global financial crisis and its aftermath. The sample covers 43 countries over 51 years, and only a minority of excess credit episodes led to a recession. For the United States, for example, where recessions declared by the National Bureau of Economic Research are clearly classified only about 15 percent of excess credit episodes were followed by a recession. Dell'Ariccia and others (2016) conduct similar analysis and find that about two-thirds of credit booms do not end up as busts but lead to subpar growth.

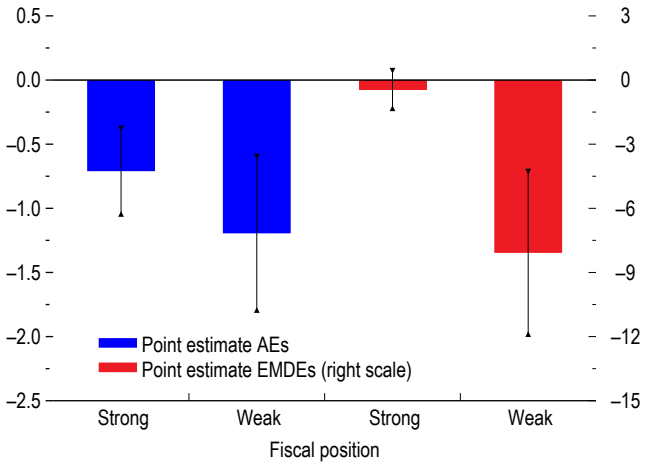
[15] Dissecting the role of debt maturity and currency denomination in emerging markets opens up avenues for future research, but data constraints are a limiting factor.

Excess credit and subsequent deleveraging are expected to have a larger negative effect on output where governments struggle to mitigate the drag through public spending—that is, those with limited fiscal space.[16]

Using the same framework as in the previous subsection, the question is explored within advanced economies and emerging market and developing economies by using quartiles of a fiscal position indicator by year to compare the dynamic responses of GDP following excess household credit (see Online Annex 2.4). Figure 2.10 contrasts countries in the two groups with fiscal positions that are relatively strong versus those that are fairly weak. It shows that dynamic responses of future aggregate output to private debt buildup are significantly more negative in countries with weak fiscal positions; they are larger by orders of magnitude in emerging market and developing economies.[17] For emerging market economies with the weakest fiscal positions, these numbers imply a drag on growth of up to 9 percent cumulative over three years.

**Figure 2.10. Fiscal Position and Deleveraging**
*(Cumulative percentage points)*

A strong fiscal position can mitigate the negative output response following excess credit buildup, especially in emerging market and developing economies.




Sources: Bank for International Settlements; Kose and others (2017); World Bank; and IMF staff calculations.
Note: The figure shows the impact of a one percentage point increase in the three-year trailing average excess household-credit-to-GDP ratio on cumulative output growth. Countries' fiscal position is proxied by within-year quartiles of the principal component of six fiscal indicators: (1) general government gross debt, (2) primary balance, and (3) fiscal balance—all three as a percent of GDP; (4) cyclically adjusted balance as a percent of potential GDP; and (5) general government gross debt, and (6) fiscal balance—both as a percent of average tax revenues. The figure contrasts the response between the top (strong) and bottom (weak) quartiles of the fiscal position. AEs = advanced economies; EMDEs = emerging market and developing economies.

## Borrower Heterogeneity and Debt-Output Dynamics

This section analyzes the implications of increasing leverage among financially constrained households and vulnerable firms. It unpacks the mechanism described in the introduction by exploiting micro-level data on firms and households.

### *Household: Inequality and the Impact of Private Debt on Output*

Here the focus is on the cyclical implications of debt buildup in countries differentiated according to wealth inequality. The analysis is based on the same empirical framework as in the first section but relies on micro-level data on household saving and income distribution to sort countries: dissaving among low-income households is used as a proxy for (bottom) wealth inequality.[18] Figure 2.11 contrasts the cumulative future output responses to the buildup of excess leverage in countries

[16] A mere measure of public debt over GDP is unlikely to be a sufficient statistic for fiscal space, a multidimensional assessment (IMF 2018). Different countries can support very different levels of public debt and fiscal deficits. See Box 2.1 and Ghosh and others (2013) for further discussion.

[17] This analysis should be interpreted as suggestive since only four emerging market economies are included.

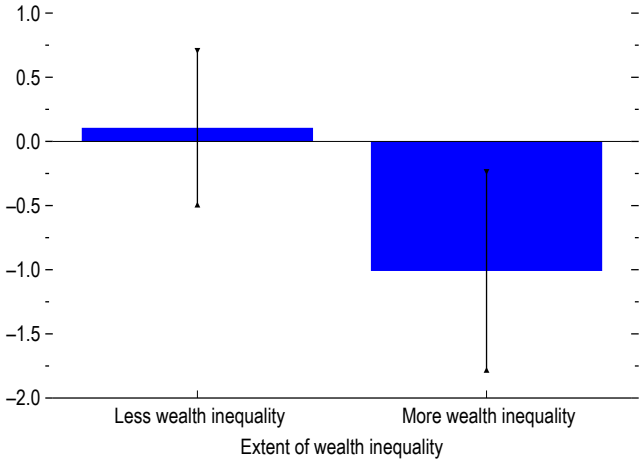
[18] To proxy for bottom wealth inequality across countries, a three-year trailing average of dissaving of households in the bottom 50 percent of income is computed using data for advanced economies from Allen, Kolerus, and Xu (forthcoming). The results are then sorted into four quartiles per year. Figure 2.11 compares the debt-output dynamics for high- (most dissaving by bottom 50 percent) and low-inequality groups.

where households are thought to be financially constrained (more wealth inequality) and others (with less wealth inequality). Countries where households are relatively more financially constrained (more wealth inequality) tend to see a larger drag on future output following excess credit buildup.

Rising inequality (Chancel and others 2022) may also have stark implications for countercyclical policy (Mian, Straub, and Sufi 2021a,b,c,d), an important consideration for governments as they contemplate unwinding exceptional support. Higher inequality tends to push down the equilibrium (natural) interest rate, a key concept to calibrate the pace of policy normalization as it affects both *fiscal* (Box 2.1) and *monetary space* (Box 2.2).

**Figure 2.11. Advanced Economies: Wealth Inequality and Deleveraging**
*(Cumulative percentage points)*

Greater wealth inequality amplifies the output response following excess credit buildup.




Sources: Allen, Kolerus, and Xu (forthcoming); Bank for International Settlements; World Inequality Database; and IMF staff calculations.
Note: The figure displays the impact of a one percentage point increase in the excess household-credit-to-GDP ratio on cumulative output growth. Countries are ranked by the extent of dissaving of the bottom 50 percent, where more dissaving proxies for greater wealth inequality. High wealth inequality denotes countries in the top quartile of dissaving of the bottom 50 percent over the past three years. Low wealth inequality denotes countries in the bottom quartile of dissaving of the bottom 50 percent over the past three years. Error bars represent 90 percent confidence intervals.

### *Corporate Leverage and Investment: The Importance of Vulnerable Firms*

Drilling down one level deeper than the macroeconomic analysis reported in Figure 2.9, panel 2, this subsection turns to the microeconomic drivers linking corporate leverage to investment. In so doing, it investigates the particular role played by vulnerable firms.

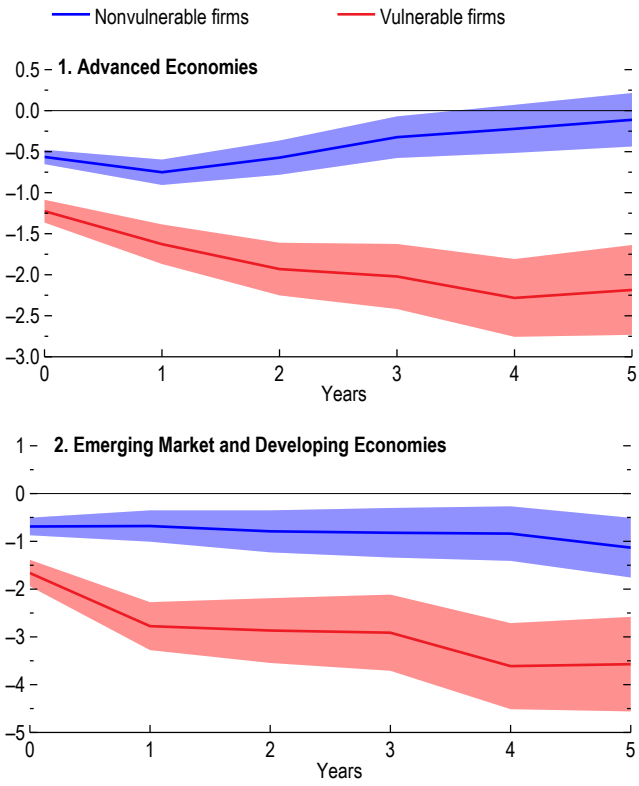
Firms' leverage buildup may hold back investment under three circumstances. First, high outstanding debt may increase the service cost of future debt, preventing further borrowing to finance new investment (Krugman 1988; Drehman, Juselius, and Korinek 2017). Second, credit booms lead to more leveraged balance sheets and tighter borrowing constraints as firms' net worth declines (Bernanke and Gertler 1989; Bernanke, Gertler, and Gilchrist 1999). Finally, for firms with excess leverage, the return on future investment is likely to go toward repaying existing debt, decreasing equity holders' incentive to finance new investment projects (Myers 1977). Vulnerable firms—defined as highly leveraged firms with low profitability and low liquidity (interest coverage ratio less than 1)—are particularly exposed to all these channels.

To quantify the role of vulnerable firms in driving investment dynamics following leverage buildup, a local projection panel based on private and listed firm-level data is estimated (see Online Annex 2.3).[19] Following Albuquerque (2021), leverage buildup is defined as the lagged three-year cumulative change in the debt-to-asset ratio. By including firm fixed effects in the panel estimation, firms' leverage buildup captures debt accumulation above their average indebtedness; sector-country-year fixed effects help pin down the partial equilibrium effect of leverage buildup by

[19] The analysis is based on Bureau van Dijk Orbis and comprises 2.5 million listed and unlisted firms from 1998 to 2018.

**Figure 2.12. The Role of Vulnerable Firms**
*(Cumulative percentage points)*

Cumulative investment losses associated with leverage buildup are larger for vulnerable firms.




Sources: Bureau van Dijk Orbis; and IMF staff calculations.
Note: The figure illustrates the responses of firms' investment ratio following a one standard deviation increase in debt-to-asset accumulation, conditional on firms being vulnerable. Vulnerable firms are defined as firms in the top tercile of the debt-to-asset ratio, the bottom tercile of returns on assets, and with an interest coverage ratio of less than one. Shaded areas represent 90 percent confidence intervals.

costly liquidation procedures, and asymmetric information may delay the restructuring process.

The effectiveness of insolvency frameworks plays a key role that can be analyzed using a novel IMF indicator that sorts countries according to the preparedness of their insolvency framework to face systemic crises.[20] Figure 2.13 compares the cumulated response of investment ratios to firms' leverage buildup in countries with well-prepared controlling other time-varying confounding factors, such as the macroeconomic cycle and general equilibrium forces at play.

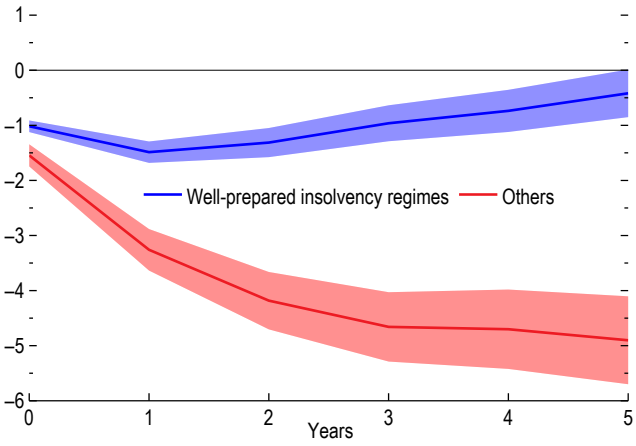
As reported in Figure 2.12, following leverage buildup, vulnerable firms reduce investments the most, generating permanent losses to the stock of tangible assets. This is true in advanced economies and emerging markets alike. The maximum effect is reached after four years.

### *The Role of Effective Insolvency Frameworks*

To mitigate these negative effects and support recovery, vulnerable nonviable firms need to be restructured or liquidated to free up resources that can be directed to new growth areas. However, coordination frictions among creditors, weak contract enforcement,

**Figure 2.13. The Role of Effective Insolvency Frameworks**
*(Cumulative percentage points)*

Effective insolvency and restructuring proceedings prevent the long-term decline in the future stock of tangible capital following firms' leverage buildup.




Sources: Bureau van Dijk Orbis; IMF, Crisis Preparedness Index; and IMF staff calculations.
Note: The figure illustrates the responses of the firms' investment ratio following a 1 standard deviation increase in debt-to-asset accumulation, conditional on a country's insolvency regime. Well-prepared insolvency regimes are defined as those of countries in the top quartile of the IMF SPR-LEG indicator of crisis preparedness in 2020. Shaded areas represent 90 percent confidence intervals.

[20] An effective and well-prepared insolvency regime is characterized by a comprehensive set of legal tools and institutions relevant for widespread restructuring and insolvency proceedings, such as out-of-court and hybrid restructuring, rapid reorganization and liquidation processes, and a proper institutional framework. For a detailed discussion on the construction of the indicator and its values, refer to Araujo and others (2022) and Online Annex 2.3.

insolvency systems in place versus others. The findings suggest that inadequate insolvency proceedings account for most of the long-term decline in the stock of tangible capital.

## Countercyclical Policy Effects amid High Private Debt

Understanding how private debt and its distribution affect the transmission of countercyclical macroeconomic policy is important to help calibrate the exit from the expansionary fiscal and monetary policy responses to the COVID-19 recession. This section analyzes (1) the importance of countries' aggregate debt levels for the impact of fiscal consolidation and monetary tightening, and (2) how policy affects different groups of households and firms. In particular, it investigates whether tightening policies have a larger impact on more financially constrained households and firms.

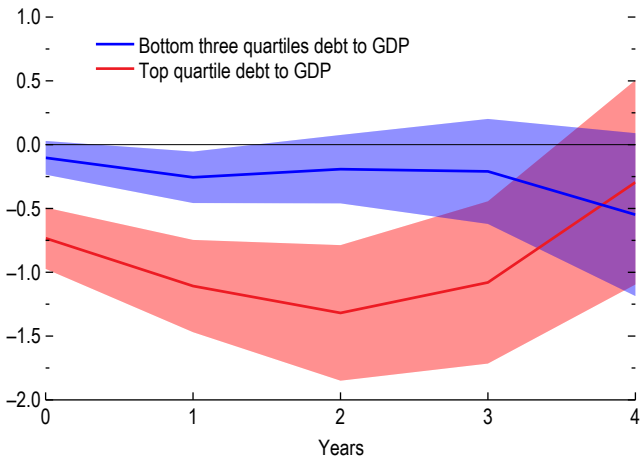
The analysis uses local projections to estimate the effects of policies on real output, household consumption, and corporate investment over time, for a sample of advanced economies and emerging markets (see Online Annex 2.5). Fiscal and monetary policy "shocks" (changes in policy that are exogeneous to the near-term economic outlook) are borrowed from previous cross-country studies (IMF 2021, Chapter 2, for fiscal consolidations; Furceri, Loungani, and Zdzienicka 2018 for monetary tightening). The aggregate response of output to these fiscal and monetary policy shocks is in line with the previous literature (Ramey 2016)[21].

### Private Debt and the Transmission of Countercyclical Policy

The increase in private debt before and through the COVID-19 recession may have changed how economies respond to policy tightening, with more-leveraged households and firms having greater sensitivity. This is first investigated at the country level by interacting the policy shock with an indicator variable equal to 1 for each country in periods when the ratio of private debt to GDP is in the top quartile for each country (Ramey and Zubairy 2018 and April 2020 WEO for fiscal policy; Tenreyro and Thwaites 2016 for monetary policy). Figure 2.14 shows that fiscal consolidation is more contractionary when the private-debt-to-GDP ratio is high.

**Figure 2.14. Private Sector Debt Increases Sensitivity to Fiscal Consolidation**
*(Percentage points)*

Fiscal consolidation leads to a larger contraction in real output when private sector debt is high.




Sources: IMF, Global Debt Database; and IMF staff calculations.
Note: The solid lines represent the estimated response of real GDP to a fiscal consolidation shock. Shaded areas represent 90 percent confidence intervals. The *x*-axis indicates the number of years after the shock.

[21] A 1 percent of GDP fiscal consolidation leads to a ¾ percent decline in output, and a monetary policy tightening of 100 basis points leads to a ½ percent decline in output after two years. See Online Annex for details.

## Heterogeneous Transmission of Monetary and Fiscal Policies

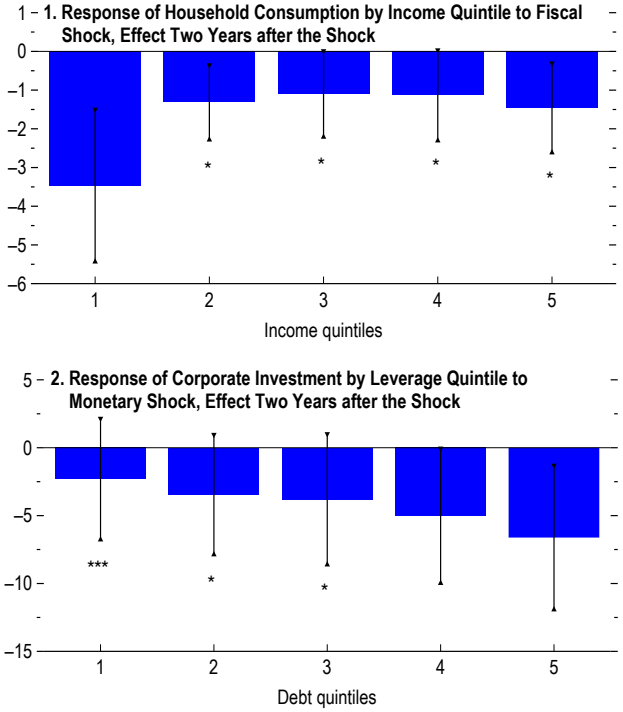
Recent studies recognize that the effects of macroeconomic policy depend on the characteristics of households and firms. For *households*, policy transmission is affected by their income, debt, and the types of assets they hold (particularly whether illiquid or liquid). The intuition is straightforward: households without liquid assets, and in particular indebted households, have a higher propensity to consume out of disposable income than savers, who can maintain consumption by drawing down savings following negative shocks to income (Jappelli and Pistaferri 2010, 2014; Crawley and Kuchler 2018; Kaplan, Moll, and Violante 2018). Studies focused on the effects of monetary policy on consumption for the United States and the United Kingdom have found that the *indirect* effects of an unexpected change in interest rates, which operate through general equilibrium changes in labor demand and housing wealth, far outweigh the standard *direct* intertemporal substitution effect (Kaplan, Moll, and Violante 2018; Slacalek, Tristani, and Violante 2020). These indirect effects are particularly large for the lowest-income households, with the largest changes in income after a monetary policy shock (Lenza and Slacalek 2018). With lower-income households having the lowest net worth (see Kumhof, Rancière, and Winant 2015 for evidence for the United States), one would also expect these to be most affected by the direct effect of monetary policy tightening on disposable income, through higher debt-service costs.

For *firms*, the channels are similar, with the literature focusing on how their balance sheets affect their access to external financing. The financial accelerator model (Bernanke, Gertler, and Gilchrist 1999) shows how changes to the net worth of firms over the business cycle amplify the effects of monetary policy and other changes to credit conditions. In the United States, the leverage and liquidity of firms have been found to affect how responsive they are to monetary policy (Ottonello and Winberry 2020; Jeenas 2019).

Figure 2.15, panel 1, reports the results for the effect of fiscal consolidation on consumption by income quintiles. Once fiscal shocks are combined with consumption data, the sample of countries is reduced to 13 European economies, from 1990 onward. The figure shows the effects on each income quintile two years after the shock. It highlights that (1) the impact of consolidation is negative for all income groups, and (2) the largest impact is on the consumption of the lowest-income-quintile households. After two years, the consumption drop of the lowest-

**Figure 2.15. Effects of Macro Policy Tightening on Heterogeneous Households and Firms**
*(Percent change)*

The effect of fiscal consolidation on consumption is largest in lower-income households. Monetary policy tightening negatively affects corporate investment for the most leveraged firms.




Sources: Allen, Kolerus, and Xu (2022); Bureau van Dijk Orbis; and IMF staff calculations.
Note: The bars in panel 1 represent the estimated effect of a fiscal consolidation shock of 1 percent of GDP on the consumption of five groups of households, according to their income levels, two years after the shock. In panel 2, the bars represent the estimated effect of a monetary policy tightening shock of 100 basis points on the real investment of five groups of firms, according to their leverage ratios, two years after the shock. The *x*-axis indicates the quintile of corporate leverage. Error bars denote 90 percent confidence intervals. Statistically significant differences between the lowest income quintile in panel 1 (and highest leverage quintile in panel 2) and other quintiles at the 1, 5, and 10 percent confidence levels are denoted, respectively, by ***, **, and *.

income quintile is twice as large as the consumption decline of the highest-income quintile.[22] The results are similar for all horizons, and the effect of the fiscal consolidation persists in each case.

Figure 2.15, panel 2, reports the results for the effect of monetary tightening on corporate investment by leverage quintiles. Once the monetary shocks are combined with investment data from 1998 onward, the sample of countries is reduced to 25 economies. The figure shows that the impact of tightening is again largest for the most leveraged quintile of firms. After two years, investment by the most leveraged quintile is a cumulative 6½ percent lower in response to a surprise 100 basis point rise in the policy rate. This is 4 percentage points lower than the decline in investment by the least leveraged quintile. As with fiscal consolidation, the effects of monetary tightening on investment are persistent.

Overall, these results point to potential amplification of output costs in countries with private debt concentrated in vulnerable households and firms. This concern may be lessened in countries where stringent macroprudential measures were in place before the COVID-19 recession. Intuitively, measures that "lean against the wind," such as loan-to-value restrictions and debt-to-income caps, may have limited the buildup of debt among vulnerable households and helped create buffers for banks, limiting the output cost of tightening monetary and financial conditions (see the discussion in the April 2021 GFSR and Online Annex 2.5).[23]

## Conclusions and Policy Implications

Soon after the pandemic broke in early 2020, exceptional measures to save lives and livelihoods were deployed. On top of direct fiscal support to households and firms, governments helped sustain the flow of credit: central banks' accommodation and temporary financial regulatory changes, including repayment moratoriums and debt guarantees, offered a lifeline to many businesses and households.

Still, the impact of the pandemic on households' and firms' balance sheets has been unequal across and within countries, in large part reflecting differences in sectoral composition. Contact-intensive services have contracted during the pandemic while production and exports of goods and services substitutes (for example, appliances, computer chips, software) have thrived. Relatedly, the situation of workers in tourism services, restaurants, hospitality, and entertainment has often remained precarious two years after the start of the pandemic, while labor shortages and rapid wage increases have become the norm in construction and logistics for example (IMF 2020,2021a). The war in Ukraine has further disrupted global supply chains. Large increases in the prices of energy and food products are likely to affect low-income households—especially in emerging markets and developing economies—and could spill over to many industries via higher input prices if the conflict is prolonged (see chapter 1 WEO April 2022).

This chapter estimates that recent leverage buildup could slow the recovery by a cumulative 0.9 percent of GDP in advanced economies and 1.3 percent in emerging markets over the next three

[22] Income and wealth inequality show close correspondence (see Figure 2.3). Low-income households will also have the lowest share of net assets to income and therefore will be the most financially constrained. However, a lack of distributional balance sheet data for most countries limits the empirical exercise to income distribution.

[23] Online Annex 2.5, Figure 2.5.4, estimates the marginal effect of macroprudential regime stringency (based in iMaPP, the IMF's integrated Macroprudential Policy database) in mitigating the output decline from monetary tightening. The medium-term effect (2 years) of tightening is reduced by half in countries where the macroprudential regime is the most stringent.

years. But these are average effects based on cross-country aggregate data.[24] Financially constrained households and vulnerable firms, which have grown in number and proportion during the pandemic, are expected to cut spending by more, especially in countries where the insolvency framework is inefficient and fiscal space limited.

As monetary policies are being normalized amid rising inflationary pressures, governments should calibrate the pace of fiscal consolidation to country circumstances to avoid large disruptions and potential scarring. Where the recovery is well underway and balance sheets are in good shape, fiscal support can be reduced faster, facilitating the work of central banks. Elsewhere, targeted support can be considered within credible medium-term fiscal frameworks (see Box 2.1).

In particular, government support to firms could be limited to circumstances when there is clear market failure (April 2022 *Fiscal Monitor*). Where a wave of bankruptcies in sectors heavily hit by the pandemic could spill over to the rest of the economy, for example, governments could incentivize restructuring over liquidation and, where necessary, solvency support could be considered. Among possible frameworks for such support, debt relief in the form of quasi-equity injections into small and medium enterprises (through, for example, profit participation loans on existing and new loans) could be considered in countries with adequate fiscal space, transparency, and accountability (see Díez and others 2021). Of course, targeting the right, viable businesses—those insolvent as a result of the pandemic but that have viable business models—is hard (see the April 2021 GFSR). To lessen the burden on public finances, temporary higher taxes on excess profits could be envisaged. This would help claw back some of the transfers to firms that did not need them (Gourinchas and others 2021).

The analysis presented in this chapter also points to the need to enhance restructuring and insolvency mechanisms (through, for example, dedicated out-of-court restructuring) to promote a rapid reallocation of capital and labor toward the most productive firms (Araujo and others 2022; Díez and others 2021). To address the short-term impact of pandemic-related insolvency, countries could prioritize the weakest aspects of their regimes while working on more long-term comprehensive reforms. Similarly, if large household debt threatens the recovery, governments should consider cost-effective debt restructuring programs aimed at transferring resources to relatively vulnerable individuals with a high propensity to consume. By design, these programs should seek to minimize moral hazard (April 2012 WEO). The debt bias in corporate and personal taxation should also be eliminated to avoid incentivizing excess debt buildup, resource misallocation, and recurrent boom-bust cycles.

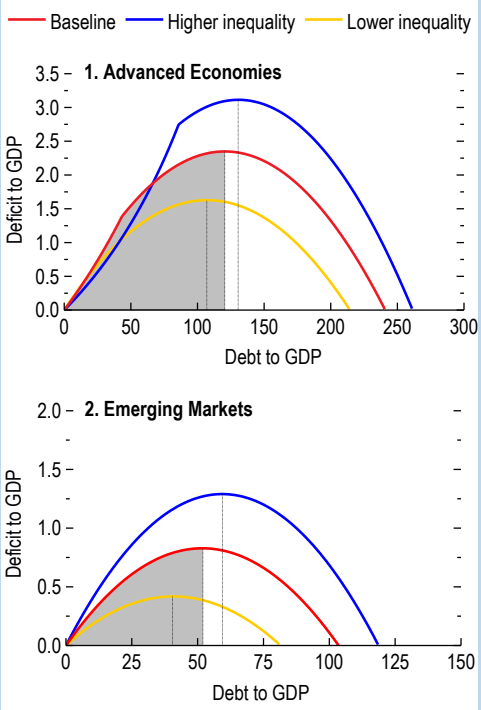
Finally, the chapter stresses the importance of distributional considerations to improve macroeconomic forecasting and policymaking. While further research is needed to enrich the tools and models available to policymakers, the priority is to the collection of more detailed and real-time data on firms' and household balance sheets.

[24] The estimates also predate the war in Ukraine and its possible consequences on balance sheets.

## Box 2.1. Inequality and Public Debt Sustainability

The pandemic has exacerbated income inequality, extending a secular trend started in the 1980s (April 2021 *Fiscal Monitor;* Azzimonti, De Francisco, and Quadrini 2014; Chancel and Piketty 2021; Chancel and others 2022). At the same time, interest rates have remained low despite steady increases in public debt. This apparent contradiction can be rationalized: higher-income households tend to save a larger share of their income, and as their share of national income increases, so do savings and the associated demand for both private and public debt securities. This increase in savings lowers equilibrium interest rates and eventually the cost of borrowing (Mian, Straub, and Sufi 2021a,b; Del Negro and others 2017; Box 2.2). Therefore, *all else equal*, higher top income inequality raises the sustainable levels of public debt and primary deficit (Mian, Straub, and Sufi 2021d; Reis 2021). Of course, all else is not always equal. Higher inequality could lead to lower potential growth and increases in government debt are eventually met with higher interest rates as liquidity, regulatory, and safety premiums on government debt erode (Krishnamurthy and Vissing-Jorgensen 2012; Lian, Presbitero, and Wiriadinata 2020). Sustainable public debt has its limits.[1]

**Figure 2.1.1. Rising Income Inequality Raises the Sustainable Level of Debt**
*(Percent)*




Sources: Organisation for Economic Co-operation and Development; and IMF staff estimates.
Note: The vertical line relates to the maximum sustainable primary deficit and its corresponding debt-to-GDP ratio. The shaded area indicates the free lunch zone. The baseline calibration identifies savers, with the top 10 percent earning a 40 percent share of income in advanced economies and 48 percent share of income in emerging markets. The advanced economies' (respectively emerging markets') model is calibrated with an initial level of debt of 105 percent (55 percent) of GDP, an initial nominal interest rate of 1 percent (4.7 percent), and a nominal long-term trend growth of 3.2 percent (6.2 percent). The higher/lower inequality scenario adds/subtracts a 5 percentage point share of income to the baseline. In both cases, the elasticity of interest rate to debt is 0.017, implying that a 10 percent increase in debt to GDP leads the interest rate to increase by 17 basis points (Mian, Straub, and Sufi 2021c). A higher (lower) elasticity would decrease (increase) debt thresholds.

This box analyzes the implications of inequality for debt sustainability in a framework that allows those counteracting forces to play out.. As governments contemplate exiting pandemic-related support policies, assessing the stringency of the fiscal budget constraint is key to calibrating the pace of consolidation. Rising inequality may lead to larger social transfers (and public debt) after the pandemic while, at the same time, enhancing governments' ability to finance them

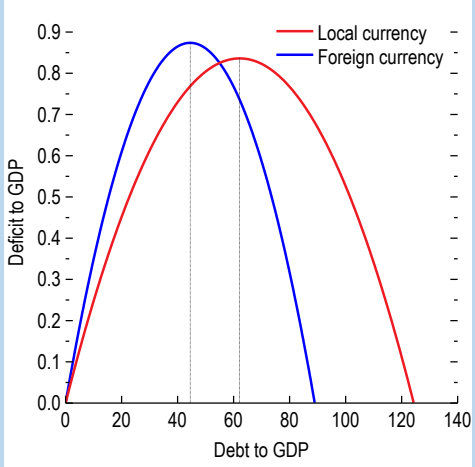
A simple calibrated model (based on Mian, Straub, and Sufi 2021c) can be used to draw a *deficit-debt-phase diagram* that depicts the set of sustainable combinations of primary deficit and debt (as a percent of GDP). The peak of the diagram shows the maximum sustainable debt-deficit level, taking into account the economies' nominal potential growth (G) and forces driving the interest rate (R). The region to the

[1] Other institutional factors matter, including the effectiveness and credibility of policy, the interaction with monetary policy, and the quality of institutions (October 2021 *Fiscal Monitor;* IMF 2016).

left of the maximum represents a *free lunch* zone: primary deficits—either through lower taxes or higher expenditures—can be increased to support the economy without going down an unsustainable debt path. Because increasing debt eventually raises interest rates, the sustainable deficit starts shrinking to the right of the peak as debt increases. Eventually, the interest-growth differential (R–G) becomes positive, and a primary surplus (negative deficit) is required for a stable debt-to-GDP ratio.

Figure 2.1.1 highlights differences between advanced economies and emerging markets[2]: the sustainable level of debt is larger in advanced economies because higher convenience premiums for liquidity and safety push (R) down.[3] In both advanced economies and emerging markets rising income inequality over the last four decades may have helped increase the sustainable *deficit-debt* pairs (Figure 2.1.1, blue lines), and the effect may have been sizable. Reasonable calibration suggests an increase in sustainable deficit of almost a full percentage point in advanced economies. This estimate is a higher bound, however. In countries where inequality undermines progress in education or leads to lower investment due to social unrest, for example, potential growth and the sustainable level of debt and deficit may be reduced. A country's resilience to higher debt is also determined by the share of public debt denominated in foreign currency. Calibrating the model above to emerging markets, the analysis shows that a higher share of foreign-currency-denominated debt tends to mean less room for fiscal support in the event of depreciation, highlighting higher solvency risks in emerging markets and the need to build buffers (Figure 2.1.2, blue line).

**Figure 2.1.2. Debt Denomination**
*(Percent)*




Sources: Organisation for Economic Co-operation and Development; and IMF staff estimates.
Note: The model assumes an exchange rate depreciation of 30 percent in the event of a negative shock. The blue line reflects the case when all debt is denominated in foreign currency, while the red line is when all debt is in local currency. An economy with mixed-denomination debt would lie between these two cases.

The author of this box is Anh Dinh Minh Nguyen.

[2] Parameters for advanced economies have been calibrated to match the purchasing-power-parity (PPP)-weighted average of OECD advanced economies in 2019, before the pandemic recession of 2020–21. Emerging market parameters have been calibrated to match the PPP-weighted average of Brazil, Chile, China, Colombia, Costa Rica, Hungary, India, Indonesia, Mexico, Poland, Russia, South Africa, and Turkey in 2019. Also see the note to Figure 2.1.1 for specific calibrations in emerging markets and advanced economies.

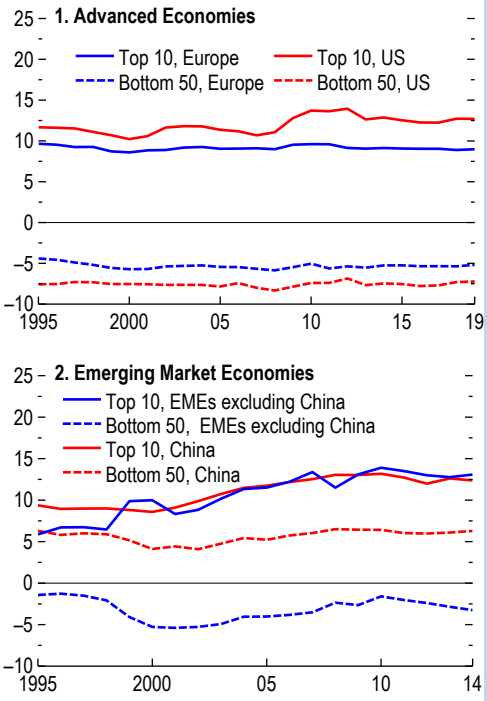
[3] Of course, country-specific factors, such as the elasticity of interest rates to debt, market access, and the currency denomination of public debt matter as well.

## Box 2.2. Rising Household Indebtedness, the Global Saving Glut of the Rich, and the Natural Interest Rate

The "saving glut of the rich" is a term coined to describe the substantial rise in saving at the very top of the income distribution in the United States over the past four decades (Mian, Straub, and Sufi 2021d). This phenomenon has coincided with rising household indebtedness concentrated among lower-income households and rising income inequality. It may have also contributed to the secular decline of the natural rate of interest (Mian, Straub, and Sufi 2021b; Platzer and Peruffo 2022; Rachel and Summers 2019). Intuitively, as debt-service payments transfer income from low propensity to save (borrower households) to high propensity to save (lender households) the ensuing rise in net supply of savings puts downward pressure on the natural interest rate.

The phenomenon may not be limited to the United States. This box presents new cross-country evidence of a *global* saving glut of the rich and its implications for the *natural interest rate*. The analysis builds on Allen, Kolerus, and Xu (forthcoming) and combines multiple sources (raw microeconomic survey data, tax tabulations, and national accounts) for 41 advanced and emerging market economies.[1]

**Figure 2.2.1. Saving by Income Group**
*(Percent of national income)*




Source: IMF staff calculations.
Note: Europe: Weighted average of 27 European economies; EMEs excluding China: Weighted average of the Dominican Republic, India, Korea, Mexico, Peru, Russia, and South Africa. EMEs = emerging market economies.

### Global Saving Glut of the Rich

Estimating saving out of permanent income or wealth is challenging, especially when considering a panel of countries. This box relies on indirect evidence that income and wealth inequality are highly correlated (Bricker and others 2020; Kuhn, Schularick, and Steins 2020; Figure 2.3) and bases the analysis on current income distribution. Figure 2.2.1 suggests that saving is distributed highly unequally. In advanced economies, the richest 10 percent of households account for most of aggregate saving, about twice that of middle-class households (6th decile to 8th decile). The poorest 50 percent typically dissave at a rate ranging from 4 percent to 7 percent of national income a year, consistently more in the United States than in Europe.[2]

The authors of this box are Gian Allen and Christina Kolerus. The analysis extends Allen, Kolerus and Xu (forthcoming) to a larger set of countries.

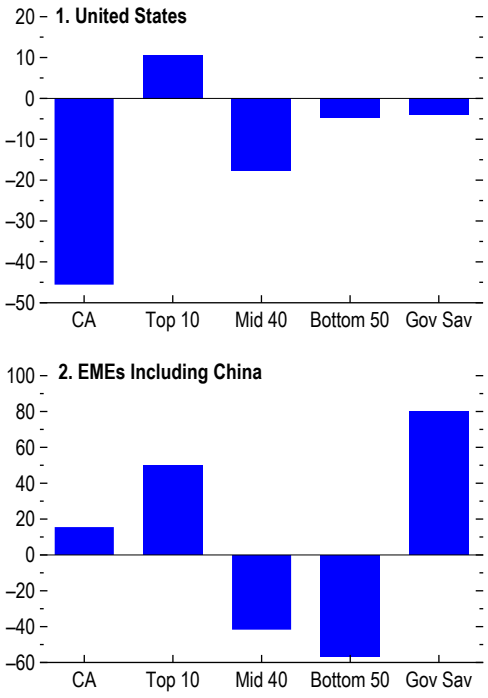
[1] Given important data limitations, extending the series to emerging market economies remains a challenge and relies on key assumptions. First, data on the distribution of (after-tax) disposable income is extended over time using growth rates of the distribution of before-tax income, which is more widely available (for countries with both series available, the time trends are very similar). Second, the raw survey data are not adjusted for underreporting of the top of the distribution, missing imputed rents and retained earnings, as it is for advanced economies.

[2] Fagereng and others (2021) stress that capital gains explain nonhomothetic saving rates across households, which otherwise would be constant.

Emerging market economies show broadly similar saving levels by the rich but slightly smaller dissaving by the bottom 50 percent, possibly because of more restricted access to finance. China stands out: middle-class saving reaches 20 percent of national income and saving by the bottom 50 is positive.

The global financial crisis triggered sizable increases in saving by the rich in the United States, unlike in Europe, where the distribution of saving remained broadly stable. In the largest emerging markets (China, India, South Africa, Mexico), rich households' saving has increased steadily since the 2000s.

**Figure 2.2.2. Absorption of Accumulated Saving**
*(Percent of national income)*




Source: IMF staff calculations.
Note: The figure shows the accumulated difference for each variable over 1996–2019 for the US and 1996–2015 for EMEs, relative to the average levels in 1994 and 1995, in percent of the national income. CA = current account; EMEs = emerging market economies; Gov Sav = government saving.

## Implications for the Natural Interest Rate

Voluminous capital market literature has established that the global saving glut was one of the drivers of the secular decline in the global natural interest rate (see for example Bernanke 2005; Caballero and others 2008). The preceding discussion stresses that rich households across the world may have been important contributors to the global saving glut. Figure 2.2.2 suggests that these two insights could be combined. Relative to the mid-1990s, the largest emerging markets have seen exports of saving by the rich, along with public saving, feeding the global saving glut via current account surpluses. In the United States, the situation has been more nuanced. Saving by the rich has been associated with financing large dissaving by the non-rich and the government (Mian and others 2021d), but foreign saving has also contributed, leading to a current account deficit (Figure 2.2.2).

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CHAPTER 2

# PRIVATE SECTOR DEBT AND THE GLOBAL RECOVERY

## Online Annex

### Annex 2.1. Data Sources, Sample Coverage, and Variable Definitions

Data sources used in the chapter are listed in Annex Table 2.1.1. The list of economies used for each exercise is provided in Annex Table 2.1.2.

*Stylized facts on household balance sheets* in Figure 2.2 in the chapter are built using aggregate data on household debt, financial and housing assets from the World Inequality Database. Household debt information is supplemented by data from the IMF's Global Debt Database. The correlation between income and wealth inequality in Figure 2.3 is measured using the shares of income and wealth that accrue to the bottom 50 percent of households along each dimension respectively. Data are taken from the World Inequality Database.

The distributions of household income and debt in Figure 2.4 for China, South Africa, Hungary, France, Italy, Germany, and the United Kingdom are derived from household wealth surveys for each country. The latest two available waves for each survey are used to train the nowcasting algorithm described in Annex 2.2 below. Macroeconomic and financial statistics on sectoral and regional gross value added, employment, wages, unemployment, house prices and sales, and bank lending are used to update the density estimates through 2020. Data sources and definitions vary slightly by country depending on data availability. For the United States, the analysis uses the 2019 and 2020 waves of the Consumer Expenditure Survey to directly estimate changes in debt ratios by income levels. Households are grouped by fixed income bands across years instead of income deciles. See Annex Table 2.1.1 below for details.

*Stylized facts on current firms' balance sheet developments* presented in Figures 2.5, 2.7, 2.8 are based on S&P Capital IQ database, covering the period from 2006Q1 to 2021Q2. The database provides balance sheet and income statement information at the firm-level and at the quarterly frequency. The data was cleaned to remove firms which had negative values for assets or debt in any year, and observations with the incorrect sign for revenue, capital expenditure, cash, tangible assets, and interest expenditure were set to missing.[1] Additionally, ratios have been winsorized at 1% (leverage, return on assets (ROA), and interests coverage ratio (ICR)).

Firms are assigned into 20 sectors by S&P Capital IQ. Sectors are further classified into "worst-hit industries", "middle", and "least-hit industries" based on the asset-weighted median operating revenue growth rate in 2020 (Figure 2.5). The top 5 worst-hit industries are consumer services; energy; automobiles and components; transportation; and consumer durables and apparel. The top 5 least-hit industries are semiconductors; software and services; pharmaceuticals and biotechnology; health care equipment and services; and household and personal products. The remaining 10 middle industries are capital goods; materials; professional services; utilities; media and entertainment; telecommunication services; food, beverage and tobacco; food and staples retailing; technology hardware and equipment; and retailing. In Figure 2.8, panel 3 sectors from

[1] See Kim, Mano, and Mr (2020) and Arbatli-Saxegaard, Firat, Furceri, and Verrier (forthcoming) for details.

S&P Capital IQ are mapped to OECD STAN sectors using concordance tables between SIC and ISIC Rev. 4 industry classifications.

Relevant variables are computed as follows:

- Leverage: total liabilities over total assets.
- Interest coverage ratio (ICR): earnings before interest and taxes (EBIT) over interests paid.
- Return on assets (ROA): net income over total assets.
- Vulnerable firm dummy: firm-level dummy that equals one if, at time *t*, firm's leverage is in the top tercile of the sector leverage distribution, in the bottom tercile of ROA and it has an ICR<1; zero otherwise. The distribution is calculating pooling all firms across time within sector in order to account for sectoral structural differences, such as high fixed costs, that may require heterogeneous structure of indebtedness or low ICR.

*Firms' investment analysis* of the effect of firms' excess leverage on investment is constructed with Bureau van Dijk Orbis firm-level data from 1998 to 2018, at an annual frequency. The analysis covers all sector of the economy except for financial and insurance activities, public administration and defense, agriculture, forestry and fishing. Data have been cleaned as in Diez and others (2021), following closely Kalemli-Özcan and others (2015). Capital variables are deflated using investment (gross fixed capital formation) deflators at the country level from the World Bank's World Development Indicators database. For monetary non-capital variables, sector-specific deflators (producer price, or value added, or gross output by sector) from various sources (OECD, Eurostat, CEIC database, and government websites) are used. All variables are expressed in constant 2015 U.S. dollars. Additionally, ratios have been winsorized at 1% (leverage, liquidity ratio, return on assets (ROA), and interests coverage ratio (ICR)).

Relevant variables for the analysis are derived as follows:

- Liquidity ratio: current assets net of current liabilities over total assets.
- Excess debt-to-assets: three-year change in liabilities-to-assets, lagged to mitigate endogeneity concerns and standardized over the entire sample to ease interpretation.
- Investment ratio: log-difference of tangible fixed assets.
- Size: logarithm of total assets.
- Revenue growth: percentage change in turnover.

Additionally, the vulnerable firm dummy, ROA, ICR and leverage are defined as in the stylized facts.

*Excess credit and subsequent output, consumption, and investment dynamics.* Data on the private credit for households and non-financial corporations as percent of GDP is taken from the Bank for International Settlements. The response variables (GDP, consumption, and investment) are from the IMF's World Economic Outlook database. The proxy measurement of fiscal space is derived using principal components drawing on the database compiled by the World Bank (see Kose and others 2017). The wealth inequality sample split is based on the dissaving of the bottom 50 percent of households as computed in Allen, Kolerus, and Xu (2022). Temporal coverage is the most extensive unbalanced sample available starting in 1965, with the vast majority of economies entering

the sample in the 1990s. Sample availability was determined by the intersection of available data. The IMF's WEO has the most extensive coverage, but fiscal space and wealth inequality coverage is somewhat more limited. See Annex Tables 2.1.1 and 2.1.2 for a detailed list of variables and country coverage.

*Policy transmission.* At the country level, data from the IMF's WEO, International Financial Statistics (IFS), Global Debt Database (GDD), and Integrated Macroprudential Policy (iMaPP) database are used. In addition, fiscal policy shocks are from IMF External Sector Report 2021 Chapter 2 and monetary policy shocks are constructed from Consensus Economics data following the approach of Furceri, Loungani, and Zdzienicka (2018). For a subset of countries, household consumption by income quintiles is from Allen, Kolerus, and Xu (2022) and corporate investment by leverage quintiles is constructed from the Bureau van Dijk Orbis dataset (with the data processed in a similar way as in the *Firms' investment analysis* section above).

## Annex Table 2.1.1. Data Sources

| Indicators | Source |
|---|---|
| *Stylized Facts on Household Balance Sheets* | |
| Household Debt (Percent of GDP) | International Monetary Fund, Global Debt Database |
| Household Financial Assets; Household Housing Assets; Wealth and Income Shares | Word Inequality Database; Eurostat; Bureau of Economic Analysis |
| Household Income and Debt Distributions | Household wealth survey data: China Family Panel Studies (China); Consumer Expenditure Survey (United States); Household Finance and Consumption Surveys (France and Hungary); Wealth and Assets Survey (United Kingdom); Survey of Household Income and Wealth (Italy); National Income Dynamics Study (South Africa); Luxembourg Wealth Study (LWS) Database (Germany).<br>Macroeconomic and financial statistics: CEIC Data Company Limited; Haver Analytics; OECD; Eurostat; Hungarian Central Statistical Office; Italian National Institute of Statistics; Bank of Italy; Statistics South Africa; Office for National Statistics, UK Finance. |
| *Stylized Facts on Current Firms' Balance Sheet Developments and Firms' Investment Analysis* | |
| Total Liabilities; Total Assets; Current Liabilities; Current Assets; Tangible Fixed Assets; EBIT; Interest Paid; Net Income; Turnover (National Currency Converted to Constant 2015 U.S. Dollars) | Bureau van Dijk Orbis |
| Total Liabilities; Total Assets; EBIT; Net Interest Expense; Net Income (Current Prices, National Currency Converted to U.S. Dollars) | S&P Global Market Intelligence, Capital IQ (IMF Aggregated Data is Not S&P Information) |
| Gross Fixed Capital Formation (Current and Constant Prices, National Currency) to Derive Investment Deflators | World Bank, World Development Indicators |
| Sector-Specific Deflators (Producer Price, or Value Added, or Gross Output by Sector) | Diez and others (2021); OECD; Eurostat; CEIC Data Company Limited; Government Websites |
| Indicator of Crisis Preparedness | International Monetary Fund, SPR-LEG |
| *Excess Credit and Subsequent Output, Consumption, and Investment Dynamics* | |
| Total Credit to Households, and Total Credit to Nonfinancial Corporations (Percent of GDP) | Bank for International Settlements, Credit to the Non-Financial Sector database |
| Gross Domestic Product, Private Consumption Expenditure, and Gross Fixed Capital Formation (Constant Prices, National Currency) | International Monetary Fund, World Economic Outlook database |
| Dissaving by the Bottom 50 Percent | Allen, Kolerus, and Xu (2022); World Inequality Database |
| General Government Gross Debt (Percent of GDP); Primary Balance (Percent of GDP); Fiscal Balance (Percent of GDP); Cyclically-Adjusted Balance (Percent of Potential GDP); General Government Gross Debt (Percent of Average Tax Revenues); Fiscal Balance (Percent of Average Tax Revenues) | Kose and Others (2017); World Bank, A Cross-Country Database of Fiscal Space |
| *Policy Transmission* | |
| Gross Domestic Product (Constant Prices, National Currency) | International Monetary Fund, World Economic Outlook database |
| Private Debt (Loans and Debt Securities, Percent of GDP) | International Monetary Fund, Global Debt Database |
| Household Consumption by Income Quintile | Allen, Kolerus, and Xu (2022); World Inequality Database |
| Corporate Investment by Leverage Quintile | Bureau van Dijk Orbis |
| Macroprudential Index | International Monetary Fund, Integrated Macroprudential Policy (iMaPP) database |

Source: IMF staff compilation.

**Annex Table 2.1.2. Economies Included in the Analysis**

| Exercise | List of Economies |
|---|---|
| *Stylized Facts on Household Balance Sheets* | |
| Aggregate Household Balance Sheets (Figure 2.2) | Austria; Belgium; Cyprus; Czech Republic; Germany; Denmark; Spain; Estonia; Finland; France; United Kingdom; Italy; Lithania; Luxembourg; Netherlands; Norway; Slovak Republic; Slovenia; Sweden; United States |
| Correlation Between Wealth and Income Inequality (Figure 2.3) | Afghanistan; Albania; Algeria; Angola; Argentina; Armenia; Australia; Austria; Azerbaijan; Bahamas, The; Bahrain; Bangladesh; Belarus; Belgium; Belize; Benin; Bhutan; Bolivia; Bosnia and Herzegovina; Botswana; Brazil; Brunei Darussalam; Bulgaria; Burkina Faso; Burundi; Cabo Verde; Cambodia; Cameroon; Canada; Central African Republic; Chad; Chile; China; Colombia; Comoros; Congo, Democratic Republic of the; Congo, Republic of; Costa Rica; Croatia; Cyprus; Czech Republic; Côte d'Ivoire; Denmark; Djibouti; Dominican Republic; Ecuador; Egypt; El Salvador; Equatorial Guinea; Eritrea; Estonia; Eswatini; Ethiopia; Finland; France; Gabon; Gambia, The; Georgia; Germany; Ghana; Greece; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hungary; Iceland; India; Indonesia; Iran; Iraq; Ireland; Israel; Italy; Jamaica; Japan; Jordan; Kazakhstan; Kenya; Korea; Kuwait; Kyrgyz Republic; Lao P.D.R.; Latvia; Lebanon; Lesotho; Liberia; Libya; Lithuania; Luxembourg; Madagascar; Malawi; Malaysia; Maldives; Mali; Malta; Mauritania; Mauritius; Mexico; Moldova; Mongolia; Montenegro, Rep. of; Morocco; Mozambique; Myanmar; Namibia; Nepal; Netherlands, The; New Zealand; Nicaragua; Niger; Nigeria; North Macedonia; Norway; Oman; Pakistan; Panama; Papua New Guinea; Paraguay; Peru; Philippines; Poland; Portugal; Qatar; Romania; Russia; Rwanda; Saudi Arabia; Senegal; Serbia; Seychelles; Sierra Leone; Singapore; Slovak Republic; Slovenia; Somalia; South Africa; Spain; Sri Lanka; Sudan; Suriname; Sweden; Switzerland; Syria; São Tomé and Príncipe; Tajikistan; Tanzania; Thailand; Timor-Leste; Togo; Trinidad and Tobago; Tunisia; Turkey; Turkmenistan; Uganda; Ukraine; United Arab Emirates; United Kingdom; United States; Uruguay; Uzbekistan; Venezuela; Vietnam; Yemen; Zambia; Zimbabwe |
| Household Income and Debt Distributions (Figure 2.4) | China; France; Germany; Hungary; Italy; South Africa; United Kingdom; United States |
| *Stylized Facts on Current Firms' Balance Sheet Developments* | |
| Advanced Economies | Australia; Austria; Belgium; Canada; Cyprus; Czech Republic; Estonia; Finland; France; Germany; Greece; Hong Kong SAR; Iceland; Ireland; Israel; Italy; Japan; Korea; Latvia; Lithuania; Luxembourg; Macao SAR; Malta; Netherlands; New Zealand; Norway; Portugal; Singapore; Spain; Sweden; Switzerland; Taiwan Province of China; United Kingdom; United States |
| Emerging Market Economies | Argentina; Bahrain; Botswana; Brazil; Bulgaria; Chile; China; Colombia; Croatia; Egypt; Hungary; India; Indonesia; Jamaica; Jordan; Kazakhstan; Kuwait; Malaysia; Mauritius; Mexico; Oman; Pakistan; Peru; Philippines; Poland; Qatar; Romania; Russia; Saudi Arabia; South Africa; Sri Lanka; Thailand; Trinidad and Tobago; Tunisia; Turkey; Ukraine; United Arab Emirates |
| *Firms' Investment Analysis* | |
| Advanced Economies | Finland; France; Germany; Greece; Ireland; Israel; Italy; Japan; Korea; Latvia; Lithuania; Luxembourg; Netherlands, The; New Zealand; Norway; Portugal; Slovak Republic; Spain; Sweden; Switzerland; United States |
| Emerging Market and Developing Economies | Bulgaria; Chile; China; Colombia; Egypt; Hungary; Indonesia; Kazakhstan; Malaysia; Mexico; the Philippines; Poland; Romania; Russia; Thailand; Turkey; Vietnam |
| *Excess Credit and Subsequent Output, Consumption, and Investment Dynamics* | |
| Advanced Economies | Australia; Austria; Belgium; Canada; Czech Republic; Denmark; Finland; France; Germany; Greece; Hong Kong SAR; Ireland; Israel; Italy; Japan; Korea; Luxembourg; Netherlands, The; New Zealand; Norway; Portugal; Singapore; Spain; Sweden; Switzerland; United Kingdom; United States |
| Emerging Market Economies | Argentina; Brazil; Chile; China; Colombia; Hungary; India; Indonesia; Malaysia; Mexico; Poland; Russia; Saudi Arabia; South Africa; Thailand; Turkey |
| *Policy Transmission* | |
| Effects of Fiscal Consolidation: Benchmark | Argentina; Australia; Austria; Belgium; Brazil; Canada; Chile; China; Colombia; Costa Rica; Denmark; Dominican Republic; Ecuador; Finland; France; Germany; Guatemala; India; Ireland; Italy; Jamaica; Japan; Mexico; Netherlands, The; Peru; Portugal; Spain; Sweden; United Kingdom; United States; Uruguay |
| Effects of Monetary Tightening: Benchmark | Argentina; Australia; Brazil; Canada; Chile; Czech Republic; France; Germany; Hong Kong SAR; Hungary; India; Indonesia; Italy; Japan; Korea; Malaysia; Mexico; Netherlands, The; New Zealand; Norway; Philippines; Poland; Singapore; Slovak Republic; Spain; Sweden; Switzerland; Taiwan Province of China; Thailand; Turkey; United Kingdom; United States |
| Consumption by Income Quintiles (Figure 2.15, panel 1) | Belgium; Denmark; Finland; France; Germany; Ireland; Italy; Netherlands, The; Portugal; Spain; Sweden; United Kingdom; United States |
| Investment by Leverage Quintiles (Figure 2.15, panel 2) | Australia; Chile; Czech Republic; France; Germany; Hungary; Indonesia; Italy; Japan; Korea; Malaysia; Mexico; Netherlands, The; New Zealand; Norway; Philippines; Poland; Slovak Republic; Spain; Sweden; Switzerland; Thailand; Turkey; United Kingdom; United States |

Source: IMF staff compilation.

# Annex 2.2. Nowcasting Household Income and Debt Distributions

## Conceptual Framework

We wish to nowcast the joint distribution of household income and debt in 2020. To do this, we build and train a nowcasting algorithm to predict this joint distribution for an earlier year when the nowcast can be compared to actual household survey microdata. The training is done by minimizing the squared distance of the actual joint density at some time $s+1$ with our nowcast of the distribution based on the previous survey wave conducted at time $s$. Specifically, our objective function is given by

$$\min \iint \left[ f(y,l|t=s+1) - \hat{f}(y,l|t=s) \right]^2 dl dy, \qquad (A.2.2.1)$$

where $y$ and $l$ are log household income and debt and $f(y,l)$ denotes their joint pdf. We also make explicit that this distribution depends on whether households have any debt $q = 1[L > 0]$, with $L = \exp(l)$, and on macroeconomic and financial data $z$

$$f(y,l|t) = \iint f(y,l|q,z,t) dF_q(q|z,t) dF_z(z|t=s). \qquad (A.2.2.2)$$

We follow DiNardo, Fortin and Lemieux (1996) and use reweighting and regression adjustment to estimate $\hat{f}(y,l|t=s)$ in terms of the income and debt distributions observed at time $s$ and the growth rates of macroeconomic variables between $s$ and $s+1$

$$\hat{f}(y,l|t=s) = \iint f(y+\Delta y, l+\Delta l|q,z,t=s) \psi_{q|z}(q,z) dF_q(q|z,t=s) \psi_z(z) dF_z(z|t=s), \qquad (A.2.2.3)$$

where $\Delta y$ and $\Delta l$ are the change in $y$ and $l$ between $s$ and $s+1$. Equation $(A.2.2.3)$ also includes the reweighting terms

$$\psi_{q|z}(q,z) = \frac{dF_q(q|z,t=s+1)}{dF_q(q|z,t=s)} \quad \text{and} \quad \psi_z(z) = \frac{dF_z(z|t=s+1)}{dF_z(z|t=s)},$$

which are the ratios of conditional mass and density functions of $q$ and $z$ respectively between time $s+1$ and $s$.

Since $q$ is a binary variable and using Bayes' rule, $\psi_{q|z}(q,z)$ can be re-expressed as

$$\psi_z(z) = \frac{\Pr(t=s+1|z)}{\Pr(t=s|z)} \frac{\Pr(t=s)}{\Pr(t=s+1)}.$$

The weighting function $\psi_z(z)$ can be estimated non-parametrically using macro variables $z$ in periods $s$ and $s+1$, for example with a constant kernel estimator as in Hall, Li and Racine (2007). In practice, we regress the dummy variable $\tau = 1[t=s+1]$ on $z$ using a logit estimator so that $\psi_z(z) = c \exp(z_{k,t}\theta)$, with constant $c$.

## Identification

In order to estimate equation $(A.2.2.3)$, we make the following two identifying assumptions:

*Assumption 1.* Conditional on their indebtedness status $q$, changes in household income and debt along the intensive margin can be modeled as a linear function[2] of the growth rates of macroeconomic and financial variables $\Delta z_{k,t}$, which include regional, sectoral and time dummies

$$E\left[\Delta x_{i\in k,t} | q_{i\in k,t} = j, \Delta z_{k,t}\right] = \Delta z_{k,t}\eta_x^j \qquad x = \{y, l\};\ j = \{0,1\}.$$

*Assumption 2.* Changes in the probability that a household has positive or zero debt can be estimated as a function of the growth rate of observed macroeconomic variables $\Delta z_{k,t}$

$$E\left[\Delta \Pr\left(q_{i\in k} = 1 | \Delta z_{k,t}\right)\right] = \Delta z_{k,t}\gamma^1 \quad \text{and} \quad E\left[\Delta \Pr\left(q_{i\in k} = 0 | \Delta z_{k,t}\right)\right] = \Delta z_{k,t}\gamma^0.$$

Using Assumptions 1 and 2, we can express the forecasted joint distribution $\hat{f}(y, l; t = s)$ as a function of microdata available at time $s$ and macroeconomic data through time $s + 1$ as

$$\hat{f}(y, l | t = s) = \iint \Psi(z, \Delta z) f\left(y + \Delta z\eta_y, l + \Delta z\eta_l \middle| q, z, t = s\right) dF_q(q | z, t = s) dF_z(z | t = s), \tag{A.2.2.4}$$

with $\Psi(z, \Delta z) = \exp(z\theta)\left[q(1 + \Delta z\gamma^1) + (1 - q)(1 + \Delta z\gamma^0)\right]$.

## Estimation

We empirically estimate equation $(A.2.2.2)$ using a bivariate Gaussian kernel product function

$$f(y, l | t = s + 1) = \frac{1}{2\pi} \sum_{i\in\{t=s+1\}} \frac{\omega_i}{h^y h^l} \exp\left[-\frac{1}{2}\left(\frac{y - y_i}{h^y}\right)^2 - \frac{1}{2}\left(\frac{l - l_i}{h^l}\right)^2\right],$$

where $\omega_i$ denotes individual household survey weights and $\{h^y, h^l\}$ are the bandwidths for log household income and debt.

The forecasted density in equation $(A.2.2.4)$ is estimated using a weighted bivariate Gaussian kernel product function[3]

$$\hat{f}(y, l | t = s) = \frac{1}{2\pi} \sum_{i\in\{t=s\}} \frac{\omega_i}{h^y h^l} \Psi_i \exp\left[-\frac{1}{2}\left(\frac{y - y_i - \Delta z\eta_y}{h^y}\right)^2 - \frac{1}{2}\left(\frac{l - l_i - \Delta z\eta_l}{h^l}\right)^2\right],$$

with the parameter vector $\Gamma = \{\eta, \gamma, \theta\}$ chosen to minimize equation. $(A.2.2.1)$.[4]

## Implementation

We assign households to $k$ groups defined by region and industry of work of the first and second earners in each household.[5] We then match households by group to a set of observable macroeconomic variables, including GVA and GDP, employment, unemployment, labor

[2] We use splines to increase flexibility and explanatory power of the macro and financial variables $z_{k,t}$.

[3] DiNardo, Fortin and Lemieux (1996) use a univariate weighted Gaussian kernel function to estimate wage distributions in the US.

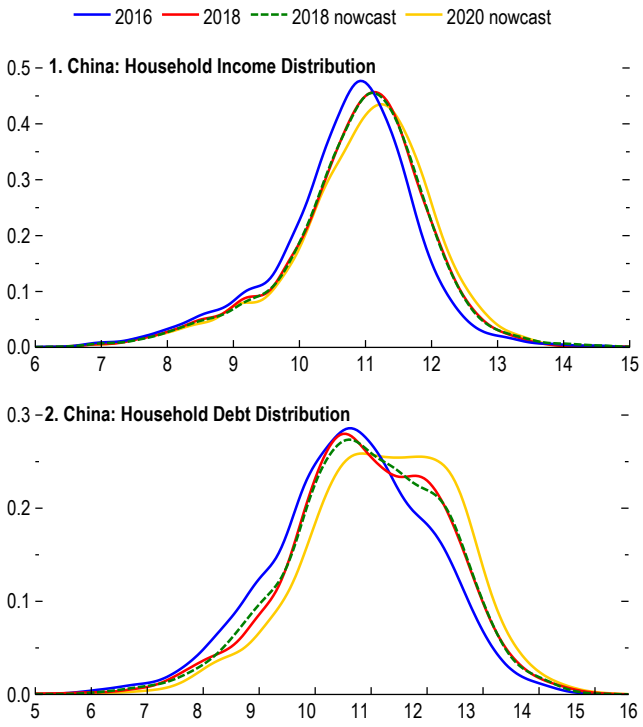
[4] The algorithm also constrains the total change in income and debt to match published statistics for 2020.

[5] Observations where industry is not observed, for example because respondents do not work, are assigned to a residual group.

compensation, house volume sales and prices and bank loans at the regional and industry levels.[6] We also include region and sector fixed effects.

The procedure then involves training the algorithm on an initial wave of the household survey to predict the joint distribution of household income and debt for the subsequent wave. The same model coefficients are then used to nowcast the distribution in 2020 based on aggregate changes in macro and financial variables through 2020. The performance of the algorithm can be assessed by comparing the 2018 nowcast curves to the actual 2018 kernel densities for income and debt (Figure 2.2.1).

**Annex Figure 2.2.1. Nowcasting the Joint Distribution of Income and Debt**
*(Density; log real yuan on the x-axis)*




Sources: CEIC Data Company Limited; and IMF staff calculations.

Importantly, our identifying assumptions rely on regional and industry-level economic variation to predict changes in income and debt for individual households. The advantage offered by these data is that they are published with a much shorter lag than household survey data, which allows us to extrapolate the microdata until 2020.

Finally, since household microdata vintages vary by country, we adjust the estimated changes in debt ratios from the nowcasted estimates to match the aggregate change between 2019 and 2020. This is done by subtracting from the nowcasted changes the aggregate change between the last year of microdata—2016 for Italy, 2017 for France, United Kingdom, Germany, Hungary and South Africa, and 2018 for China—and 2019.

## Annex 2.3. Firms' Investment Analysis

### Methodology

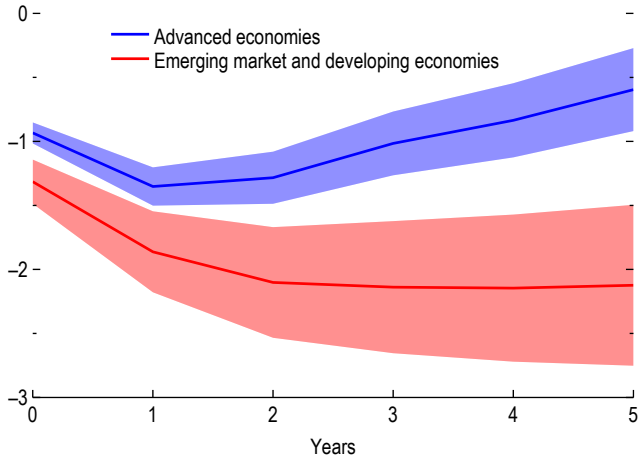
Following Albuquerque (2021), we estimate the following *unconditional equation* at the firm-level in a local projection framework. The sample covers 21 advanced and 17 emerging market and developing economies, over the timeframe 1998–2018:

$$k_{it+h} - k_{it-1} = \boldsymbol{\beta_1^h}\Delta_3 Lev_{i,t-1} + \beta_2^h X_{it-1} + \alpha_i^h + \mu_{cst}^h + \epsilon_{csit}^h \qquad (A.2.3.1)$$

[6] The specific variables vary by country depending on their availability.

The dependent variable is the firms' cumulative investment ratio in tangible fixed assets at different horizons *h=0,..,5*,[7] $\Delta_3 Lev_{i,t-1}$ is the firms' leverage buildup, defined as the three-year change in debt-to-assets $(Lev_{i,t-1} - Lev_{i,t-4})$ and standardized over the entire sample to ease the interpretation, $X_{it-1}$ is a vector of lagged firm level controls (liquidity ratio, leverage, revenue growth, size, ICR and the dependent variable). The specification includes firms fixed effects. Thus, the firms' leverage buildup captures leverage accumulation above firms' average debt-to-assets. Sector-country-year fixed effects allow to pin down the partial equilibrium effect of credit booms by absorbing other time-varying confounding factors and general equilibrium forces at play. Finally, robust standard errors are clustered at firm level.

**Annex Figure 2.3.1. Unconditional Effect of Firms' Leverage Buildup on Investment Ratio**
*(Cumulative percentage points)*




Sources: Bureau van Dijk Orbis; and IMF staff calculations.
Note: Shaded areas represent 90 percent confidence intervals. The figure reports firms' investment ratio response to a one standard deviation change in leverage buildup.

The key parameter of interest is $\beta_1^h$, which captures the unconditional sensitivity of investment ratio to firms' leverage buildup over a five-year horizon. As illustrated in Annex Figure 2.3.1, investment ratio drops relatively more in EMDEs, consistently with the evidence found using country-level data, where investment spending decreases following a one percent of GDP persistent rise in debt-to-GDP. Following a one-standard-deviation change in cumulated leverage, investment ratio decreases by almost 1 percentage points at impact in advanced economies and 1.7 percentage points in emerging economies. While in the former the cumulated loss gradually decreases after the first year, in EMDEs, the cumulated effect on firms' investment ratio leads to permanent effects on the tangible capital stock. As underlined in Albuquerque (2021), the inclusion of pre-determined firms' controls in the specification reduces concerns that the observed behavior of firm's investment ratio is driven by other factors than leverage accumulation.

To estimate the *contribution of vulnerable firms*, the unconditional equation (A.2.3.1) is augmented to include the interaction between excess leverage accumulation with the vulnerable dummy $(I_{it})$, constructed as described in Online Annex 2.1. To control for heterogeneity between vulnerable and non-vulnerable firms via channels other than leverage buildup, the dummy is included by itself as well as interacted with the other covariates.

$$k_{it+h} - k_{it-1} = \boldsymbol{\beta_1^h}\Delta_3 Lev_{i,t-1} + \boldsymbol{\beta_2^h}\Delta_3 Lev_{i,t-1} * I_{it} + \beta_3^h X_{it-1} + \beta_4^h X_{it-1} * I_{it} + \beta_5^h I_{it} + \alpha_i^h + \mu_{cst}^h + \epsilon_{csit}^h \quad (A.2.3.2)$$

[7] Although intangible capital is another important aspect to consider, it is out of the scope of this analysis.

Results are reported in Figure 2.12, panel 1 and 2 in the main text, for AEs and EMDEs respectively. For both advanced and emerging market economies, most of the effect is attributable to vulnerable firms and is measured by $\beta_1^h + \beta_2^h$.

As robustness check, we identify vulnerable firms pooling firms across time within sector and country group to additionally account for structural differences between advanced and emerging markets economies. Finally, we use an alternative definition of vulnerable firms similar to Albuquerque (2021). The dummy equals one if, at time *t*, firm's leverage is in the top quartile of the sector leverage distribution, and in the bottom quartile of the sector liquidity ratio distribution; zero otherwise. In both cases, results are consistent with the baseline analysis.

Finally, the role of *insolvency and reorganization proceedings* in preventing a large drop of investment is analyzed using the same specification as in (A.2.3.2) above but replacing the dummy indicator by a country level one based on the cross-country distribution of the newly created IMF crisis preparedness (Araujo and others 2022). The indicator captures the existence and availability of a comprehensive set of legal tools and institutions relevant for restructuring and insolvency proceedings in response to systemic crises, and it is based on five sub-indicators: out-of-court restructuring, hybrid restructuring, reorganization, liquidation, and institutional framework.[8] Figure 2.13, in the main text, compares the cumulated response of investment ratios to firms' leverage buildup for firms located in countries with well-prepared insolvency systems in place versus firms in jurisdictions with shortcomings in crisis preparedness. As illustrated by the cumulative investment ratio response, inadequate insolvency and restructuring proceedings account for most of the long-term decline in the stock of tangible capital.

## Annex 2.4. Credit-Output Dynamics

*Excess Credit and Subsequent Macroeconomic Dynamics.* Little consensus exists among economists on an operational concept of private *excess credit*—leverage buildup that leads to subsequent deleveraging pressures (Del'Ariccia and others 2016). Here we define excess credit ($excess\ credit_{i,t}$) as the cyclical component of the Hamilton filter (Hamilton 2018) which we use to disentangle secular trends—associated with financial deepening—from cyclical changes.[9] To improve the noise-to-signal ratio and focus on large and persistent credit cycles, we compute a three-year trailing average of the cyclical component that is then used in local projections in the spirit of Jordà (2005) to quantify the impact of excess credit on future output, consumption, and investment. This is comparable to other approaches such as Mian, Sufi, and Verner (2017). Country-level measures of excess credit are used in a panel of 43 countries (27 advanced economies, AEs, and 16 emerging market and developing economies, EMDEs) for with an unbalanced time coverage from 1969 to 2020 with time- and country-fixed effects for each projection horizon.

[8] For further discussion on the construction of the indicator, tailored policy recommendations and the value of the indicator for the full set of countries, also the ones not included in this analysis, refer to Araujo and others (2022).

[9] In an ideal empirical setting, we would be able to identify instruments for excess credit buildups across a broad range of countries and time-periods. Due to data constraints, the chapter instead relies on three-year trailing average of the Hamilton-filtered excess credit.

The two country groupings for which the empirical exercises are conducted are the IMF World Economic Outlook sub-groups "Advanced Economies" (AEs) and "Emerging Market and Developing Economics" (EMDEs) that have data on credit, fiscal space, and wealth inequality available. The list of economies in the sample is provided in Annex Table 2.1.2. The local projection equation is defined as:

$$\Delta y_{i,\,t+h|t-1} = \mu_i^h + \beta^h \cdot excess\ credit_{i,t} + v_t^h + \varepsilon_{i,t+h} \qquad (A.2.4.1)$$

where the left-hand-side variables are the cumulative percent change from $t-1$ to $t+h$ with $h = 1,2,\ldots,5$

$$\Delta y_{i,\,t+h|t-1}^{(k)} = 100 \cdot \left( \frac{y_{i,t+h}^{(k)} - y_{i,t-1}^{(k)}}{y_{i,t-1}^{(k)}} \right)$$

and where k is either output, consumption, or investment. The figures 2.9–2.11 in the chapter visualize the $\beta^h$ and their confidence intervals for the different projection horizons and can be interpreted as the cumulative change in left-hand-side variable to a one-percentage point increase in the credit-to-GDP ratio.

*Differential Fiscal Position Credit-Output-Dynamics.* Measuring the fiscal position is a science in and of itself. IMF (2018) uses a multi-dimensional framework that incorporates country-specific factors and judgements. Such assessments are not available for a sizeable cross-country panel of historical data. This subsection computes the fiscal position based on six indicators: (1) general government gross debt, (2) primary balance, (3) fiscal balance – (1) – (3) as percent of GDP – (4) cyclically-adjusted balance as a percent of potential GDP, (5) general government gross debt and (6) fiscal balance as percent of average tax revenues. These six indicators (Kose and others 2017) jointly reflect government's pre-existing debt stock, relative to overall output and relative to the government's revenue generating capacity and its fiscal cost of existing debt. While by no means an in-depth, country specific assessment of fiscal position, these six ratios taken together proxy for an economy's ability to undertake discretionary fiscal policies. The fiscal indicator used in the chapter's analysis is a proxy for the fiscal position based on a principal component of those six indicators. The first principal component explains about 60 percent of the variation in the data. Within year the data is sorted into quartile bins and the dynamics credit-output are contrasted between economies with weak and strong fiscal position classified by the principal component proxy. The resultant differential cumulative output responses for the two groups of economies, contrasting the response of the quartile with the strongest fiscal position and the weakest fiscal position after three years are presented in Figure 2.10.

*Differential Wealth Inequality Excess Credit-Output-Dynamics.* Figure 2.11 displays the household credit output dynamics for two different sets of economies with high and low wealth concentrations respectively. The group of advanced economies is split into two subgroups: First, one where the dissaving of the bottom 50 percent over a trailing three-year moving average had been highest, those are the economies that are, by that flow-based proxy, most unequal in terms of their wealth. Second, those economies where the dissaving of the bottom 50 percent over a trailing three-year average had been lowest. Note that in Allen, Kolerus, and Xu (2022) the bottom 50 percent households always dissave.

*Robustness Checks.* A couple of exercises to check on the robustness of the results were implemented. For the baseline results we also consider a credit-to-GDP ratio where the GDP figure is lagged by one year to ensure that results are not driven by abrupt movements in the denominator. For the fiscal space exercises, variations that included variables about the maturity structure ("Sovereign debt average maturity, years", mnemonic *avglife* in the World Bank Fiscal Space Database) and currency denomination ("General government debt in foreign currency, percent of total", mnemonic *fxovsh* in the World Bank Fiscal Space Database) as part of the principal component fiscal position classification. Another variant of the robustness checks was to include a long-term interest rate differentials vis-à-vis the United States using the "Long-term bond yield (Percent, Units)" in the IMF WEO database. Due to data limitations these robustness checks reduce the sample coverage, but the overall results are little changed. They are available upon request.

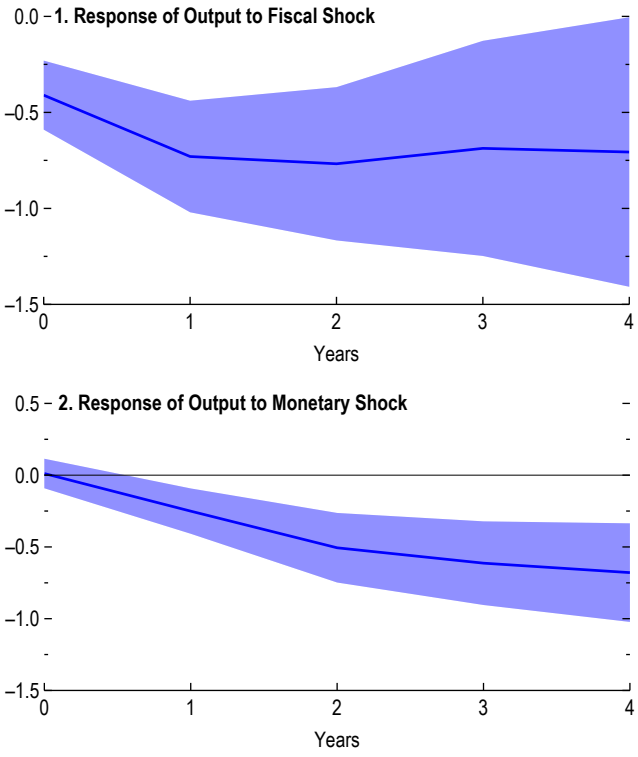
## Annex 2.5. Effectiveness of Countercyclical Policies in the Presence of High Private Debt

This section analyses how private-sector debt affects the transmission of fiscal and monetary policies, with a focus on the effects for heterogeneous households and firms, with weaker and stronger balance sheets. Using fiscal policy shocks and monetary policy shocks that have been validated in previous cross-country studies, the effects of fiscal and monetary policy on real GDP are first estimated using local projections:

$$y_{i,t+h} - y_{i,t-1} = \mu_i^h + X_{i,t}\gamma^h + s_{i,t}\beta^h + v_t + \varepsilon_{i,t+h}, \quad s \in \{fiscal, monetary\} \quad \text{(A.2.5.1)}$$

where the dependent variable of interest is the change in real GDP over various horizons, $h$; $\mu_i$ and $v_t$ are country fixed effects and year dummies, respectively; and $s_{i,t}$ is the annual fiscal or monetary policy shock. The coefficient $\beta^h$ measures the cumulative response of real GDP in year $t+h$ to a policy shock in year $t$. Robust standard errors are clustered by country.

**Annex Figure 2.5.1. Effects of Macro Policy Tightening**
*(Percent change)*




Sources: Consensus Economics Inc.; Guajardo, Leigh, and Pescatori (2014); and IMF staff calculations.
Note: Shaded areas represent 90 percent confidence intervals.

### Fiscal and Monetary Transmission: Aggregate Data Benchmark

The fiscal shocks employed are fiscal consolidations from Chapter 2 of the 2021 External Sector Report, who use a narrative approach to identify exogenous changes in government spending or

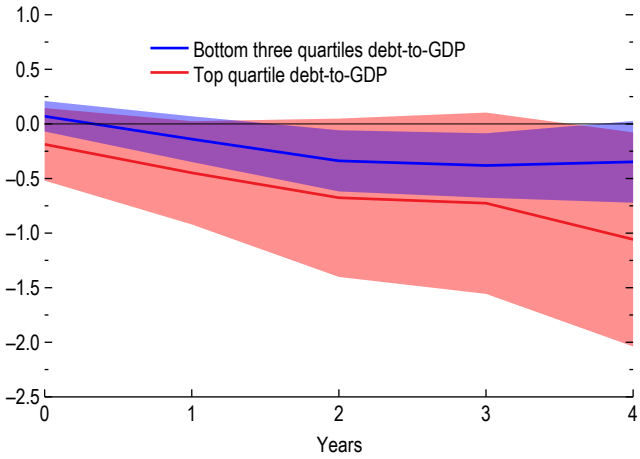
taxes. The sample consists of 31 countries, half AEs and half EMs, from 1978 to 2019. Monetary policy shocks are constructed from forecast errors for the short-term (3-month) interest rate as in Furceri, Loungani, and Zdzienicka (2018). That is, unanticipated changes in the policy rate (proxied by 3-month interest rates) are calculated as the forecast error ($FE^r_{it}$). This is the difference between the actual short-term rate at the end of the year and the rate expected by analysis as of the beginning of October (3-months prior) for the same year. For each country, the interest rate forecast error is then regressed on the forecast errors for real GDP growth and inflation, calculated in the same manner. The residuals then capture the unanticipated movements in the rate that are not driven by news about economic activity.

$$FE^r_{it} = \alpha_i + \beta_i FE^r_{it} + \gamma_i FE^r_{it} + \varepsilon_{it} \qquad \text{(A.2.5.2)}$$

Data needed to calculate $FE^r_{it}$ is available for 31 countries, 21 AEs and 12 EMs, which thus make up the benchmark sample for the analysis for monetary tightening. For the United States, the resulting monetary policy shocks are very similar to an (annualized version) of the Romer and Romer (2004) monetary shocks.

Annex Figure 2.5.1 shows the *benchmark results*. The effects of fiscal and monetary policy estimated using these shocks are similar to that seen in the literature. A 1 percent of GDP fiscal consolidation leads to 3/4 percent decline in output after 2 years, which is the peak effect (Panel A). In panel 2, a 100 basis points monetary policy tightening leads to a ½ percent decline in output after 2 years, increasing to ¾ percent decline in year 4. Both the size and lagged impact of the monetary tightening are in line with the literature.[10]

**Annex Figure 2.5.2. Response of Output to Monetary Shock: High Private-Debt-to-GDP**
*(Percent change)*




Sources: Consensus Economics Inc.; IMF, Global Debt Database; and IMF staff calculations.
Note: Shaded areas represent 90 percent confidence intervals. The *x*-axis indicates the number of years after the monetary policy shock.

*High aggregate private debt.* The analysis then investigates whether the policy transmission is affected by the level of aggregate private-sector debt. This is done by including an interaction term equal to 1 when private debt-to-GDP is in the top-quartile of observations for each country. That is

$$y_{i,t+h} - y_{i,t-1} = \mu^h_i + X_{i,t}\gamma^h + s_{i,t}I_{i,t}\beta^h_A + s_{i,t}(1 - I_{i,t})\beta^h_B + v_t + \varepsilon_{i,t+h} \qquad \text{(A.2.5.3)}$$

where $I_{i,t}$=1 if private debt to GDP is in the top quartile of observations for each country. This is similar to the approach of Ramey and Zubairy (2018), April 2020 WEO Chapter 2, and others who study the state-dependence of multipliers, testing the hypothesis that the effect of fiscal

[10] See Coibion (2012) for a comparison on the effects of different approaches to calculating and estimating the effects of monetary policy shocks for the US.

stimulus is larger during recessions. In our analysis, we control for the output gap to account for this form of state-dependence, among other control variables.

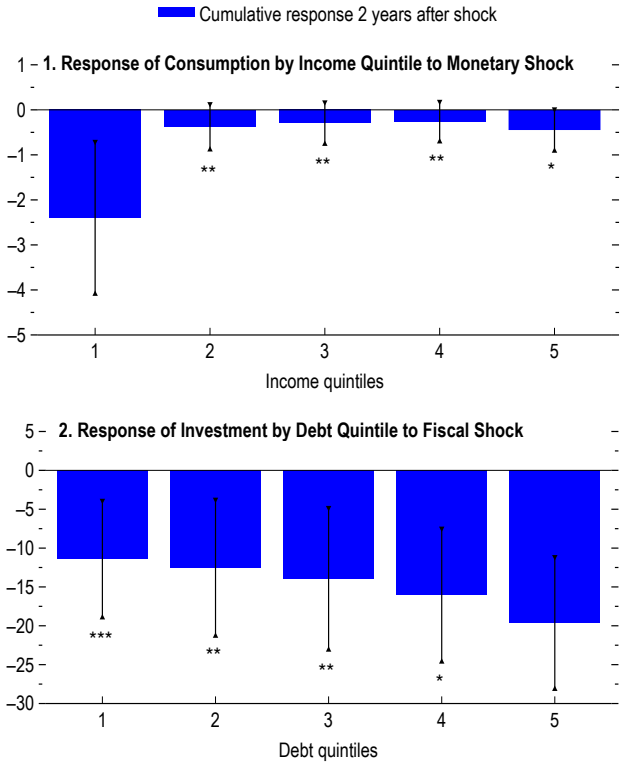
Figure 2.14 in the main text shows that the estimated effects of a fiscal consolidation are larger when private debt-to-GDP is in the top quartile. Annex Figure 2.5.2 shows both the interaction term, $\beta_A^h$, following a monetary policy shock, and $\beta_B^h$ which represents the effect when debt-to-GDP is in the bottom three quartiles The estimated interaction term is negative, suggesting a larger contraction following the shock, but not statistically significant.

## Fiscal and Monetary Transmission: Importance of Heterogeneity

*Transmission of policies to heterogeneous households and firms.* Recent studies have more explicitly recognized that the effects of macroeconomic policy will depend on the characteristics of households and firms. See the main chapter text for a discussion of how household and firm heterogeneity affects their responsive to policies.

The empirical analysis in this subsection uses two main datasets. For *households*, data from Allen, Kolerus, and Xu (2022), on consumption by quintiles of income. That is, for each country and year in the sample, the consumption of the lowest income group of households – the lowest quintile of household income – is calculated, and the consumption of the next four income quintiles is calculated. Since the data do not allow for a complete and regular picture of household balance sheets, consumption by debt-quintiles cannot be constructed. There is generally a positive relationship between income level and net worth across households, however (Figure 2.4 in the main text). Once this data is combined with the policy shocks, the sample consists of 13 countries from 1990 onwards. For *firms*, similar data on investment is built using the Bureau van Dijk Orbis dataset. Firms are sorted into quintiles by their leverage (debt-to-assets ratio) and then the real capital stock of firms in each group is aggregated. Once this data is combined with the policy shocks, the sample consists of 20 countries from 1997 onwards for fiscal policy, and 25 countries from 1997 onwards for monetary policy.

**Annex Figure 2.5.3. Effects of Macro Policy Tightening on Heterogeneous Households and Firms: Additional Results**
*(Percent change)*




Sources: Allen, Kolerus, and Xu (2022); Bureau van Dijk Orbis; and IMF staff calculations.
Note: In panel 1, the bars represent the estimated effect of a monetary policy tightening shock of 100 basis points on the consumption of five groups of households, according to their income levels, two years after the shock. In panel 2, the bars represent the estimated effect of a fiscal consolidation shock of 1 percent of GDP on the real investment of five groups of corporate, according to their leverage ratios. The *x*-axis indicates the quintile of corporate leverage. Error bars denote 90 percent confidence intervals. Statistically significant differences between the lowest income quintile in panel 1 (and highest leverage quintile in panel 2) and other quintiles at the 1, 5, and 10 percent confidence levels are denoted by ***, **, * respectively.

The empirical specification is similar to the benchmark specification in equation A.2.5.1 , except that the dependent variables of interest are now (1) household consumption for each income quintile, and (2) corporate investment for each leverage quintile.

$$c_{ij,t+h} - c_{ij,t-1} = \mu_{ij}^{h} + X_{i,t}\gamma_{j}^{h} + s_{i,t}\beta_{j}^{h} + v_{t} + \varepsilon_{ij,t+h} \quad , \quad j = 1,2,3,4,5 \quad \text{(A.2.5.4)}$$

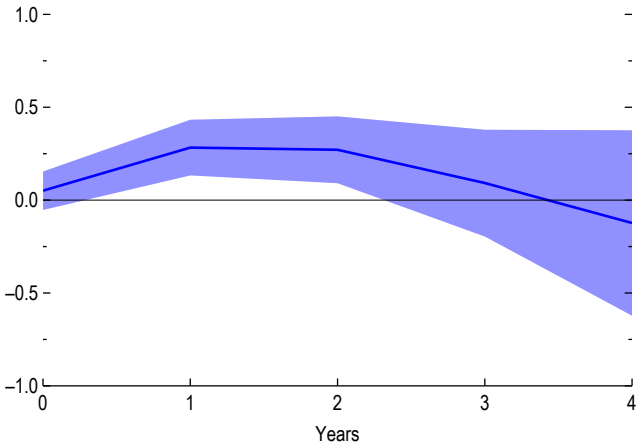
$$k_{ij,t+h} - k_{ij,t-1} = \mu_{ij}^{h} + X_{i,t}\lambda_{j}^{h} + s_{i,t}\delta_{j}^{h} + v_{t} + \eta_{ij,t+h} \quad , \quad j = 1,2,3,4,5 \quad \text{(A.2.5.5)}$$

Equation A.2.5.4 is estimated following a seemingly unrelated regression (SUR) approach, to account for potential correlation of residuals across quintiles, with robust standard errors clustered by country. Equation A.2.5.5 is also estimated as a SUR.

Figure 2.15 in the main text shows that, as expected, fiscal consolidation has the largest effect on the consumption of lower-income households, and monetary tightening negatively affects corporate investment for the most-leveraged corporates. Annex Figure 2.5.3 shows the effects of monetary policy on consumption and fiscal policy on investment. As with fiscal policy, monetary policy has the largest effect on the consumption of the lower-income quintile. Fiscal policy affects corporate investment negatively for all quintiles of leverage, but more so for the most leveraged quintile.

*Macroprudential policy interaction.* The final part of the analysis assesses how macroprudential settings across countries factor into monetary policy normalization. Macroprudential policies have been shown to mitigate the effects of negative financial shocks, though with a cost in good times (April 2020 WEO Chapter 3). At the country level, the analysis uses the index of macroprudential stringency from the IMF's integrated Macroprudential Policy (iMaPP) database. The index, which captures changes in 17 main macroprudential measures, is cumulated over time to measure the relative level of macroprudential policy across countries. This measure is then interacted with the monetary policy shock, for a sample of 31 countries from 1990 onwards:

**Annex Figure 2.5.4. Response of Output to Monetary Shock Interaction with Macroprudential Stringency**
*(Percent change)*




Sources: Consensus Economics Inc.; IMF, iMaPP database; and IMF staff calculations.
Note: The solid line represents the estimated coefficient on the interaction between monetary policy and the level of macroprudential policy; the shaded area represents 90 percent confidence interval. The *x*-axis indicates the number of years after the monetary policy shock.

$$y_{i,t+h} - y_{i,t-1} = \mu_{i}^{h} + X_{i,t}\gamma^{h} + s_{i,t}\beta^{h} + s_{i,t}MPru_{i,t}\delta^{h} + v_{t} + \varepsilon_{i,t+h} \quad \text{(A.2.5.6)}$$

where $MPru_{i,t}$ is the level of macroprudential regulation. The estimated interaction coefficient is reported in Annex Figure 2.5.4, showing that more stringent macroprudential policy mitigates the negative impact of monetary tightening on output.