2 NONFINANCIAL SECTOR

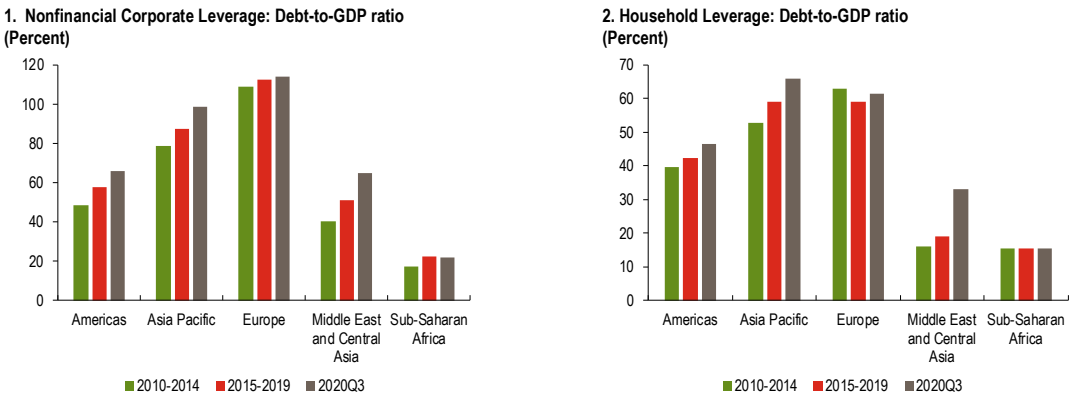
Loose Financial Conditions, Rising Leverage, and Risks to Macro-Financial Stability—Online Annexes

Online Annex 2.1. Data Sources and Leverage by Region

Online Annex Table 2.1.1. Data Sources

Variable	Description	Source
Aggregate Macrofinancial Indicators		
Nonfinancial Corporations Leverage	The debt-to-GDP ratio for non-financial corporations, country-specific or weighted global average, percent of GDP, quarterly	Institute of international finance, downloaded in mid-November 2020.
Household Leverage	The debt-to-GDP ratio for household sector, country-specific or weighted global average, percent of GDP, quarterly	Institute of international finance, downloaded in mid-November 2020.
Output Gap	Output gap, constant prices in national currency, percent, annual	IMF, World Economic Outlook
Real Gross Domestic Product	Gross domestic product, constant prices in national currency, quarterly	IMF, World Economic Outlook
Consumer Price Index	Consumer price index, quarterly	IMF, World Economic Outlook
Financial Conditions Indices (FCIs)	Financial Conditions Indices (FCIs), quarterly. See Online Annex 1.1 of the October 2018 GFSR.	IMF Calculations
Short-Term Interest rate	3-month Treasury Bill rate, 3-month Money Market Rate, 3-month Deposit Rate, quarterly.	Haver Analytics
Monetary Policy Rate	Policy rate series for the United States (US), euro area, Japan, and the United Kingdom (UK) are Shadow Short Rate (SSR) estimates to capture nonconventional monetary policy during zero lower bound (ZLB) episodes, as constructed by Krippner. The policy rate for rest of countries are central bank policy rate from BIS. Quarterly series.	BIS; Leo Krippner: https://www.ljkmfa.com/test-test/international-ssrs/
Macroprudential Policy	17 types of macroprudential measures, quarterly	Integrated Macroprudential Policy (iMaPP) database

Online Annex Figure 2.1.1. Leverage by Region



Sources: Institute of International Finance; and IMF Staff calculations.
Note: The sample includes the following 52 economies: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, Egypt, Finland, France, Germany, Ghana, Greece, Hong Kong SAR, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Kenya, Korea, Lebanon, Luxembourg, Malaysia, Mexico, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Philippines, Poland, Portugal, Russia, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Arab Emirates, United Kingdom, and the United States.

Online Annex 2.2. Financial Conditions and Leverage

The specification for the linear regression is the following:

$$y_{i,t,h} = \alpha_i^h + \beta^h fci_{i,t} + \gamma^h X_{i,t} + \theta^h Time_t + e_{i,t,h}\,, \quad (1)$$

where *i* indexes country, *t* is the quarter, and *h* is the horizon. The superscript *h* indicates that the coefficients α, β, γ and θ are horizon-specific coefficients. $y_{i,t,h}$ is the change in leverage between period *t* and period *t+h,* that is, the *h*-quarter change in the sector-specific debt-to-GDP ratios. α_i^h are country fixed effects, and $fci_{i,t}$ is a measure of financial conditions. $X_{i,t}$ is a set of country-specific controls, which includes lagged value of inflation (year-on-year), real GDP growth (quarter-on-quarter), and the short-term interest rate, as well as lagged one-quarter change in the sector-specific debt-to-GDP ratio. Global time effects are represented by $Time_t$, which is alternatively a dummy variable for the global financial crisis that take a value of 1 during 2008:Q4 - 2009:Q4, or time fixed effects in the robustness analyses. The estimated relationships should be interpreted as associations between variables rather than causal relationships since prospects of future changes in leverage could affect current financial conditions. Standard errors are calculated following the Driscoll-Kraay (1998) approach.

The sample includes 19 advanced economies and 10 emerging economies, and the sample size extends from 1996:Q1 to 2020:Q3. The start date of the sample is related to the availability of the financial condition indices.

Regime-dependent responses to investigate the possibility of heterogeneous effects of financial conditions on the changes in leverage are based on the following regression:

$$y_{i,t,h} = \Theta_{i,t}\left[\alpha_i^{h,HIGH} + \beta^{h,HIGH} fci_{i,t} + \gamma^{h,HIGH} X_{i,t}\right] + \left(1 - \Theta_{i,t}\right)\left[\alpha_i^{h,LOW} + \beta^{h.LOW} fci_{i,t} + \gamma^{h,LOW} X_{i,t}\right] + + \theta^h Time_t + e_{i,t,h}, \quad (2)$$

where $\Theta_{i,t}$ is a country-specific dummy variable indicating a credit boom regime (that is, when the country-specific *fci* is below the median of its distribution—a lower *fci* represents looser financial conditions—and the eight-quarter change in the credit-to-GDP ratio is in the top three deciles of its distribution. The same control variables are used as in equation (1). Standard errors are also calculated following the Driscoll-Kraay approach.

To evaluate the robustness of the findings to alternative measures of financial conditions and alternative econometric specifications in both equations (1) and (2), a range of robustness checks are performed:

- Using the residuals of a regression of the country-specific financial conditions index on contemporaneous GDP growth, inflation, and the change in the short-term interest rate, such that macroeconomic conditions are purged from the price of risk.
- Using a global measure of the financial conditions index calculated following the methodology described in the Online Annex 1.1 of the October 2018 GFSR.
- Using the Chicago Board Options Exchange Volatility Index (VIX).
- Using time fixed effects instead of a dummy variable for the global financial crisis.

- Using inflation-adjusted percent changes in household or non-financial corporate debt as a dependent variable (instead of the change in the debt-to-GDP ratios).
- Using alternative and additional control variables in equations (1) and (2) such as the output gap (instead of GDP growth), the unemployment rate to control for labor market conditions, or the government budget balance as a percentage of GDP to control for the fiscal position.
- Using alternative definitions of the threshold variables in equation (2): defining credit booms episodes following the definition of Adrian and others (forthcoming) or using thresholds based on a combination of high debt levels and tight financial conditions.
- Including fiscal controls. The government balance was positively associated with both nonfinancial corporate and household leverage buildups (suggesting the possibility of crowding out effects of public spending), while keeping the main result on the effects of financial conditions and macroprudential tools little changed.

The conclusions are qualitatively robust to these changes.

As an additional exercise, the degree of asymmetry between loosening versus tightening episodes of financial conditions is assessed based on the following specification:

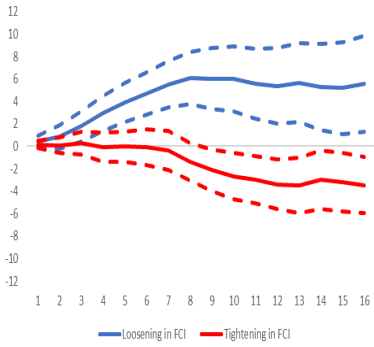
$$y_{i,t,h} = \alpha_i^h + \beta_{Loose}^h \Delta fci_{i,t}^{Loose} + \beta_{Tight}^h \Delta fci_{i,t}^{Tight} + \gamma^h X_{i,t} + \theta^h Time_t + e_{i,t,h}\ , \qquad (3)$$

where $\Delta fci_{i,t}^{Loose}$ indicates a loosening of financial conditions (that is, equal to 1 when the first difference in the country-specific *fci* is negative, and zero otherwise) and $\Delta fci_{i,t}^{Tight}$ indicates a tightening of financial conditions (that is, equal to 1 when the first difference in the country-specific *fci* is positive, and zero otherwise).

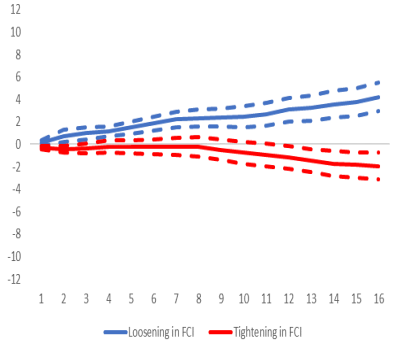
Online Annex Figure 2.2.1., panel 1 shows that a loosening in financial conditions has a stronger impact in the near term than does a tightening. In particular, a one-unit loosening in financial conditions leads to a 6 percentage point of GDP increase in non-financial corporate debt after eight quarters, while a one-unit tightening in financial conditions leads to a 1 ½ percentage point of GDP decrease in non-financial corporate debt after eight quarters. Panel 2 shows a similar pattern for household debt: one-unit loosening in financial conditions leads to a 3 percentage point of GDP increase in household debt after three years, while a one-unit tightening in financial conditions leads to a 1 percentage point of GDP decrease in household debt after three years.

Online Annex Figure 2.2.1. Asymmetric Effects of Financial Conditions on Leverage Build-ups

1. Impact of Financial Conditions on Non-financial Corporate Leverage; All Economies
(one to sixteen quarters ahead, cumulative response); Percentage point of GDP)



Panel 2. Impact of Financial Conditions on Household Leverage; All Economies
(one to sixteen quarters ahead, cumulative response); Percentage point of GDP)



Sources: IMF Staff Calculations.

Note: The blue line denotes the effects of a loosening in financial conditions (the coefficient β^{h}_{Loose} in equation (3)), while the red line denotes the effects of a tightening in financial conditions (the coefficient β^{h}_{Tight} in equation (3)). The dependent variable is the h-quarter change in non-financial corporate or household debt-to-GDP ratios. The control variables in all regressions are lagged one-quarter change in the sector-specific debt-to-GDP ratios, lagged GDP growth, lagged short-term interest rate, lagged inflation, and a GFC dummy. Dotted lines denote the 90 percent confidence intervals.

Online Annex 2.3. Growth-at-Risk Analysis

The annex provides details on the analysis of the term structure of Growth-at-Risk (GaR). The following panel quantile local projection model is estimated, building on Adrian and others (forthcoming):

$$y_{i,t,h}^{\tau} = \alpha_{i,h}^{\tau} + \beta_{1,h}^{\tau} fci_{i,t} + \beta_{2,h}^{\tau} \Delta NFC\_Lev_{i,t} + \beta_{3,h}^{\tau} \Delta HH\_Lev_{i,t} + \gamma_h^{\tau} X_{i,t} + \varepsilon_{i,t,h}^{\tau}, \quad (4)$$

where $y_{i,t,h}$ is the year-on-year growth rate of real GDP in country i in quarter $t+h$. $fci_{i,t}$ is country i's financial condition index in quarter *t*; and $\Delta NFC\_Lev_{i,t}(\Delta HH\_Lev_{i,t})$ is the difference in the nonfinancial corporate (household) leverage-to-GDP ratio from quarter *t-8* to *t*. Finally, $X_{i,t}$ is a vector of control variables in quarter t that includes lagged year-on-year real GDP growth, lagged year-on-year inflation rate, and a global time trend. The regression is estimated at $\tau = 10^{\text{th}}$ percentile. The estimation method for panel quantile models follows Machado and Santos Silva (2019). Standard errors are bootstrapped.

The sample includes 19 advanced economies and 10 emerging market economies, and spans the period from 1996:Q1 to 2020:Q3.

Equation (4) is then augmented with interactions with a regime-dependent dummy $\Theta_{i,t}$ as follows:

$$\begin{aligned} y_{i,t,h}^{\tau} = {} & \Theta_{i,t}\left[\alpha_{i,h}^{\tau,HIGH} + \beta_{1,h}^{\tau,HIGH} fci_{i,t} + \beta_{2,h}^{\tau,HIGH} \Delta NFC_{Lev_{i,t}} + \beta_{3,h}^{\tau,HIGH} \Delta HH_{Lev_{i,t}} + \gamma_h^{\tau,HIGH} X_{i,t}\right] \\ & + (1-\Theta_{i,t})\left[\alpha_{i,h}^{\tau,LOW} + \beta_h^{\tau.LOW} fci_{i,t} + \beta_{2,h}^{\tau,LOW} \Delta NFC_{Lev_{i,t}} + \beta_{3,h}^{\tau,LOW} \Delta HH_{Lev_{i,t}} + \gamma_h^{\tau,LOW} X_{i,t}\right] \\ & + \varepsilon_{i,t,h}^{\tau}, \end{aligned} \quad (5)$$

where $\Theta_{i,t}$ is a dummy variable equal to 1 if country i is in a credit boom, as defined in Online Annex 2.2. The specification generates two sets of coefficients of interest for the credit-boom and non-credit-boom regimes: $\mathrm{B}_h^{HIGH} = \{\beta_{1,h}^{\tau,HIGH}, \beta_{2,h}^{\tau,HIGH}, \beta_{3,h}^{\tau,HIGH}\}$ and $\mathrm{B}_h^{LOW} = \{\beta_{1,h}^{\tau,LOW}, \beta_{2,h}^{\tau,LOW}, \beta_{3,h}^{\tau,LOW}\}$

The main results of the GaR analysis are robust to the following alternative specifications of the empirical tests:

- Replacing domestic *fci* at time *t* by (i) a global FCI at *t*, (ii) a purged FCI at *t*, or (iii) FCIs during *t* to *t+h* . These specifications help address endogeneity or reverse causality concerns involving *fci*. A global FCI is less affected by macro factors in a single country so that endogeneity concerns are mitigated. The purged FCI is obtained as a residual after running FCI on several macro variables including real GDP growth, inflation rate, and global FCI, which also mitigates endogeneity concerns. Approach (iii) addresses concerns related to the Teulings Zubanov (2013) critique (i.e., future FCI, which may be correlated with current FCI, is driving the future growth-at-risk).

- Replacing the change in non-financial corporate leverage $\Delta NFC\_Lev_{i,t}$ and household leverage $\Delta HH\_Lev_{i,t}$ by the shocks to these two leverage ratios obtained through the Cholesky Decomposition of the PVAR model described in the Online Annex Box 2.2.
- Replacing the time-trend variable by a post-GFC dummy variable, equal to zero before 2008Q4 and equal to one from 2008Q4 onward.
- Including fiscal policy controls such as the government balance to GDP ratio.
- Using the bandpass filter (Baxter and King 1999) to remove cyclical components over the business cycle duration (6-32 quarters) from real GDP (in log), leverage, and FCI.

Online Annex 2.4. The Role of Macroprudential Policy

Macroprudential Tightening and Leverage Buildups

The specification used to examine the relationship between macroprudential policies and leverage buildup is the following:

$$y_{i,t,h} = \alpha_i^h + \beta^h Macropru_{i,t} + \gamma^h X_{i,t} + \theta^h Time_t + e_{i,t,h}\ , \qquad (6)$$

where *i* is the country, *t* is the quarter, and *h* is the horizon. The superscript *h* indicates that the coefficients α, β, γ and θ are horizon-specific coefficients. $y_{i,t,h}$ is changes in leverage in the sector-specific debt-to-GDP ratio from period *t* to period *t+h*. α_i^h are country fixed effects, $Macropru_{i,t}$ is a measure of macroprudential policies obtained from the IMF's integrated Macroprudential Policy (iMaPP) database. $X_{i,t}$ is a set of country-specific controls: lagged values of inflation (year-on-year), real GDP growth (quarter-on-quarter), domestic financial conditions, and short-term interest rate, as well as lagged one-quarter change in the sector-specific debt-to-GDP. Global time effects are represented by $Time_t$, which is a dummy variable for the global financial crisis that takes a value of 1 between 2008:Q4 and 2009:Q4 (or time fixed effects in the robustness analyses). Standard errors are calculated following the Driscoll-Kray's approach.

The *Macropru* variable used in this analysis is defined as the net number of instruments tightened within a given category in quarter *t*. That is, it is equal to the number of instruments tightened minus the number loosened in quarter *t*. The categories analyzed are the following:

- *Borrower-based*: debt-service-to-income (DSTI) limits and loan-to-value (LTV) instruments.
- *Bank Liquidity*: reserve requirements (RR), liquidity requirements, and limits to loan-deposit ratio (LTD).
- *Bank FX exposure*: limits on foreign currency lending (LFC), limits on gross open FX positions (LFX), and reserve requirements on foreign currency assets (RR_FCD).

The original conclusions are robust to including time fixed effects rather than a dummy for the global financial crisis and using inflation-adjusted percent changes in household or non-financial corporate debt as a dependent variable (instead of the change in the debt-to-GDP ratios).

Macroprudential Tightening and Growth at Risk

The downside-risk-mitigation effect of macroprudential measures is analyzed using the Growth-at-Risk framework. The following equation is estimated:

$$y_{i,t,h}^{\tau} = \alpha_{i,h}^{\tau} + \beta_{1,h}^{\tau} FCI_{i,t} + \beta_{2,h}^{\tau} \Delta NFC_{Lev_{i,t}} + \beta_{3,h}^{\tau} \Delta HH_{Lev_{i,t}} + \beta_{4,h}^{\tau} SUM\_17_{i,t} + \gamma_h^{\tau} X_{i,t} + \varepsilon_{i,t,h}^{\tau}, \qquad (7)$$

where $SUM\_17_{i,t}$ is a discrete variable, which indicates the net number of macroprudential tightening actions undertaken in quarter t, that is the number of tightening measures minus the

number of loosening measures.[1] The estimated quantile coefficient for $SUM\_17_{i,t}$, noted as $\beta_{4,h}^{\tau}$, indicates the direct impact of one additional net macroprudential tightening action on the left-tail of the future growth distribution. Panel 1 of Figure 2.8 in the Chapter reports the values of $\beta_{4,h}^{\tau}$.

A regime variable $\Theta_{i,t}$ is defined as a dummy that takes a value of 1 if the sum of $SUM\_17_{i,t}$ in the past 4 quarters is positive and is equal to 0 otherwise. Panel 2 of Figure 2.8 in the Chapter reports the values of $\{\beta_{1,h}^{\tau,Tight}, \beta_{1,h}^{\tau,No\_Tight}\}$ in the following specification:

$$\begin{aligned} y_{i,t,h}^{\tau} = \Theta_{i,t}\left[\alpha_{i,h}^{\tau,Tight} + \beta_{1,h}^{\tau,Tight} fci_{i,t} + \beta_{2,h}^{\tau,Tight} \Delta NFS_{Lev_{i,t}} + \gamma_{h}^{\tau,Tight} X_{i,t}\right] \\ + \left(1 - \Theta_{i,t}\right)\left[\alpha_{i,h}^{\tau,No\_Tight} + \beta_{h}^{\tau.No\_Tight} fci_{i,t} + \beta_{2,h}^{\tau,No\_Tight} \Delta NFS\_Lev_{i,t}\right. \\ \left. + \gamma_{h}^{\tau,No\_Tight} X_{i,t}\right] + \varepsilon_{i,t,h}^{\tau}, \end{aligned} \quad (8)$$

where ΔNFS_Lev is the 8-quarter change in the non-financial sector (includes both non-financial corporate and household) debt-to-GDP ratio.

Consistent with other exercises in the chapter, the sample includes 19 advanced economies and 10 emerging market economies, and spans the period from 1996:Q1 to 2020:Q3. The estimation method for panel quantile models follows Machado and Santos Silva (2019). Standard errors are bootstrapped.

[1] For instance, if country i tightened the LTV ratio twice in quarter t but loosened the reserve requirement once in the same quarter, the discrete variable $SUM\_17_{i,t}$ takes the value of 1.

Online Annex Box 2.1. Literature Review on Leverage and Financial Vulnerability

A vast body of literature identifies high levels or rapid increases in nonfinancial sector leverage as key predictors of downside risks to economic growth and financial stress.[2] Verner (2019) discusses the crucial distinction between beneficial episodes of credit deepening and more disruptive episodes of booms in private credit, which tend to precede growth slowdowns and lead to a series of macroeconomic imbalances. In a similar vein, Schularick and Taylor (2012) find that, while not all booms in private credit result in financial instability, most instances of financial distress are preceded by credit booms. Jordà and others. (2016) show that high levels of leverage are associated with dampened business cycle volatility, but more pronounced crashes—implying that business cycles are more asymmetric in high-debt economies. High corporate leverage is also associated with weaker post-crisis recovery, as investment is held back by debt overhang (Kalemli-Ozcan and others, 2020), which could generate a self-reinforcing cycle. Mian, Sufi, and Verner (2017) find that it is household debt accumulation that is particularly related to financial stability risk. Positive shocks to household debt tend to precede a near-term upswing in economic activity followed by a medium-term downturn, that is, a boom-bust cycle.[3] Adrian and others (forthcoming) identify a similar tradeoff for total nonfinancial private debt from a Growth-at-Risk (GaR) perspective as well: the combination of loose financial conditions and rapid increase in aggregate credit tends to reduce downside risk to economic activity in the near-term but increases it in the medium run.

[2] See for example, Bank for International Settlements (2014); Gilchrist, Siemer, and Zakrajsek (2018); Gertler and Gilchrist (2018); Verner (2019); as well as Chapter 2 of the October 2017 GFSR and Chapter 2 of the April 2018 GFSR. Gilchrist and Zakrajšek (2012) find that credit spreads have considerable predictive power for future economic activity.

[3] Existing studies show that household debt tends to be concentrated in low-wealth quantiles, which could amplify the effects of the COVID-19 shock on the financial vulnerabilities of the household sector (Institute of International Finance, 2020).

Online Annex Box 2.2. Examining the Relationship between Financial Conditions, Leverage and Economic Activity in a System

In the main analysis of the chapter, separate estimations are used to examine the relationships between financial conditions and leverage, and between financial conditions and economic activity. A case can be made, however, for estimating relationships between all variables of interest in one single system. Arguably, causality between financial conditions, leverage and economic activity can go in all directions, and prior assumptions which restrict these dynamics may lead to biased estimates. To give way to these considerations, this box presents estimates from a panel vector autoregressive (PVAR) model that imposes minimal restrictions or prior assumptions about the overall relationship of variables, treating all variables as endogenous, and thus giving the data the ability to speak for themselves.

Using the same dataset as the analysis in the rest of the chapter, the (recursively identified) PVAR results presented below model the relationship between economic activity, household leverage, non-financial corporate leverage, and a financial conditions index (FCI). To separate national from global leverage, dynamic, quarter (time) dummies are added to the model. Note that, in contrast to the GaR analysis in Online Annex 2.4, the impulse response functions derived from the PVAR relate to mean, rather than low quantile future responses.

Results fully support the findings of the main analysis in the chapter. As in the section on financial conditions and leverage buildups, the PVAR suggests that a loosening in financial conditions leads to a significant increase in both household and non-financial corporate leverage, where the increase in household leverage is about half the size of the increase in non-financial corporate leverage (Online Box Figure 2.2.1). An unexpected loosening of financial conditions by one standard deviation leads to an increase in household leverage by about 0.2 percentage points after 4 years, while the increase in non-financial corporate leverage is about 0.4 percentage points.

Supporting the findings on financial conditions on downside risks to growth, results from the PVAR suggest that economic activity expands after a loosening in financial conditions, but contracts after an increase in leverage (Online Box Figure 2.2.2). A one standard-deviation loosening in FCI leads to an increase in real GDP by about 0.2 to 0.3 percent in the 4 years after the shock, with most of the boost frontloaded in the first year. These results mirror the findings on the downside risks to growth which show that the positive effect of looser financial conditions on output tends to fade after about 6 quarters.

The Impact of Leverage on Economic Activity

Turning in more detail to the effect of leverage on economic activity, the PVAR suggests mostly negative consequences following an increase in leverage. An unexpected increase in household leverage by one standard deviation leads, on average, to a fall in real GDP of about 0.2 percent after 4 years. The drag on GDP is immediate and continues to build across all horizons. This contrasts with previous findings that suggest a short-run boost to GDP following a shock to household leverage (as in Mian, Sufi and Verner, 2017). The difference in results is partly explained by the inclusion of quarter dummies, which filter out global leverage dynamics.

Excluding the dummies leads to a marginally significant boost to output in the first year after the shock.[4]

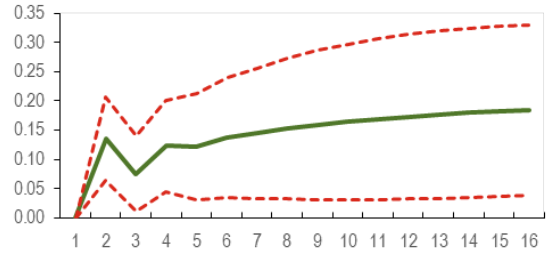
A shock to non-financial corporate leverage also acts as a drag on GDP, albeit smaller in size than a household leverage shock, reducing GDP by about 0.1 percent within the first 4 years after the shock. Again, these results support prior findings that the impact of non-financial corporate leverage on output is smaller compared to household leverage.

Overall, estimating the relationship between financial conditions, leverage and economic activity in a system fully supports the results obtained through other methods in this chapter.

Online Annex Box Figure 2.2.1. PVAR-Estimated Response of Leverage to Loosening Financial Conditions

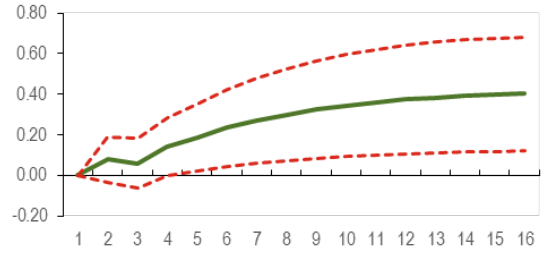
Looser financial conditions increase household debt…

1. Impulse response function of household leverage following a surprise loosening of financial conditions (Percentage points, quarters)



…but have an even larger impact on non-financial corporate debt.

2. Impulse response function of non-financial corporate leverage following a surprise loosening of financial conditions (Percentage points, quarters)

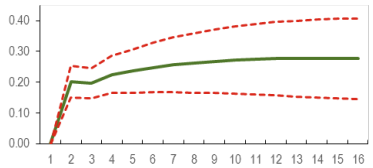


Sources: IMF staff calculations.
Note: Each panel shows the response to a one-standard-deviation loosening in financial conditions. Dotted line show +/- 2 standard deviation error bands.

Online Annex Box Figure 2.2.2. PVAR-Estimated Responses of Output to Loosening Financial Conditions and to Increasing Leverage

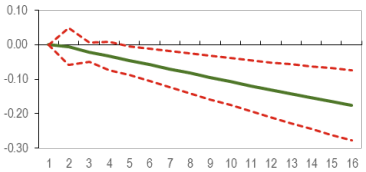
Looser financial conditions act as a boost to output

1. Impulse response function of real GDP following a surprise loosening of financial conditions (Percent, quarters)



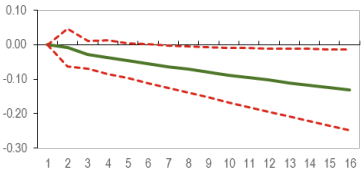
A shock to household leverage acts as a significant drag on economc activity across all horizons…

2. Impulse response function of real GDP following a surprise increase in household leverage (Percent, quarters)



…as does a shock to non-financial corporate leverage.

3. Impulse Reponses Function of Real GDP Following a Surprise Increase in Non-Financial Corporate Leverage (Percent, quarters)



Sources: IMF staff calculations.
Note: Panel 1 shows the response to a one-standard-deviation loosening in financial conditions. Panels 2 and 3 show the response to a one-standard-deviation increase in leverage. Dotted line show +/- 2 standard deviation error bands.

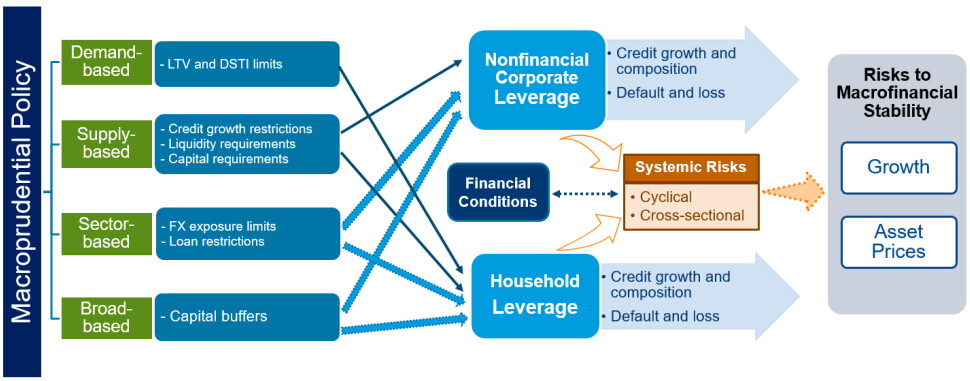
[4] The PVAR as specified in Mian, Sufi and Verner (2017) does not include time dummies. However, the authors examine the inclusion of time dummies in a local projections setup and find that the inclusion weakens the expansionary effect of higher household leverage on output.

Online Annex Box 2.3. Transmission Channels for Macroprudential Policy

Macroprudential policy—aimed at mitigating the materialization of systemic risk to achieve financial stability (ESRB 2014)—can tame leverage buildups and reduce risks to macrofinancial stability. Various types of tools can be deployed to effectively curb credit growth and alter its composition (by, e.g., maturity and currency denomination), as well as affect default and losses, and financial resilience associated with nonfinancial corporate and household leverage (Online Annex Box Figure 2.3.1). **Borrower-based tools** (LTV and DSTI) constrain borrowing eligibility from the demand side—preventing borrowers from stretching their borrowing capacity too far above their budgets or collateral values—and provide affordability buffers to improve resiliency of banks. **Supply-based tools**, aimed at altering lenders' incentives and taming credit supply, include credit growth limits, capital- (capital adequacy and loan loss provisions), and liquidity-oriented tools (liquidity coverage, net stable funding, and loan-to-deposit ratios). **Sector-based tools** include FX exposure limits and sector-specific loan restrictions, **while broad-based ones** include countercyclical capital buffers to lean against the buildup phase of the credit cycle. For the characteristics of these tools, see ESRB (2014), IMF (2014), and Alam and others (2019).

These tools can help tame leverage buildups and financial imbalances and reduce systemic risks. They may also help moderate growth volatility directly (e.g., by reducing default risk) or indirectly by dampening the impact of financial conditions on growth. Policymakers should be mindful of leakages, such as cross-border circumvention (e.g., increase in foreign provision of financing to domestic corporates) and domestic spillover effects (e.g., credit demand shifts from banks to nonbank financial institutions). Communications with timely announcements for implementation have been shown to enhance policy effectiveness.

Online Annex Box Figure 2.3.1. Macroprudential Policy Transmission Channels



Source: IMF staff.

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