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ARTICLE

Scarring and corporate debt

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Abstract

This paper estimates the scarring effect of recessions on corporates' investment and how it is amplified by the level of corporate debt. Our results suggest that the effect of firms' debt in shaping the response of investment to recessions is statistically significant and economically sizeable, with high-debt firms seeing a larger decline in investment. Back-of-the-envelope calculations suggest that firms' debt accounts for at least 28% of the average medium-term decline of investment. This effect is especially larger for: (i) countries with less efficient bankruptcy systems; (ii) during global recessions and firms operating in sectors with higher export dependences; and (iii) firms that are credit-constrained—small and less profitable firms, and those with high share of short-term debt.

Keywords: scarring; corporate debt; recessions; firms; local projection

JEL classifications: E22; E32; G39

1. Introduction

Major headwinds associated with the COVID-19 pandemic have had devastating economic consequences around the world, and the scars from these shocks are likely to be sizeable. According to estimates of the IMF World Economic Outlook (WEO) April 2022, cumulative per capita income losses over 2020–2023, compared to pre-pandemic projections, are equivalent to about 2½% of 2019 per capita GDP for the world as whole and over 4% in emerging markets (EM) and developing economies.

These shocks have occurred in the context of rising corporate debt. Corporate debt as a share of GDP increased significantly in the decade following the global financial crisis (GFC), both in advanced economies (AE) and EM and developing economies. And while there were signs of debt levels moderating after 2016, this trend was reversed in 2020, as debt ratios increased sharply with the pandemic (Figure 1). The fear is that this higher corporate debt may further aggravate the scarring effects associated with the COVID-19 pandemic. The focus of our paper is to shed light on this issue by examining the role of firms' debt in shaping the response of firms' investment to (past) recessions.

There exists already a well-established literature on the effects of corporate debt on investment and growth. In his seminal paper, Myers (1977) stipulated that highly leveraged firms are unlikely to be able to raise new debt and thus invest in new projects as their profits must be used to pay existing debt holders. His work spawned the literature on debt overhang, highlighting the effect of the level of firm leverage on investment and the negative association between leverage and growth.[1]

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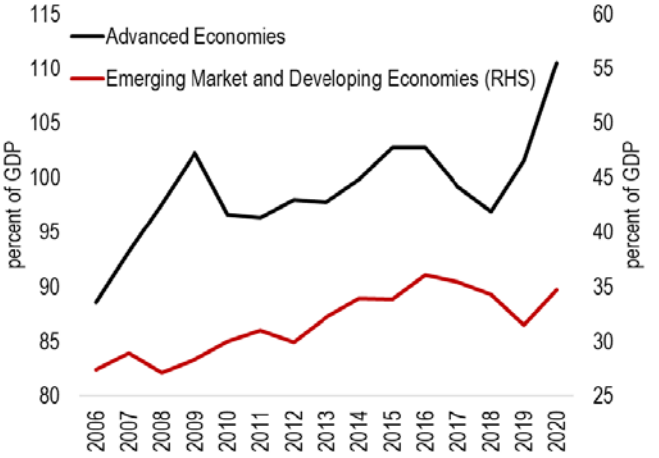


Figure 1. Nonfinancial corporate debt, loans and debt securities (percent of GDP).
Source: IMF Global Debt Database and authors calculations.
Note: Consistent sample of 70 countries across time: advanced economies (35) and emerging market and developing economies (35). Dotted upper(lower) lines depict the 75th (25th) percentiles of the overall distribution. Solid lines depict the median.

The onset of the GFC revived the literature on the effects of high leverage and credit constraints on economic outcomes, especially in AE. One strand of the literature used country-level data to uncover the effects of debt booms in the private sector on overall economic activity: Dell'Ariccia et al. (2016) find that credit booms often result in financial crises but can also be associated with financial reforms and economic growth. Jordà et al. (2013) find that credit-intensive expansions tend to be followed by deeper recessions and slower recoveries.[2]

Another strand of the literature focused on the strength of firms' balance sheet prior to recessions in determining their overall resilience, relying mostly on firm-level data to show that weak balance sheets could constrain investment. Focusing on the US, Giroud and Mueller (2017) use granular plant-level data to find that firms with more leverage saw bigger declines in employment and investment following the GFC, while Ottonello and Winberry (2020) find that higher-leverage firms respond less to monetary policy shocks. Using cross-country firm-level data, Duval et al. (2020) find that firms with weaker pre-GFC balance sheets, particularly those exposed to rollover risk, experienced a highly persistent decline in postcrisis total factor productivity growth relative to their less vulnerable counterparts. Kalemli-Ozcan et al. (2022) use European firm-bank matched data and find that firms with higher debt levels pre-GFC reduced their investment more after the crisis, with the effect stronger for firms holding short-term debt in countries with sovereign stress.[3] Campello et al. (2010) find that credit-constrained firms in the US, Europe, and Asia had to undertake deeper cuts in employment, and technological and capital spending in 2008.[4]

While the literature has extensively studied both the scarring effect of recessions and the effect of leverage on investment, the literature on how leverage can amplify investment scarring after a recession is sparser, usually focusing on a small subset of countries and for the GFC period (e.g., Kalemli-Ozcan et al. (2022) which focuses on European countries, or Giroud and Mueller (2017) focusing on the US[5]). This paper contributes to, and expands, this literature in three areas. First, from a methodological point of view, the paper uses a difference-in-difference setup along with local projection methods to estimate the effects of recessions on investment conditional on the level of corporate debt, thus estimating the full dynamics of how corporate debt can add to investment scarring. Second, it employs a larger firm-level sample than commonly used in the literature, consisting of 75 AE and EM and developing economies from 2001Q1 to 2021Q4. The large sample

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also allows us to control for a large set of unobservable sector-country-time characteristics, while the high (quarterly) frequency of the data is particularly well-suited to estimate the dynamic effects of recessions. Third, and a major contribution of the paper, the breadth of the sample allows us to estimate how heterogeneity across countries (based on the efficiency of bankruptcy systems), sectors (according to trade exposures), firms (based on financial constraints), and types of recessions (global vs. domestic) amplifies the impact of leverage on investment scarring.

We use Jordà's (2005) local projection method to estimate the scarring effects of recessions and how it is amplified by the level of debt at the firm level. In particular, we proceed in two steps. In the first step, we estimate the average (unconditional) effect of recessions—we use a dummy which takes value 1 for the beginning (quarter) of a technical recession in a given country—on firms' investment. In the second step, we analyze how this response varies with the level of firms' debt, by interacting the recession dummy with a firm time-unvarying dummy which equals to one if the level of the firm's corporate debt is above the median debt of its industry.[6] In this second part of the analysis, we perform an extended difference-in-differences analysis, where we control for country-sector-time fixed effects to account for macro-economic shocks and their differential effect across sectors (such as, for example, the differential effect of recessions) as well as sector-specific shocks at the country level (such as for example, changes in country regulations affecting a given sector).

Our results suggest that recessions are associated with persistent effects on the level of investment. In particular, we find that the average recession in our sample is associated with a reduction in the average level of firms' investment by 30% compared to pre-recession trends four quarters after a recession and by about 15% 12 quarters after. This effect, however, varies across firms depending on the level of debt: the decline in investment for firms with high levels of debt is about 2% larger compared to firms with medium-to-low levels of debt four quarters after a recession, with the difference increasing to about 5% 12 quarters after. The effect of firms' debt in shaping the investment response to recessions is statistically significant and economically sizeable. In particular, back-of-the-envelope calculations suggest that firms' debt accounts for at least 28% of the average medium-term response of investment to recessions.

In addition, we find that this effect is especially larger for: (i) countries with less efficient bankruptcy systems; (ii) during global recessions and firms operating in sectors with higher export dependences; and (iii) firms that are credit-constrained—small and less profitable firms, and those with a high share of short-term debt.

The results are robust to several checks, including to the use of various subsamples (across countries and time), alternative measures of recessions and explanatory variables, and controlling for a large set of potential cofounding factors at the macro and firm level that may be correlated with the interaction term of recession and corporate debt and affect the level of firms' investment.

The rest of the paper is organized as follows. Section 2 presents the data and a few stylized facts. Section 3 describes the empirical methodology used to assess the (unconditional) effects of recession on firms' investment and how it varies with the level of firms' debt. Section 4 discusses the baseline results, Section 5 presents results for an extensive list of robustness checks, and Section 6 explores heterogeneity in results across various dimensions. Section 7 concludes.

2. Data

This section describes the data used in the paper, their sources, descriptive statistics, and key stylized facts.

2.1. Firm-level data

Our firm-level data comes from S&P Capital IQ. The database provides extensive balance sheet and income statement information at the firm-level and at the quarterly frequency. It covers 150

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Table 1. Contribution of leverage to the average investment response following recessions

Horizon	(1) Unconditional impact $\left(\frac{\partial K_t}{\partial R_t}\right)$	(2) Impact via leverage $\left(\frac{\partial K_t^1}{\partial R_t} - \frac{\partial K_t^2}{\partial R_t}\right)$	(3) Contribution at each horizon
1	−0.071	−0.006	7.2%
2	−0.188	−0.010	4.5%
3	−0.248	−0.025	8.7%
4	−0.304	−0.024	6.8%
5	−0.300	−0.039	11.0%
6	−0.374	−0.042	9.7%
7	−0.344	−0.042	10.3%
8	−0.303	−0.041	11.4%
9	−0.235	−0.067	24.4%
10	−0.224	−0.047	18.1%
11	−0.208	−0.059	24.3%
12	−0.153	−0.051	28.2%
Share of capital expenditure	Low leveraged firms ω_2	High leverage firms ω_1	
	15%	85%	

Note: the table reports the coefficient at each horizon from impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from XX countries for the period 2000Q1 to 2020Q4. Estimates for the average investment response reported in column (1) are based on the regression estimated from equation (1), while estimates for the investment response of high-debt companies relative to low-debt companies are reported in column (2) are based on the regression estimated from equation (2). Column (3) estimates the contribution of high-debt companies to the decline in investment following a recessionary shock as equal to: $\omega_1 \left(\frac{\partial K_t^1}{\partial R_t} - \frac{\partial K_t^2}{\partial R_t}\right) / \frac{\partial K_t}{\partial R_t}$, assuming that group 2(low-debt companies) does not respond to the shock.

countries from 1950Q1 to 2021Q2. In order to reduce significant gaps in the time series, we restrict the sample to 2001Q1 onwards, and to advanced and emerging and developing economies. This leaves us with a sample of 75 countries. Details regarding the sample of countries used in the analysis, by geographic region, are available in Table A1 of Appendix A. The data is restricted to nonfinancial corporations and 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—see Kim et al. (2020) and Arbatli-Saxegaard et al. (2025) for details. We further restrict the sample to exclude real estate and insurance companies. Tables A2 and A3 display the number of firms across countries and 20 economic sectors.

We make use of a set of balance sheet and cash flow statement indicators from S&P Capital IQ to investigate the evolution of firm-level investment following recession episodes, and its heterogeneity depending on firms' characteristics—mainly focusing on firms' debt levels.

As for our investment measure, we use capital expenditures (IQ_CAPEX-2021). This variable refers to funds used by firms to acquire assets—such as property, plant, or equipment—and generally used to undertake new investments.

Our leverage indicator measures the total amount of debt relative to assets owned by a firm. To construct this, we compute the ratio of total debt (IQ_TOTAL_DEBT-4173) to total assets (IQ_TOTAL_ASSETS - 1007). We classify each company to be high or low debt based on whether average leverage for the company over the entire sample is above or below their industries median.

We further make use of a selection of key indicators for firms' characteristics.

Their Capital IQ code description and detailed explanation of the calculations are listed below:

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- Total Assets (IQ_TOTAL_ASSETS - 1007).
- Return on Assets (IQ_RETURN_ASSETS - 4178): this metric indicates how profitable is a company in relation to its total assets.
- Liquidity ratio: Net working capital ratio that measures firm's ability to pay its short-term liabilities with its current assets. The ratio is computed as the difference between current total assets (IQ_TOTAL_CA - 1008) and current total liabilities (IQ_TOTAL_CL - 1009), divided by total assets (IQ_TOTAL_ASSETS - 1007).
- Firm age (IQ_YEAR_FOUNDED[7]): Difference between the year of the observation and the year in which the firm was founded.
- Capital expenditure (IQ_CAPEX-2021) to lagged assets (IQ_NPPE - 1004): Ratio of capital expenditure to lagged net property, plant, and equipment. This ratio depicts how capital intensive a firm is.
- Revenues (IQ_TOTAL_REV-Line - 28): Revenues raised by the firm through its business activities.
- Firm size: Size is defined using the logarithm of total assets.

All firm level variables have been winsorized at the 1st and 99th percentiles to eliminate outliers.[8]

Table A4 reports summary statistics for selected firm variables, distinguishing between high- and low-debt firms. From this table, we can discern that a typical firm, independently of the level of debt, has similar characteristics in terms of changes in capital expenditure, capital expenditure to lagged assets and revenue. Moreover, highly indebted firms are larger in size, have a higher life-span and present lower liquidity. Table A5 of Appendix A reports the summary statistics of the balance sheet and cash flow statement variables used in our empirical analysis.

2.2. Recessions and other macroeconomic data

Our baseline measure for recessions is the start of a technical recession, defined by two consecutive quarters of negative GDP growth. Quarterly real gross domestic product growth from Haver Analytics is the main source used to construct this variable, but we complement it with WEO data for countries that have limited data in Haver. For these countries, we replace the full country series with WEO data. We then define a dummy where the first observation for each country's recession episode is set to 1. This leaves us with a total of 231 recessions for AE and 336 for EM and developing economies.

We also use two alternative measures for recession dummies: banking and financial crises (banking currency and debt) dummies from the Global Crises Data of Reinhart and Rogoff (2009) and peak-to-trough in GDP calculated using the Harding and Pagan (2006) algorithm.[9] Recessions dummies' data summary statistics are reported in Table A6.

2.3. Stylized Facts On Scarring and Corporate Debt

To cross-validate our firm-level investment data we compare it with investment data at the macro level. We do this for the level of investment as well as its growth rate. We first aggregate our firm-level investment variable (CAPEX) to the country-year level. To control for outliers, we first winsorize 5% tails of our firm level investment variable within each country and set investment to missing when the number of companies reporting CAPEX within a country changes abruptly.[10] Then, we calculate the countries' annual investment growth rate as well as the log level of investment (we use USD values of investment when taking logs to make values comparable across countries).[11] We compare the log levels and growth rates of investment from the firm level dataset to aggregate investment from the WEO database. In particular, we compute these using private gross fixed capital formation from the WEO database. This variable is also converted to USD for the calculations in logarithms.

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In Table A7 of Appendix A, we report the estimation results of regressing log investment from firm-level data against log-investment from macro-level data. The results show that the level of investment is highly correlated (R-squared above 0.7) across the two sources. In addition, we find that the relation between these variables remains strong and highly statistically significant when we control for country fixed effects, and when considering growth rates.

3. Empirical methodology

We use Jordà's (2005) local projection method to estimate the scarring effects of recessions and how it is amplified by the level of corporate debt at the firm level. In particular, our empirical approach consists of quantifying the short- and medium-term effect of recessions on the level of a firm's investment. We proceed in three steps. In the first step, we estimate the average (unconditional) effect of recessions on firms' investment. Specifically, we estimate the following specification:

$$y_{n,i,t+k} = \alpha_{is}^{k} + \gamma_{nq}^{k} + \sum_{j=-k}^{4} \beta_{j}^{k} R_{i,t-j} + \sum_{j=1}^{4} \theta_{j}^{k} y_{n,i,t-j} + \varepsilon_{n,i,t}^{k}, \tag{1}$$

where dependent variable, $y_{n,i,t+k}$, is the log difference of capital expenditure in firm n of country i at time (quarter) t over k quarters; $R_{i,t}$ is a dummy that denotes the occurrence (beginning) of an economic (technical) recession—defined as two quarters of consecutive negative GDP growth—in country i at time (quarter) t; β_{j}^{k} denotes the average firm-level response of investment to recessions after k quarter. γ_{nq} indicates firm-quarters dummies to control for unobservable time-unvarying firm characteristics as well as firm-specific seasonality in the level of investment; α_{is}^{k} are country-sector fixed effects to account for cross-sector variations across countries—such as country-specific comparative advantages in specific sectors. Following Teulings and Zubanov (2014), we also include leads of the recession variable in our regressions to control for recessions that fall within the horizon of the local projection.

In the second step, we expand equation (1) to estimate how the scarring effect of recessions on the level of investment varies across firms depending on the degree of corporate debt. In particular, we estimate the following specification:

$$y_{n,i,t+k} = \alpha_{ist}^{k} + \gamma_{nq}^{k} + \sum_{j=-k}^{4} \mu_{j}^{k} R_{i,t-j} * D_{n} + \sum_{j=1}^{4} \theta_{j}^{k} y_{n,i,t-j} + \varepsilon_{n,i,t}^{k}, \tag{2}$$

where D is a dummy which equals to one if the level of corporate debt associated with the firm is above the median of the industry. We use the average leverage over the entire sample to define this dummy to reduce endogeneity due to the potential time-varying response of corporate debt to recessions. α_{ist}^{k} are country-sector-time fixed effects to account for macro-economic shocks and their differential effect across sectors (such as, for example, the differential effect of recessions) as well as sector-specific shocks at the country level (such as for example, changes in country regulations affecting a given sector).[12] μ_{j}^{k} indicates the marginal (additional) response of investment to recessions in quarter k for firms with a high (above-median) level of corporate debt relative to those with low levels of debt.

In the section of robustness checks, we consider alternative versions of equations (1)–(2) based on: changes in the definition of the recession and corporate debt dummies; different functional forms to capture how the response of firms' investment varies with the level of debt; additional controls to include firms characteristic such as total assets, liquidity, ROA, and age; additional interaction terms to control for potential confounding factors that are correlated with recessions and/or corporate debt and that may affect the level of investment.

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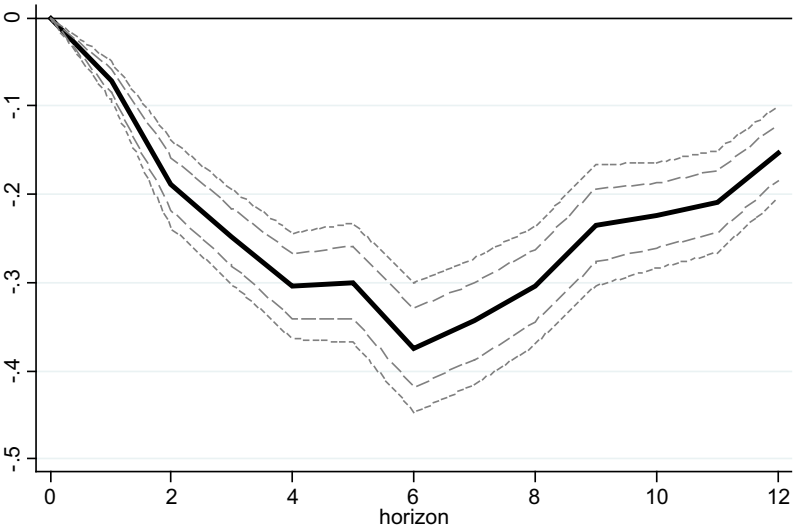


Figure 2. Evolution of (log) investment following a recession.
Note: Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha_{is}^{k} + \gamma_{nq}^{k} + \sum_{j=-k}^{4} \beta_{j}^{k} R_{i,t-j} + \sum_{j=1}^{4} \theta_{j}^{k} y_{n,i,t-j} + \varepsilon_{n,i,t}^{k}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession (and is the variable of interest), γ_{nq}^{k} are firm-quarters fixed effects, and α_{is}^{k} are country-sector fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for β_{0}^{k} for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

Equation (1)−(2) are estimated using OLS, and standard errors are two-way clustered on firm and country-time, over a panel of over 24,000 firms for the period 2001Q1 to 2020Q4 (for a total of more than 800,000 observations).

4. Results

Figure 2 presents the evolution of (log) investment following a recession episode. Time (quarter) is indicated on the x-axis; the solid line displays the average estimated response, dashed and dotted areas denote 90 and 68% confidence bands, respectively. The results suggest that recessions are associated with persistent effects on the level of investment relative to pre-recession trends. In particular, we find that the average recession in our sample is associated with a reduction in the level of investment of 30% four quarters after the recession and by 15% after 12 quarters. This effect is statistically significant and economically sizeable. The magnitude of the effect is also consistent with macro evidence on the scarring effect of recessions on investment (e.g., Furceri and Mourougane, 2012).

Figure 3 is analogous to Figure 2, but it reports the differential response of investment to recessions between a firm with relatively high corporate debt (above industry median) and firms with medium-to-low corporate debt levels. The results show that the differential investment loss for a firm with high corporate debt compared to a firm with medium-to-low corporate debt is about 2% four quarters after a recession and rises to 5% 12 quarters after. Also in this case, the effect is statistically significant and precisely estimated. Interestingly, while the average investment effects shown in Figure 2 diminish in the medium term, the differential effect for high-debt firms tend to persist. This may reflect the fact that while all firms see a large decline in investment at the start of a recession, low leverage firms may see a quicker recovery while high-debt firms see more persistent declines.

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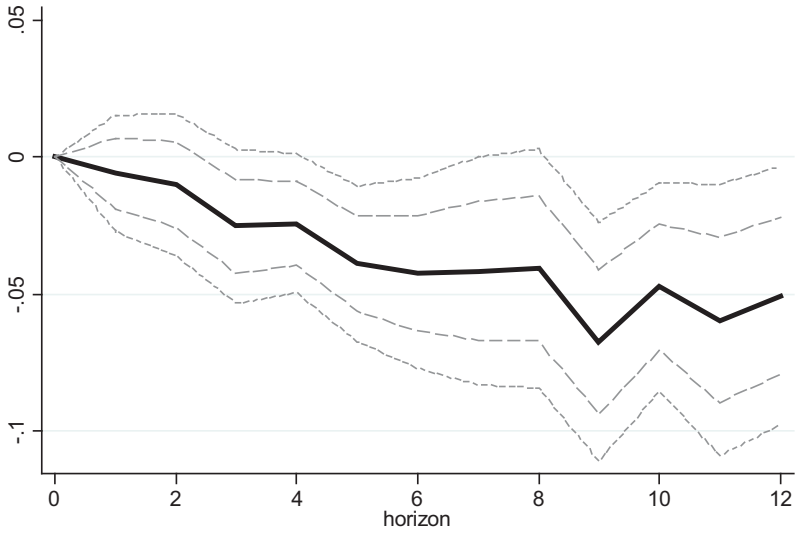


Figure 3. Differential effect of recession on (log) investment for high-debt companies relative to low-debt companies.
Note: Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

To give a sense of the role of corporate debt in amplifying the effect of recessions on investment, we perform a back-of-the-envelope calculation. We follow the approach of Arbatli-Saxegaard et al. (2025) and Ciminelli et al. (2022) among others, and we use the coefficients from the estimation of equations (1)–(2) as well as the weights of firms with high corporate debt in the sample.

Since the firms in our analysis are grouped into two buckets (high leveraged firms and low leveraged firms), we can write the average response of capital expenditure as the weighted average of capital expenditure in these two groups:

$$K_{t=} \omega_1 K^1_t + \omega_2 K^2_t \tag{3}$$

where K denotes total capital expenditure, ω_i and K^i_t are the capital expenditure share and investment of firms in group i, respectively. Based on equation (3), we can write the response of capital expenditure to recessions as follows:

$$\frac{\partial K_t}{\partial R_t} = \omega_1 \frac{\partial K^1_t}{\partial R_t} + \omega_2 \frac{\partial K^2_t}{\partial R_t} = \omega_1 \left(\frac{\partial K^1_t}{\partial R_t} - \frac{\partial K^2_t}{\partial R_t} \right) + \frac{\partial K^2_t}{\partial R_t}$$

where $\omega_2 = 1 - \omega_1$.

We obtain $\frac{\partial K_t}{\partial R_t}$ from estimating equation (1), while $\left(\frac{\partial K^1_t}{\partial R_t} - \frac{\partial K^2_t}{\partial R_t} \right)$ from estimating equation (2). Using the coefficients from these estimations, we calculate the contribution of leverage as $\frac{\omega_1 \left(\frac{\partial K^1_t}{\partial R_t} - \frac{\partial K^2_t}{\partial R_t} \right)}{\frac{\partial K_t}{\partial R_t}}$, assuming that group 2 ($\frac{\partial K^2_t}{\partial R_t}$) does not respond to the shock.

The results of this exercise suggest that firms' leverage contributes significantly to the average medium-term response of firms' investment to recessions and in amplifying scarring (Table 1). In particular, we find that firms' debt account for about 7% of the short-term (fourth quarters ahead)

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response of investment to recessions and about 28% of the medium-term (12 quarters ahead) response.

5. Robustness checks

The results in the previous section highlight the role of corporate debt in amplifying the effect of recessions on firms' investment. This section provides several robustness checks to demonstrate the generality of our results. We provide three types of checks, changing: (i) the sample; (ii) our key regressors and explanatory variable; and iii) the set of control variables to include potential cofounding factors at the macro and firm level that may be correlated with the interaction term of the recession and corporate debt dummy and that may affect the level of firms' investment.

5.1. Sample

As a first robustness check, we examine the sensitivity of our results to alternative samples. First, we look at whether the results are driven by important episodes of corporate debt buildup such as those observed in 2009 as the outcome of the GFC and in 2020 because of COVID-19. The results reported in Figure B1 of Appendix B show that the differential response of investment for firms with high corporate debt obtained excluding these two years is similar to, and not statistically different from, the baseline. Second, we check whether the results are driven by specific countries or groups of countries. To this end, we re-estimate equation (2) by excluding one country at a time and one region at a time. The results reported in Figures B2 and B3 of Appendix B suggest that our baseline results are not driven by specific countries. Next, we repeat the analysis by excluding one 2-digit sector at a time. The results also in this case are almost unchanged compared to those reported for the full sample (Figure B4 of Appendix B). Finally, we look at whether the results are determined by influential extreme observations. To this end, we winsorize 0.05 and 5% of the tails of the distribution of our dependent variable, respectively. The results obtained are very similar to the baseline (Figure B5).

5.2. Alternative dependent variables, recessions, and debt dummies

We replicate the analysis using alternative dependent variables: (i) the ratio of capital expenditure to total lagged assets; and (ii) log of revenue. The results obtained using these variables confirm that the negative effects of recessions tend to be amplified in firms with high corporate debt (Figure B6 of Appendix B). We next look at the sensitivity of results to the definition of recessions. While our approach follows the standard in the literature and in the definition of recessions, we also consider alternative versions of recessions such as: (i) continuous GDP growth (with the sign inverted); (ii) the peak to through changes in GDP growth; (iii) a dummy for financial (banking, debt and currency) crises; and (vi) a dummy for banking crises. The results produced with these variables confirm our main findings (Figure B7). Next, we examine the robustness of the results to the way we identify firms with high corporate debt. In our baseline specification, we consider a firm to have high corporate debt if the average level of debt of the firm over the entire sample is above the median of the industry. This assumption tries to isolate the role of debt from other firms' characteristics that may vary across sectors. As an alternative approach, we identify high-corporate-debt-firms as those with average level of debt above the median in the country or the income group specific industry median. The results reported in Figure B8 are similar to the baseline.

In our baseline, to mitigate endogeneity concerns, we consider the average leverage of a company over the entire sample so firms cannot switch classification, including in response to recessions.[13] To further mitigate endogeneity, we augmented our baseline identification to exclude the recessions years in the computation of the firms' average level of corporate debt (Figure 4). Next, we modify the way we estimate the role of firms' debt in amplifying the effect of recessions on investment. Instead of considering an interaction between a dummy which takes

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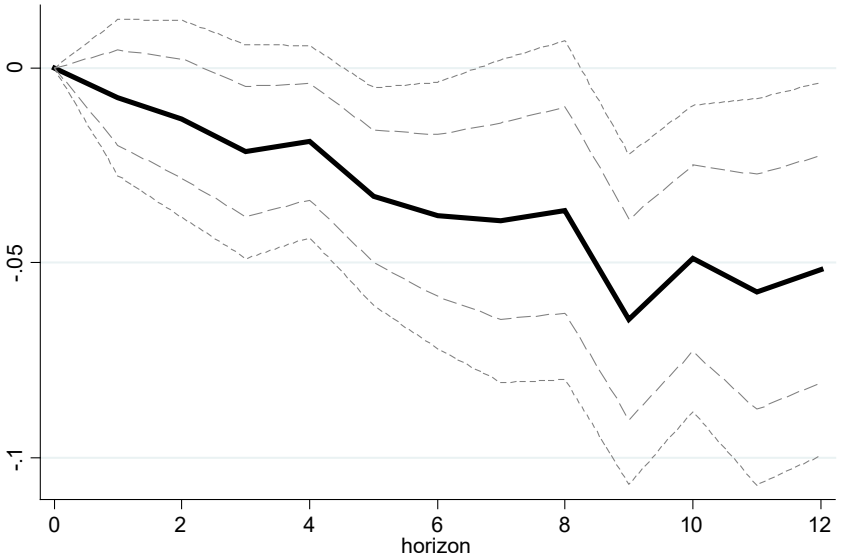


Figure 4. Robustness: exclude recessions years when computing high-debt dummy.
Note: Robustness check where companies are classified into high or low debt based on whether average leverage in all non-recession years is above or below median of their industry. Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage in non-recession years within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

value 1 if a firm's level of debt is above the industry-median, we consider high-debt firms as those with debt level above the 4th quartile of the industry distribution. The results in Figure B9 are qualitatively similar to those obtained using the industry median as a threshold. Finally, instead of considering only one dummy, we modify equation (2) to consider two interaction terms: one between recessions and a dummy which takes value 1 for firms with level of debt above the 4th quartile of the industry distribution (high-debt firms); one between recessions and a dummy which takes value 1 for firms with level of debt below the 2nd quartile of the industry distribution (low-debt firms). In Figure B10, we report the coefficients associated with these terms for each estimation horizon. Note that each of these coefficients captures the marginal effect of being in a high (low) state of debt compared to firms with level of debt between the 2nd and the 4th quartile of the distribution. The results show that the effect of recessions on investment for firms with lower debt is always smaller compared to firms with higher debt.

5.3. Additional control variables

We augment our baseline regressions to include additional firm characteristics such as total assets, ROA, liquidity, and age. The results obtained adding these control variables do not change the baseline results (Figure B11).

Our baseline regression includes a constellation of sector-country-time fixed effects and therefore effectively controls for all macroeconomic shocks and their effect across sectors. The inclusion of firm fixed effects further controls for unobservable firm characteristics that do not vary over time. While this set of controls should reduce concerns about endogeneity, a possible

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concern in estimating equation (2) is that the results are biased due to the omission of macroeconomic variables affecting firm-level investment through the level of corporate debt and are at the same time correlated with our recession dummies.

The first obvious candidate is the degree of financial stress (Dell'Ariccia et al., 2008). To check whether the inclusion of financial stress alter our results, we augment equation (2) by interacting the new indicator of financial stress from Ahir et al. (2022) with the firms' corporate debt dummy.[14] The results presented in the top left panel of Figure 6 show that the effect of recessions on firms' investment through corporate debt remains of the expected sign and also statistically significant, even though the point estimates are smaller, especially in the short-term. This is because one channel through which recessions affect investment is by increasing financial stress. In addition, and in line with Ahir et al. (2022), we also find that financial stress has a statistically significant effect on investment (Figure B12, top-left panel).[15]

Uncertainty can also affect firms' investment through corporate debt (Ahir et al. 2022; Choi et al. 2018). According to these studies, fluctuations in uncertainty tend to have larger effects on firms (sectors) that are more financially constrained. To control for the role of uncertainty, we repeat the analysis by including as an additional control variable the interaction between a measure of country-specific uncertainty—The World Uncertainty Index of Ahir, et al. (2022)—and the firm's corporate debt dummy.[16] The effect of recessions on firms' investment (top-left panel of Figure 6) also in this case are similar to, and not statistically different from, the baseline results presented in Figure 4. In addition, and consistent with the evidence from Ahir et al. (2022) for sectoral data, we find that the level of investment falls after uncertainty shocks (Figure B12, top-right panel), with an even larger decline for firms with higher debt levels, which are therefore more credit-constrained (Figure B13, top-right panel).

Another variable that may affect firms' investment through corporate debt is inflation. Inflation may lead to capital misallocation and to the extent that more financially dependent firms are those that suffer more from capital misallocation, it may have larger negative effects on firms with higher corporate debt. Moreover, inflation may affect firms' level of investment by increasing price level uncertainty (Choi et al. 2022). To further check the robustness of our results, we include an interaction term between inflation and the corporate debt dummy as a control. The results reported in the middle-left panel of Figure 6 show that effect of recession on firms' investment via corporate debt is unchanged, while the interaction between inflation and corporate debt is negative and statistically significant for some horizons (Figure B13, bottom-left panel).

Fiscal policy can also affect firms' investment level through high corporate debt—to the extent that expansionary fiscal policy can reduce the magnitude of recessions. In addition, Aghion et al. (2014) and Choi et al. (2022) shows that an increase in a country's degree of fiscal countercyclicality raises investment, and more so for industries with higher financial dependence. Also, in this case adding this control variable does not change our results (middle-right panel of Figure 6), and we do not find a significant effect of fiscal policy on investment through firms' corporate debt (Figure B14, bottom-right panel).

Finally, the results are also robust when these four controls are included simultaneously (bottom-left panel of Figure 5).

Another possible concern with our results is that recessions affect firms' investment though other firm-specific variables that are correlated with corporate debt. If this is the case, we may wrongly conclude that firms' corporate debt is implying the scarring effect of recessions on investment when de facto other firm characteristics are at play. To address this source of omitted variable bias, we augment our specification to include the interaction between recessions and a dummy (constructed as for debt) for several firms' characteristics: total assets, ROA, liquidity and age. The results obtained after adding these variables do not alter our finding that corporate debt is a significant factor affecting the response of investment to recessions (Figure 6). In addition, we find that the effect of recessions on investment tends to be smaller for firms with higher total assets, ROA, liquidity, and that are older, but these effects are not always precisely estimated (Figure B14).

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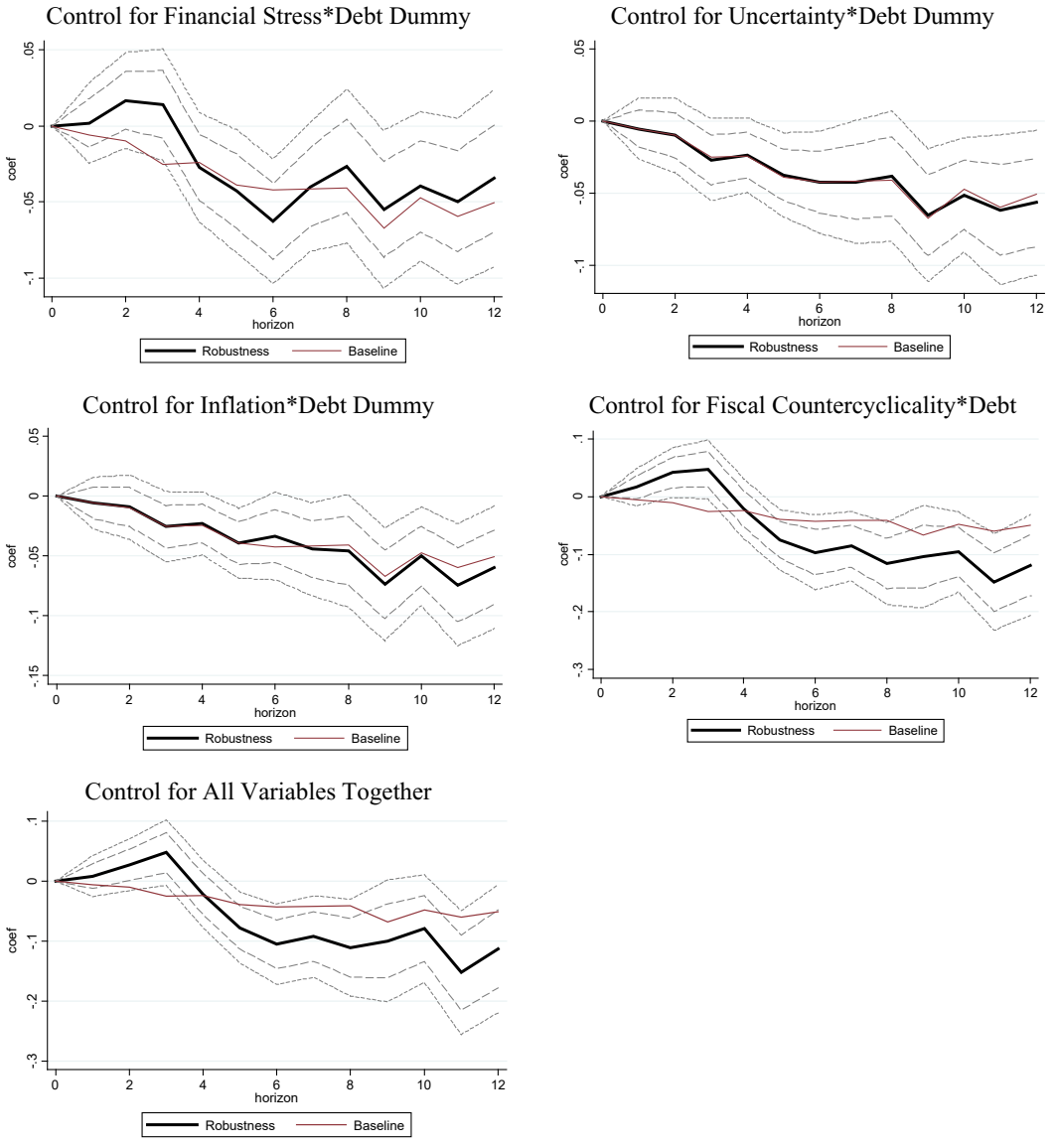


Figure 5. Robustness: include interaction of macro variables with high-debt dummy.
Note: Robustness check where interaction of macro variables with high-debt dummy are included as controls. Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum \nu^k_j M_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage in non-recession years within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. Interaction of various macro variable $M_{i,t-j}$ with the high-debt dummy are included as controls. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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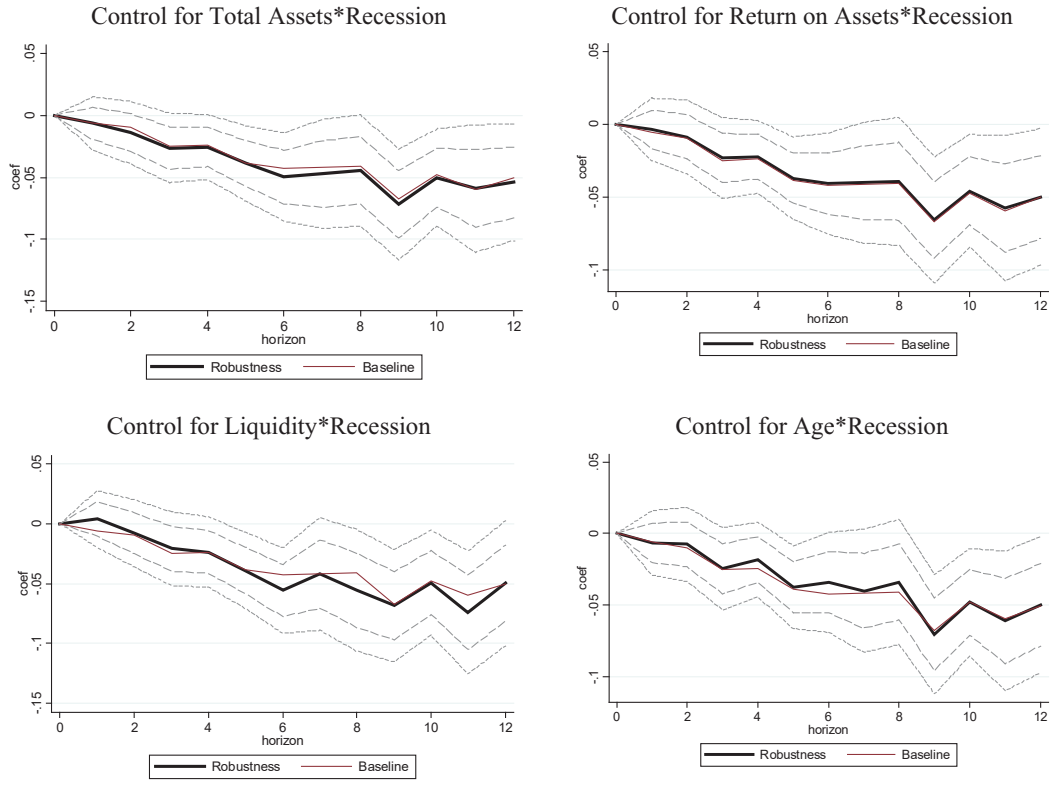


Figure 6. Robustness: include interaction of recession dummy with firm characteristics.
Note: Robustness check where interaction of dummy variables for various firm characteristics and the recession variable are included as controls. Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum v^k_j R_{i,t-j} * F_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. F_n is a dummy variable defined analogously to the high-debt dummy but for different firm characteristics i.e. firm classified as 1 if it is above the median as per the characteristic when averaged across the entire sample. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

Finally, high leverage may indicate deteriorating business health. To ensure that the observed effects are driven by high debt rather than underlying business conditions, we augment our specification by including the interaction between recessions and a dummy variable (constructed similarly to the debt dummy) based on firms' profits. The results show that the effects for high leverage remain statistically significant and very close to the baseline when this interaction term is included (Figure 7).

5.4. Placebo test

We next conduct a placebo test to check if investment in treated firms (i.e., highly indebted firms) behaves differently to firms in the control group even in the absence of a recession. To test this, we create 200 different random dummies with a distribution analogous to that of our original recession dummy.[17] We then rerun our baseline specification, replacing our recession dummy with the random dummies. We plot the distribution of the resulting coefficients at each horizon in Figure B15 together with the estimated coefficient in our baseline specification (vertical red line).

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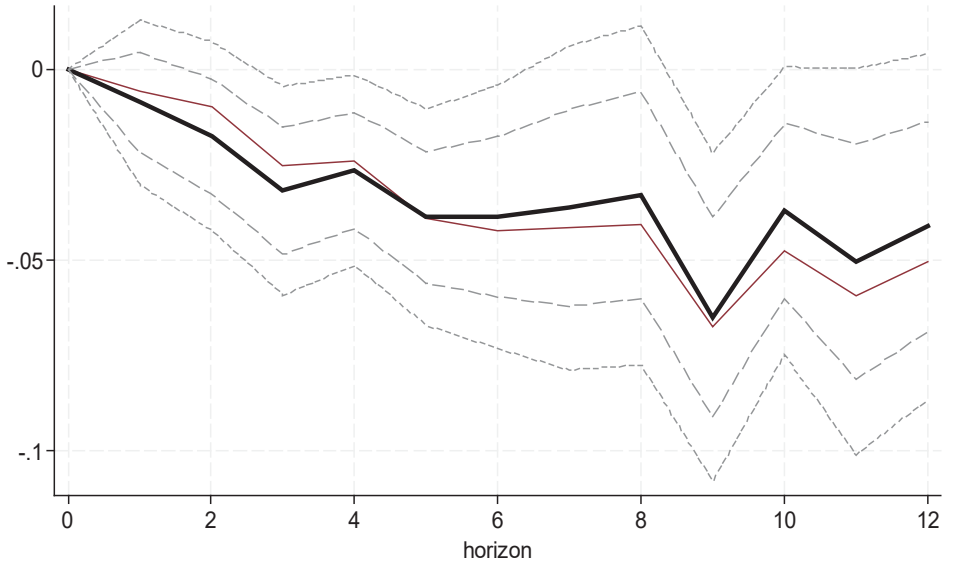


Figure 7. Differential effect of recession on (log) investment for high-debt companies relative to low-debt companies—controlling for profitability.
Note: impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid black line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. The solid red line indicates the baseline response reported in Figure 3. Standard errors are clustered at two-way at the firm and country-time level.

All the coefficients obtained using the random dummies are close to, and centered on, zero—that is, we observe no differential decrease in investment after randomly assigned placebo "recessions". This reinforces our conclusion that firms with high debt experience larger decreases in investment after recessions compared to low-indebted firms, distinct from any other time-varying factors that might reduce their investment levels.

6. Heterogeneity

In this section, we examine the potential heterogeneity in how leverage amplifies the scarring effects of recessions. Specifically, we analyze whether the effects discussed in the previous sections are influenced by macroeconomic conditions (such as country characteristics and types of crises) as well as sector- and firm-specific factors.

6.1. Country characteristics

One macroeconomic factor that can significantly influence how leverage amplifies scarring effects is the degree of bankruptcy efficiency (Kornejew et al. 2024). Well-functioning restructuring systems can mitigate inefficiencies arising from liquidation and help to identify viable firms—those for which the continuation value of operations exceeds the liquidation value—and restructure them effectively.

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To measure the quality of a country's bankruptcy system, we use the Strength of Insolvency Framework Index from the World Bank's Doing Business database. This de jure indicator evaluates the extent to which a country's laws and regulations support collective action, protect creditor rights, and facilitate efficient reorganization or liquidation. The overall index ranges from 0 to 16, with higher values indicating stronger legal provisions for resolving insolvency. The index covers 190 economies from 2004 and 2020. To test the role of a country's bankruptcy system, we extend equation (2) as follows:

$$y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=-k}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=-k}^{4} \sigma^k_j R_{i,t-j} * D_n * Z_{i,t-1}$$
$$+ \sum \delta^k_j D_n * Z_{i,t-1} + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}, \tag{4}$$

where $Z_{i,t-1}$ is a dummy which takes value 1 if the efficiency score is above the sample median and zero otherwise. The coefficient on the triple interaction term σ^k_j measures whether the differential response of investment for high-debt firms in quarter k varies based on the country's degree of bankruptcy efficiency. The results reported in Panel A of Figure 8 suggest that the coefficient is positive and statistically significant in the medium term, indicating that the differential scarring effects for high-leverage firms are markedly lower in countries with more efficient bankruptcy systems.

AE are generally characterized by a higher level of bankruptcy efficiency (Figure A1). A potential concern is that the results in Panel A of Figure 8 may simply reflect the differential response of scarring across income groups. To address this possibility, we re-estimated equation (4) separately for AE and EM economies. The results presented in Panel B of Figure 8 indicate that, for each income group, the differential scarring effects for high-leverage firms are smaller in countries with stronger bankruptcy institutions. These results indicate that bankruptcy efficiency is an independent factor influencing scarring, separate from the level of income.

6.2. Types of recessions

Our sample encompasses two major global recessions: the GFC and the Covid-19 pandemic. These crises have been notable not only for their scarring effects but also for the tighter financial conditions they have created. Both factors are likely to amplify the long-term effect of recessions on investment through leverage. To assess the differential impact of these global recessions, we re-estimated equation (2) for both global and domestic recessions. The results presented in Figure 9 indicate that the differential scarring effects for high-debt firms are approximately twice as large during global recessions compared to domestic ones.

6.3. Sectoral and firm characteristics

Global and domestic recessions are likely to affect firms differently, depending on the extent of their trade exposure. Data limitations hinder our ability to exploit firm-level heterogeneity regarding the trade channel. While CIQ provides export revenue data for firms, its coverage is quite limited. To address this limitation, and following Arbatli-Saxegaard et al. (2025), we use the World Input–Output Database (WIOD) as our baseline, which offers cross-country trade data for 56 sectors in 43 countries from 2000 to 2014.[18] We calculate the average export dependence for each sector-country pair during this period such that: $ExportDependence_{cs} = \frac{Exports_{cs}}{Output_{cs}}$ where c and s denote country and sector, respectively. $ExportDependence_{cs}$ denotes the average share of exports ($Exports_{cs}$) in sector s and country c in the value of total output ($Output_{cs}$).

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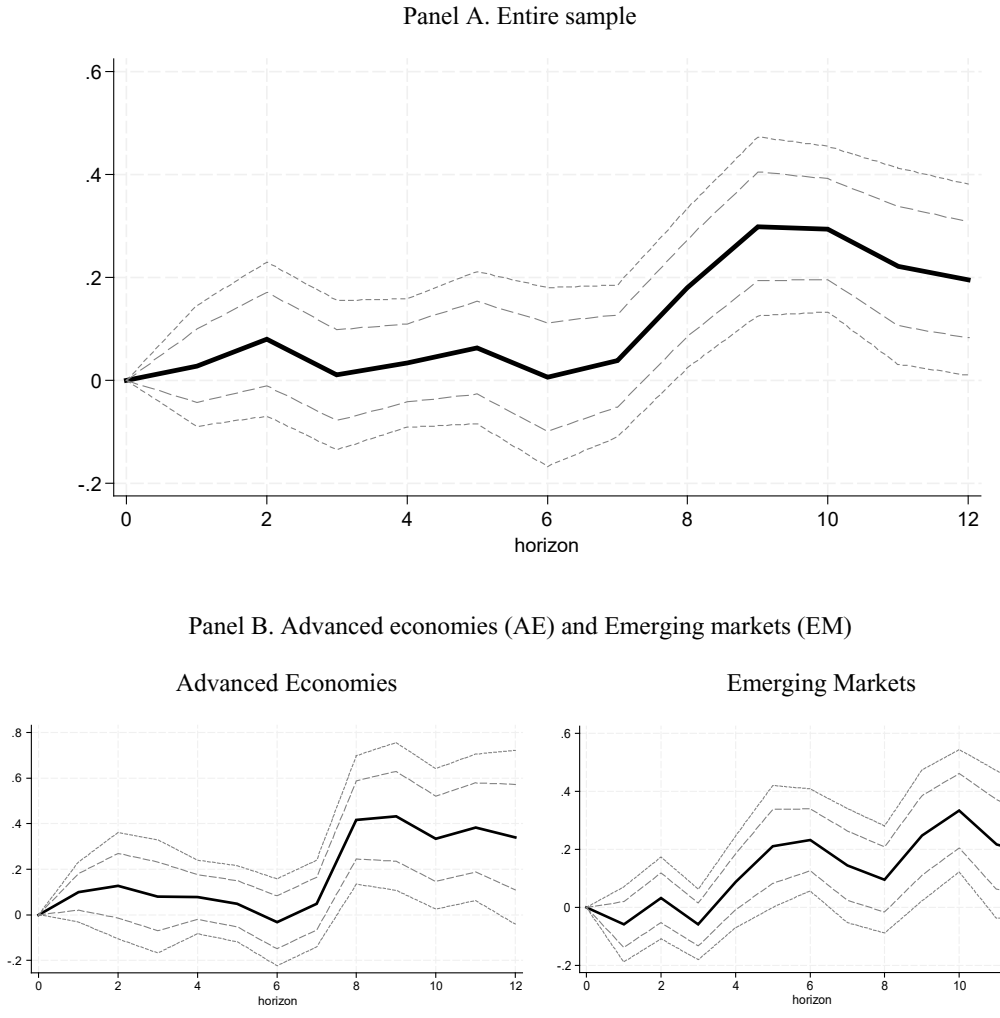


Figure 8. Differential effect of recession on (log) investment for high-debt companies relative to low-debt companies—role of bankruptcy efficiency.

Note: Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=-k}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=-k}^{4} \sigma^k_j R_{i,t-j} * D_n * Z_{i,t-1} + \sum \delta^k_j D_n * Z_{i,t-1} + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company *n* is a high-debt company (above median leverage within industry), $Z_{i,t-1}$ is an indicator of bankruptcy efficiency, λ^k_{nd} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid black line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 percent and 90 percent confidence intervals. The solid red line indicates the baseline response reported in Figure 3. Standard errors are clustered at two-way at the firm and country-time level.

To test for the role of trade dependency, we segment equation (2) as follows:

$$y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=-k}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=-k}^{4} \sigma^k_j R_{i,t-j} * D_n * M_{i,s,t-1}$$

$$+ \sum \delta^k_j D_n * M_{i,s,t-1} + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}, \tag{5}$$

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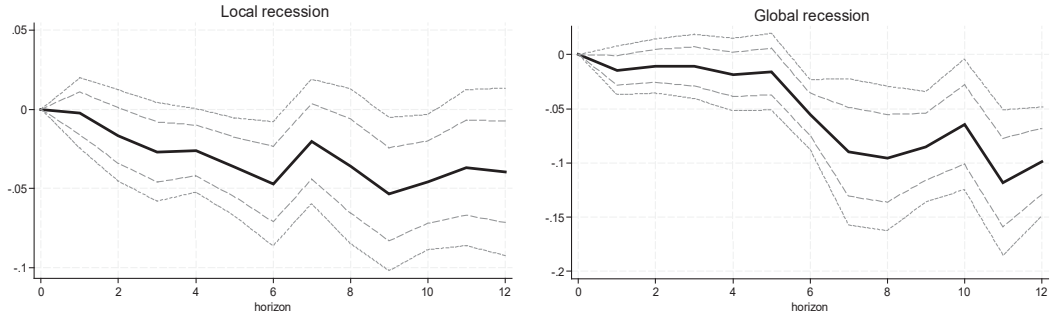


Figure 9. Differential effect of recession on (log) investment for high-debt companies relative to low-debt companies—global vs. domestic recessions.
Note: Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid black line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. The solid red line indicates the baseline response reported in Figure 3. Standard errors are clustered at two-way at the firm and country-time level.

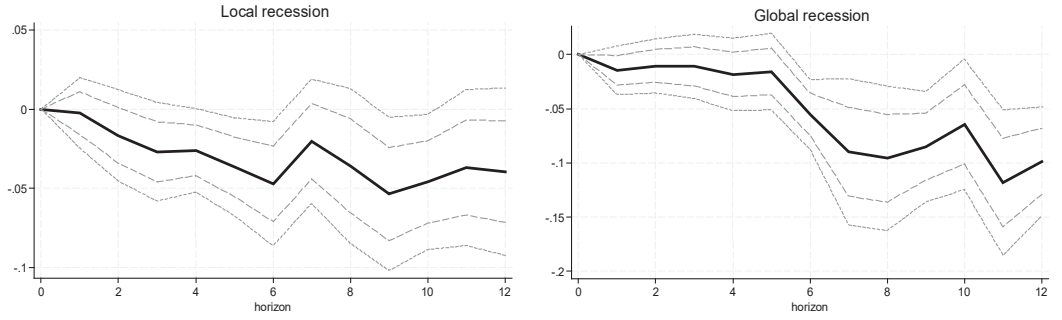


Figure 10. Differential effect of recession on (log) investment for high-debt companies relative to low-debt companies—global vs. domestic recessions and export dependence.
Note: Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=-k}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=-k}^{4} \sigma^k_j R_{i,t-j} * D_n * M_{i,s,t-1} + \sum \delta^k_j D_n * Z_{i,s,t-1} + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), $M_{i,s,t-1}$ is a dummy for high export dependence, γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid black line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. The solid red line indicates the baseline response reported in Figure 3. Standard errors are clustered at two-way at the firm and country-time level.

where $M_{i,s,t-1}$ is a dummy variable which take value 1 for sectors that have above average export dependency and zero otherwise. The coefficient on the triple interaction term σ^k_j measures whether the differential response of investment for high-debt firms in quarter k varies depending on the extent of export dependence. The results presented in Figure 10 for global and domestic recessions confirm that the differential scarring effects for global (domestic) recessions are larger (smaller) for firms in sectors characterized by higher export dependence.

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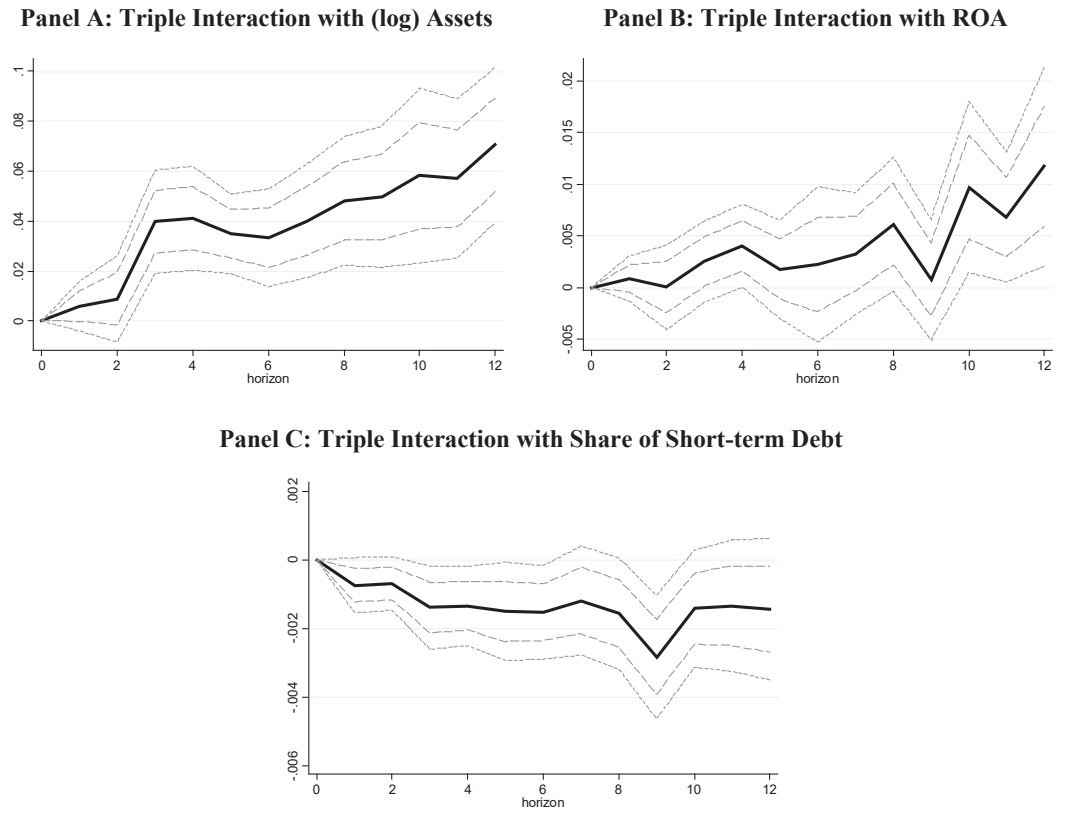


Figure 11. Differential effect of recession on (log) investment for high-debt companies relative to low-debt companies—firms characteristics.
Note: Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on equation (3) for different horizons 'k'. The solid line shows the point estimate for ν_o^k, the coefficient on the triple interaction term, for different horizons k, while the dotted lines are the 68% and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

Finally, in the third step, we further expand equation (2) to test whether the differential effect of recessions on investment for high-debt firms depends on other firm characteristics. In particular, we estimate the following triple-interaction specification:

$$y_{n,i,t+k} = \alpha_{ist}^k + \gamma_{nq}^k + \sum_{j=-k}^{4} \mu_j^k R_{i,t-j} * D_n + \sum_{j=-k}^{4} \nu_j^k R_{i,t-j} * D_n * X_{n,i,t-1} + \sum \beta_j^k R_{i,t-j} * X_{n,i,t-1}$$
$$+ \sum \delta_j^k D_n * X_{n,i,t-1} + \sum_{j=1}^{4} \theta_j^k y_{n,i,t-j} + \varepsilon_{n,i,t}^k, \quad (6)$$

where $X_{n,i,t-1}$ is the lagged value (averaged over four quarters to reduce noise) of a firm level characteristic like size, profitability, or share of short-term debt. The coefficient on the triple interaction term ν_j^k measures whether the differential response of investment for high-debt firms in quarter k varies depending on the firm characteristic $X_{n,i,t-1}$.

First, we test the impact of firm size measured by the log of total assets. We find that the coefficient on the triple interaction term in equation (3) is positive and significant (Figure 11A), indicating that larger firms with high debt see less scarring in investment following recessions compared to smaller firms with high debt. This could reflect the fact that for a given level of debt,

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credit constraints are more binding for smaller firms than larger firms, potentially because larger firms have more collateral available for borrowing, or because lenders see larger firms as less risky compared to smaller firms (Ghosal and Loungani, 2000; Cloyne et al. 2019; Arbatli-Saxegaard et al. 2025). Therefore, larger firms even with high debt are better positioned to take advantage of investment opportunities following a recession compared to similar smaller firms.

Next, we test whether profitability, measured using return on assets, also impacts the differential effect on investment of high- versus low-debt firms following a recession. We find that the triple interaction term when using return on assets is also positive and significant at longer horizons (Figure 11B), indicating that more profitable firms with high debt see less scarring compared to less profitable firms. This could reflect the fact that more profitable firms have greater access to internal funds to finance investment activities, thus relaxing credit constraints faced by less profitable high-debt firms.

Finally, we test whether the differential effect on investment of high- versus low-debt firms following a recession depends on the maturity structure of the firms' debt. The hypothesis we want to test is that it is harder for high short-term debt firms to rollover it in the aftermath of a recession, thus making it more difficult for them to invest in new projects. Our results suggest that this is the case, and we find that the triple interaction term when using share of short-term debt is negative (Figure 11C), indicating that companies with shorter maturity structures of debt see more scarring compared to those with longer maturities.

Appendix Figure B16 checks the robustness of the triple interaction results to using a smooth transition function (Granger and Terävistra, 1993) to transform the size and return on assets variable before estimating the triple interaction. The results are robust to this alternative specification and generally more precisely estimated. In contrast, we did not find statistically significant effects for triple interactions with other variables commonly used in the literature to proxy financial constraints such as age and liquidity. While the signs of the estimated effects are consistent with those obtained for size and profitability—that is, the differential investment effect between high- and low-debt firms is larger for younger and less liquid firms—these effects are not precisely estimated.

7. Conclusions

Corporate debt has increased markedly in the last two decades in both AE and EM economies. In this paper, we show that this rising trend will reduce the resilience of economies to recessionary shocks, other things equal. In particular, applying Jordà's (2005) local projection methods to a large panel of more than 24,000 firms, we find that the recessionary shocks that occurred during the period 2001–2020 have resulted in significant and persistent drops in investment, with the effects being larger for firms with higher debt. The effect of firms' leverage in shaping the investment response to recessions is statistically significant, and robust to a wide range of sensitivity checks. It is also economically sizeable: back-of-the-envelope calculations suggest that firms' debt accounts for at least 28% of the average medium-term response of investment to recessions.

These effects are larger for countries with less efficient bankruptcy systems, and tend to be amplified during global recessions—especially for firms operating in sectors with higher export dependence. In addition, we find that these effects are larger for smaller and less profitable firms, suggesting that for a given level of debt, credit constraints are more binding for smaller firms than larger firms, potentially because larger firms have more collateral available for borrowing, or because lenders see larger firms as less risky compared to smaller firms. Moreover, we find that it is harder for high short-term debt firms to rollover debt in the aftermath of a recession, thus making it more difficult for them to invest in new projects.

Our results have important policy implications. They point to the need to adopt improved policy regimes for restructuring unviable firms (see Grigorian and Raei, 2010 for lessons from the GFC), avoid firms' zombification, reduce overall leverage at the country-level and promote reallocation of capital and labor toward the more productive firms.

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Notes

1 See for example Hennessy (2004), Hennessy et al. (2007), Moyen (2007), Occhino and Pescatori (2015) and Gilje (2016).
2 Related, Jordà et al. (2022) find that frameworks that efficiently facilitate the restructuring or liquidation of debt reduce the macroeconomic fallout of corporate debt booms.
3 Other studies have focused on specific countries. For example, Buera and Karmakar (2019) find that highly leveraged firms in Portugal contracted more in the aftermath of financial shocks. Blickle and Santos (2020) using US data find that debt overhang leads to slower asset growth even in ordinary times, and that the effects of debt overhang during crises are more pronounced for firms with greater need for external funding.
4 Meanwhile, other researchers highlighted how other characteristics alongside high leverage can amplify the effects of corporate debt buildups. Albuquerque (2021) measures debt accumulation in the years preceding debt booms in the US and finds that corporate debt overhang is associated with weaker future investment growth in the medium term.
5 For the US, see also Opler and Sheridan (1994) and Duchin et al. (2010).
6 We use the industry-specific median to isolate the role of debt from other firm characteristics that may vary across sectors. The use of a time-unvarying firm dummy reduces endogeneity due to the potential time-varying response of corporate debt to recessions. In the robustness checks, we show that the results are similar to, and not statistically different from the baseline, when using alternative measures of recessions at the country level and debt dummies at the firm level.
7 Line details for this variable not available in the Capital IQ Glossary of terms. However, the name of the variable is available in the S&P Capital IQ Formula Index Excel spreadsheet.
8 All variables have been winsorized at the 1st and 99th percentiles but the average firm age and leverage which have been winsorized at the 5th and 95th percentiles to account for extreme outliers.
9 These two dummies are originally calculated at yearly frequency and are converted to quarterly frequency using our technical recession variable. If the yearly dummies show a recession for a certain year, we code this variable as 1 for the quarters of such year for which our quarterly variable shows a recession.
10 To account for extreme changes, we convert to missing when changes are in the 1st and 99th percentile.
11 These variables are further winsorized at the 1st and 99th percentiles after this computation.
12 The country-sector-time fixed effects also controls for possible reverse causality concerns, where changes in investment may drive the economic cycle.
13 This approach also ensures that the treated and untreated firms are always the same—a key assumption for the validity of the difference-in-difference estimates.
14 The authors use a narrative approach, based on the reading of Economist Intelligence Unit (EIU) reports, to construct an indicator of financial stress for 110 developing and advanced countries over the period 1970–2022, on a quarterly basis.
15 In contrast, we did not find a statistically significant effect of the interaction between financial stress and the corporate debt dummy (Figure B13, top-right panel).
16 The index covers an unbalanced panel of 143 individual countries on a quarterly basis from 1952. It reflects the frequencies of the word "uncertainty" (and its variants) in the EIU country reports.
17 Approximately 3% quarters are randomly set to 1, the same as the original recession dummy (for the start of a technical recession).
18 Note that we have 63 countries in our sample. Only 35 out of 63 countries have data from WIOD. Therefore, we use the average sectoral export dependence ratios for the remaining 28 countries in our sample.

References

Aghion, P., D. Hemous and E. Kharroubi. (2014) Cyclical fiscal policy, credit constraints, and industry growth. *Journal of Monetary Economics* 62, 41–58.
Ahir, H., N. Bloom and D. Furceri. (2022). *The World Uncertainty Index*. National Bureau of Economic Research.
Albuquerque, B. (2021) Corporate debt booms, financial constraints and the investment nexus. *Bank of England Working Paper*, 935.
Arbatli-Saxegaard, E., M. Firat, D. Furceri and J. Verrier. (2025) U.S. monetary policy shock spillovers: evidence from firm-level data. *Journal of International Money and Finance*, Elsevier, 158(C).
Bank, W. (2020) *Doing Business reports: Historical data*. Doing Business Archive. *Available at* https://archive.doingbusiness.org/en/data.
Blickle, K. S. and J. A. Santos. (2020). *The Costs of Corporate Debt Overhang Following the COVID-19 Outbreak*". Federal Reserve Bank of New York.

https://doi.org/10.1017/S1365100525100655 Published online by Cambridge University Press

Buera, F. and S. Karmakar. (2019) *Real Effects of Financial Distress: The Role of Heterogeneity*. Bank of England Working Papers, 814.
Campello, M., J. R. Graham and C. R. Harvey. (2010) The real effects of financial constraints: evidence from a financial crisis. *Journal of Financial Economics* 97(3), 470–487.
Choi, S., D. Furceri, P. Loungani and M. Shim. (2022) Inflation anchoring and growth: the role of credit constraints. *Journal of Economic Dynamics and Control* 134, 104279.
Choi, S., D. Furceri, Y. Huang and P. Loungani. (2018) Aggregate uncertainty and sectoral productivity growth: the role of credit constraints. *Journal of International Money and Finance* 88, 314–330.
Ciminelli, G., R. Duval and D. Furceri. (2022) Employment protection deregulation and labor shares in advanced economies. *The Review of Economics and Statistics* 104(6), 1174–1190. https://doi.org/10.1162/rest_a_00983
Cloyne, J., K. Huber, E. Ilzetzki and H. Kleven. (2019) The effect of house prices on household borrowing: a new approach. *American Economic Review* 109(6), 2104–2136.
Dell Ariccia, G., E. Detragiache and R. Rajan. (2008) The real effect of banking crises. *Journal of Financial Intermediation* 17(1), 89–112.
Dell"Ariccia, G., D. Igan, L. Laeven and H. Tong. (2016) Credit booms and macrofinancial stability. *Economic Policy* 31(86), 299–355.
Duchin, R., O. Ozbas and A. S. Berk. (2010) Costly external finance, corporate investment, and the subprime mortgage credit crisis. *Journal of Financial Economics* 97(3), 418–435.
Duval, R., G. H. Hong and Y. Timmer. (2020) Financial frictions and the great productivity slowdown. *The Review of Financial Studies* 33(2), 475–503.
Furceri, D. and A. Mourougane. (2012) The effect of financial crises on potential output: new empirical evidence from OECD countries. *Journal of Macroeconomics* 34(3), 822–832.
Ghosal, V. and P. Loungani. (2000) The differential impact of uncertainty on investment in small and large businesses. *Review of Economics and Statistics* 82(2), 338–343.
Gilje, E. P. (2016) Do firms engage in risk-shifting? Empirical evidence. *The Review of Financial Studies* 29(11), 2925–2954.
Giroud, X. and H. M. Mueller. (2017) Firm leverage, consumer demand, and employment losses during the great recession. *The Quarterly Journal of Economics* 132(1), 271–316.
Granger, C. W. J. and T. Teräsvirta. (1993) *Modelling Nonlinear Economic Relationships*. New York: Oxford University Press.
Grigorian, D. and A. Raei. (2010) *Government Involvement in Corporate Debt Restructuring: Case Studies from the Great Recession*. IMF Working Paper No. 10/260.
Harding, D. and A. Pagan. (2006) Synchronization of cycles. *Journal of Econometrics* 132(1), 59–79.
Hennessy, C. A. (2004) Tobin's Q, debt overhang, and investment. *The Journal of Finance* 59(4), 1717–1742.
Hennessy, C. A., A. Levy and T. M. Whited. (2007) Testing Q theory with financing frictions. *Journal of Financial Economics* 83(3), 691–717.
International Monetary Fund. (2022). *World Economic Outlook: War Sets Back the Global Recovery*. Washington.
Jordà, O. (2005) Estimation and inference of impulse responses by local projections. *American Economic Review* 95(1), 161–182, March.
Jordà, Ò., M. Kornejew, M. Schularick and A. M. Taylor. (2022) Zombies at large? Corporate debt overhang and the macroeconomy. *The Review of Financial Studies* 35(10), 4561–4586.
Jordà, O., M. Schularick and A. M. Taylor. (2013) When credit bites back. *Journal of Money, Credit and Banking* 45(s2), 3–28.
Kalemli-Ozcan, S., L. Laeven and D. Moreno. (2022) Debt overhang, rollover risk, and corporate investment: evidence from the European crisis. *Journal of the European Economic Association* 20(6), 2353–2395,
Kim, M., R. C. Mano and M. Mrkaic. (2020) *Do FX interventions lead to higher FX debt? Evidence from firm-level data*. International Monetary Fund Working Paper, 20/197.
Kornejew, M., C. Lian, Y. Ma, P. Ottonello and D. Perez. (2024) Bankruptcy resolution and credit cycles. In Kornejew, M., C. Lian, Y. Ma, P. Ottonello and D. Perez. (eds.), *NBER Macroeconomics Annual 2024*, Chicago: University of Chicago Press.
Moyen, N. (2007) How big is the debt overhang problem? *Journal of Economic Dynamics and Control* 31(2), 433–472.
Myers, S. C. (1977) Determinants of corporate borrowing. *Journal of Financial Economics* 5(2), 147–175.
Occhino, F. and A. Pescatori. (2015) Debt overhang in a business cycle model. *European Economic Review* 73, 58–84.
Opler, T. C. and T. Sheridan. (1994) Financial distress and corporate performance. *Journal of Finance* 49(3), 1015–1040.
Ottonello, P. and T. Winberry. (2020) Financial heterogeneity and the investment channel of monetary policy. *Econometrica* 88(6), 2473–2502.
Reinhart, C. M. and K. S. Rogoff. (2009) The aftermath of financial crises. *American Economic Review* 99(2), 466–472.
Teulings, C. and N. Zubanov. (2014) Is economic recovery a myth? Robust estimation of impulse responses. *Journal of Applied Econometrics* 29(3), 497–514.

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Appendix A. Data

Table A1. Sample of 75 countries by region

Africa—AFR (3)	Middle East and Central Asia - MCD (11)	Western Hemisphere -WHD (10)
Botswana	Bahrain	Argentina
Mauritius	Egypt	Brazil
South Africa	Jordan	Canada
	Kazakhstan	Chile
	Kuwait	Colombia
	Oman	Jamaica
	Pakistan	Mexico
	Qatar	Peru
	Saudi Arabia	Trinidad & Tobago
	Tunisia	United States
	United Arab Emirates	
Asia & Pacific APD (17)	Europe- EUR (34)	
Australia	Austria	Lithuania
Bangladesh	Belgium	Luxembourg
China	Bulgaria	Malta
Hong Kong	Croatia	Netherlands
India	Cyprus	Norway
Indonesia	Czech Republic	Poland
Japan	Estonia	Portugal
Macau	Finland	Romania
Malaysia	France	Russia
New Zealand	Germany	Serbia
Philippines	Greece	Slovakia
Singapore	Hungary	Spain
South Korea	Iceland	Sweden
Sri Lanka	Ireland	Switzerland
Taiwan	Israel	Turkey
Thailand	Italy	Ukraine
Vietnam	Latvia	United Kingdom

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Table A2. Number of firms and observations by country

Country	Number of firms	Obs.
United States	4,740	388,680
China	4,077	334,314
Japan	3,085	252,970
India	2,672	219,104
Canada	2,213	181,466
South Korea	1,747	143,254
Taiwan	1,693	138,826
Australia	1,356	111,192
Hong Kong	1,106	90,692
United Kingdom	870	71,340
Malaysia	771	63,222
Thailand	555	45,510
Sweden	525	43,050
Poland	522	42,804
Singapore	471	38,622
France	467	38,294
Germany	450	36,900
Vietnam	412	33,784
Indonesia	399	32,718
Israel	322	26,404
Pakistan	321	26,322
Turkey	280	22,960
Brazil	246	20,172
Italy	220	18,040
Sri Lanka	183	15,006
Bangladesh	178	14,596
South Africa	178	14,596
Russia	177	14,514
Switzerland	168	13,776
Philippines	157	12,874
Greece	155	12,710
Egypt	134	10,988
Norway	129	10,578
Chile	128	10,496
Spain	119	9,758
Finland	117	9,594
Saudi Arabia	114	9,348
Netherlands	105	8,610
New Zealand	105	8,610

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Table A2. Continued

Country	Number of firms	Obs.
Mexico	98	8,036
Peru	87	7,134
Jordan	83	6,806
Belgium	75	6,150
Ireland	71	5,822
Oman	71	5,822
Argentina	65	5,330
Romania	63	5,166
Kuwait	61	5,002
Croatia	57	4,674
Bulgaria	54	4,428
Colombia	49	4,018
Austria	45	3,690
Cyprus	45	3,690
United Arab Emirates	45	3,690
Mauritius	44	3,608
Luxembourg	39	3,198
Jamaica	37	3,034
Portugal	36	2,952
Tunisia	27	2,214
Lithuania	23	1,886
Qatar	21	1,722
Malta	20	1,640
Hungary	18	1,476
Bahrain	17	1,394
Kazakhstan	15	1,230
Estonia	14	1,148
Iceland	14	1,148
Latvia	14	1,148
Trinidad & Tobago	14	1,148
Serbia	12	984
Ukraine	11	902
Macau	10	820
Botswana	7	574
Czech Republic	6	492
Slovakia	6	492

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Table A3. Number of firms and observations by sector

Sector	Number of firms	Obs.
Materials	5,433	445,506
Capital Goods	4,888	400,816
Technology Hardware and Equipment	2,286	187,452
Consumer Durables and Apparel	2,032	166,624
Software and Services	2,027	166,214
Pharmaceuticals and Biotechnology	1,833	150,306
Food, Beverage and Tobacco	1,800	147,600
Energy	1,714	140,548
Media and Entertainment	1,398	114,636
Consumer Services	1,315	107,830
Retailing	1,291	105,862
Health Care Equipment and Services	1,287	105,534
Professional Services	1,160	95,120
Transportation	933	76,506
Automobiles and Components	865	70,930
Utilities	854	70,028
Semiconductors	774	63,468
Telecommunication Services	407	33,374
Food and Staples Retailing	383	31,406
Household and Personal Products	361	29,602

Table A4. Summary statistics by leverage

Stat	Log difference of investment	Log difference capex to lag assets	Log difference of revenue	Return on assets	Log of assets (size)	Firm average age	Net working capital ratio
High debt							
Count	578,167	533,674	843,137	760,256	794,191	1,209,254	832,654
Mean	0.02	0.00	0.02	−2.41	1.61	34.59	0.01
Std	1.03	0.09	0.34	28.07	0.55	28.62	0.63
25th	−0.41	−0.01	−0.09	−0.42	1.41	13.76	−0.03
50th	0.01	0.00	0.02	2.66	1.71	24.76	0.09
75th	0.43	0.01	0.12	5.64	1.96	47.76	0.23
Low debt							
Count	556,704	514,915	750,153	773,571	780,024	1,191,542	831,273
Mean	0.01	0.00	0.02	−4.84	1.36	28.44	0.24
Std	1.10	0.12	0.37	30.78	0.63	25.46	0.56
25th	−0.47	−0.02	−0.10	−3.73	1.13	10.76	0.12
50th	0.00	0.00	0.02	2.03	1.51	19.76	0.29
75th	0.49	0.02	0.13	6.31	1.77	37.76	0.47

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Table A5. Summary statistics of firm-level database

Variable	Count	Mean	Std	25th	75th
Log difference of investment	1,164,201	0.0	1.1	−0.4	0.5
Log difference Capex to Lag Assets	1,077,027	0.0	0.1	0.0	0.0
Log difference of revenue	1,621,998	0.0	0.4	−0.1	0.1
Return on Assets	1,540,139	−3.7	29.7	−1.8	5.9
Log of Assets (Size)	1,574,488	1.5	0.6	1.3	1.9
Firm average age	2,461,886	31.4	27.2	11.8	42.8
Net working capital ratio	1,664,821	0.1	0.6	0.0	0.4

Table A6. Summary statistics of macroeconomic variables

Variable	Source	Countries	Coverage	Obs.	Mean	Std	Min	Max
Start of Technical Recession	Haver Analytics and World Economic Outlook	106	1960Q2-2022Q4	12,011	0.05	0.21	0	1
Peak-to-through periods (converted to quarterly)	Harding and Pagan (2006)	93	1960q2-2018q4	1,108	0.34	0.47	0	1
Banking crises (converted to quarterly)	Reinhart and Rogoff (2009)	68	1960q2-2014q4	6,488	0.04	0.20	0	1
GDP growth (Q-o-Q)	Haver Analytics and World Economic Outlook	106	1960Q2-2022Q4	12,011	0.83	2.95	−38.02	31.71
Financial Stress	Ahir et al. (2022)	110	2000Q1-2018Q4	8,360	0.03	0.12	0.00	2.08
World Uncertainty Index	Ahir, et al. 2022	143	2000Q1-2021Q4	12,441	0.19	0.20	0.00	2.04
Inflation (CPI growth)	World Economic Outlook	71	1996q1-2021q2	6,782	1.17	2.47	−4.67	62.77
Time-varying fiscal measure of fiscal policy countercyclicality (converted to quarterly)	Choi et al. (2020)	61	2000Q1-2016Q4	4,216	0.25	0.34	−0.84	2.17

Table A7. Correlation of investment between Capital IQ and World Economic Outlook data

Variables	Log Investment USD (CIQ)		Investment Growth (CIQ)	
(1)	(2)	(3)	(4)	
Investment growth (WEO)			0.942***	0.867***
			(0.207)	(0.211)
Log investment USD (WEO)	1.173***	1.350***		
	(0.0218)	(0.0693)		
Constant	3.240***	2.556***	14.65***	15.29***
	(0.106)	(0.276)	(2.432)	(2.588)
Observations	1,107	1,107	1,107	1,107
R-squared	0.717	0.925	0.032	0.101
Country FE	NO	YES	NO	YES

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

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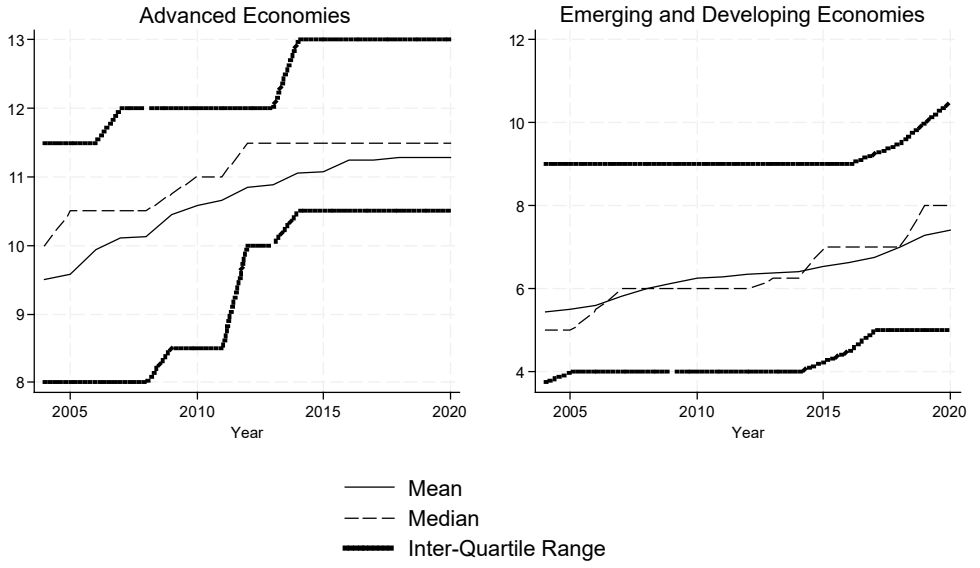


Figure A1. Bankruptcy efficiency in advanced economies (AE) and emerging markets (EM).
Source: World Bank.

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Appendix B. Additional results

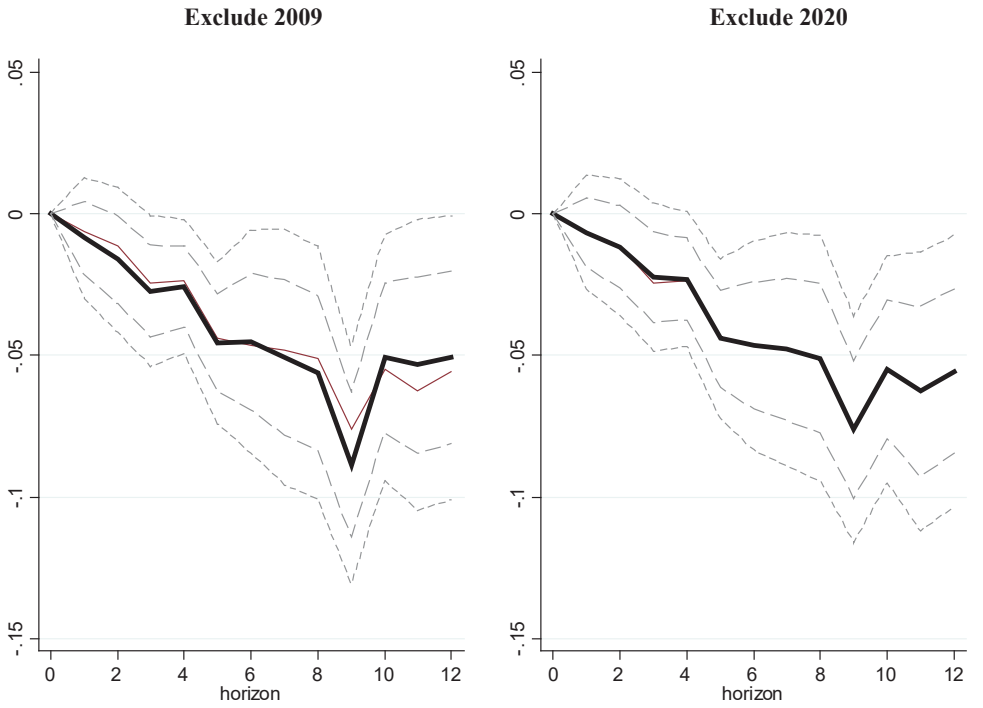


Figure B1 Robustness: excluding GFC and COVID-19.
Note: Left panel excludes the year 2009 from the estimation while the right panel excludes the year 2020. Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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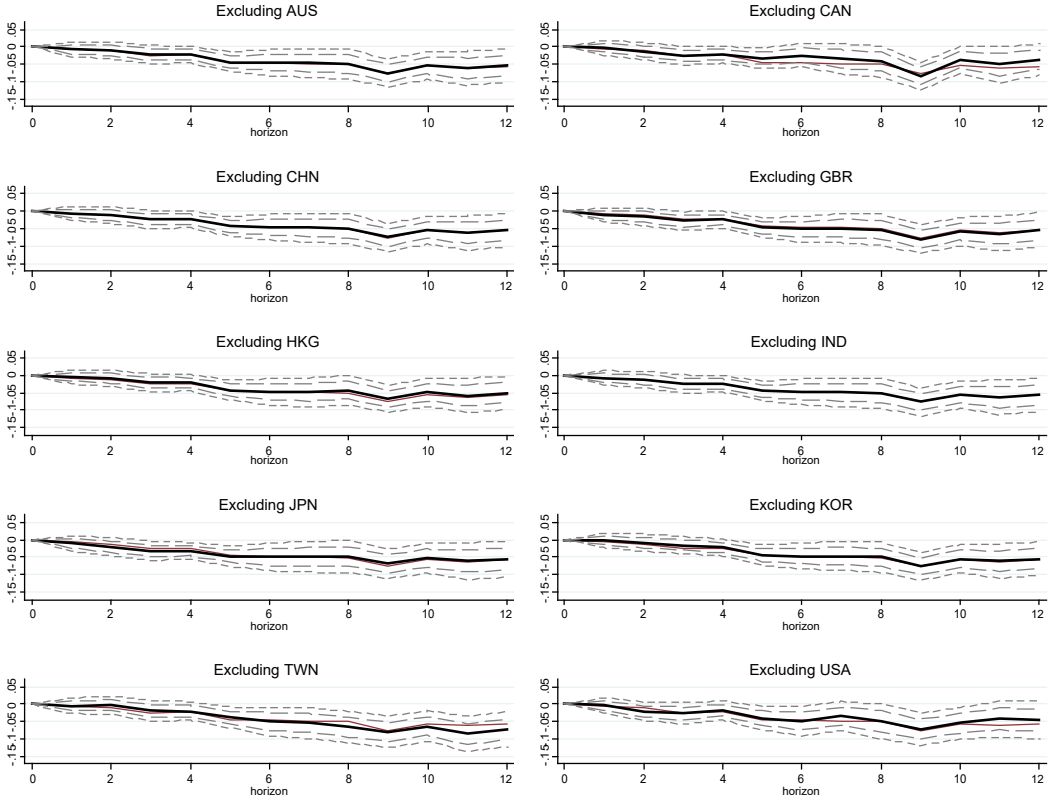


Figure B2. Robustness: excluding countries with most observations.
Note: Each impulse response checks robustness to excluding one country from the baseline regression—the 10 countries with the most observations in the sample are excluded one at a time. Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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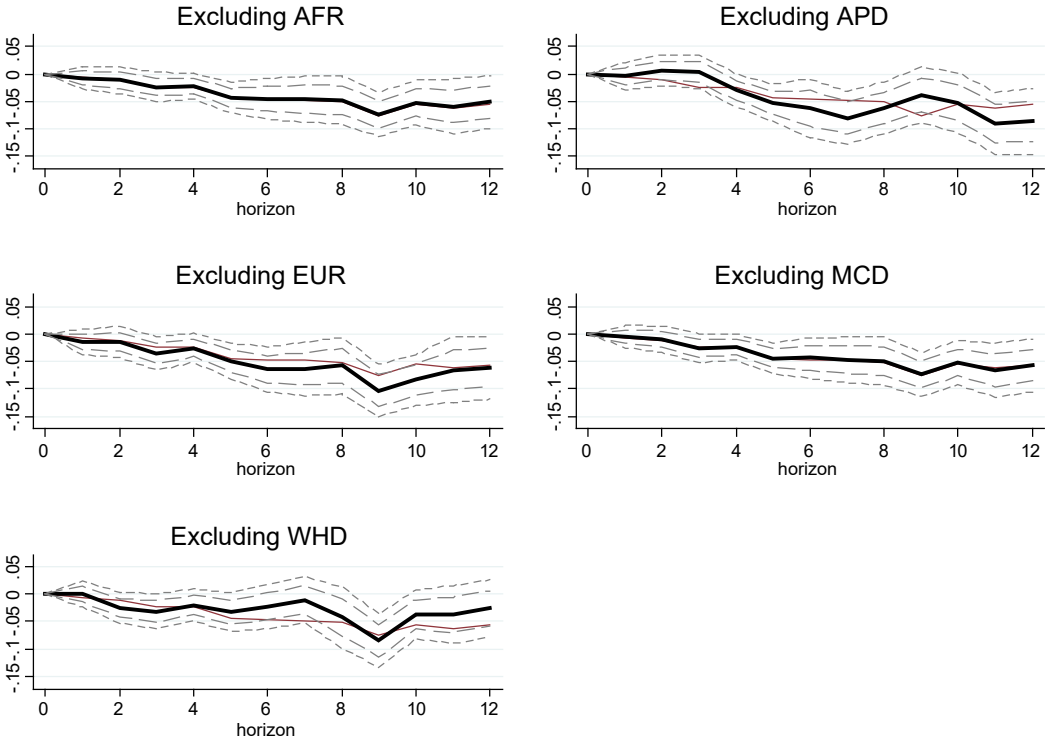


Figure B3. Robustness: excluding one region at a time.

Note: Each impulse response checks robustness to excluding one region at a time. Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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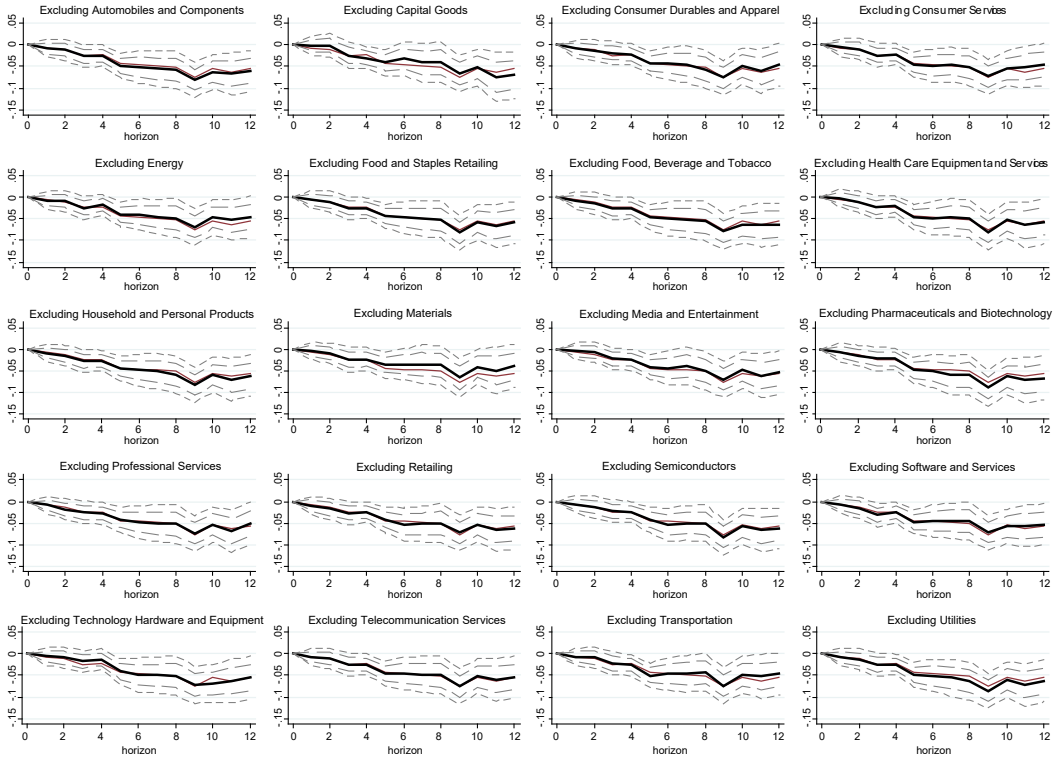


Figure B4. Robustness: excluding one sector at a time.

Note: Each impulse response checks robustness to excluding one 2-digit sector at a time. Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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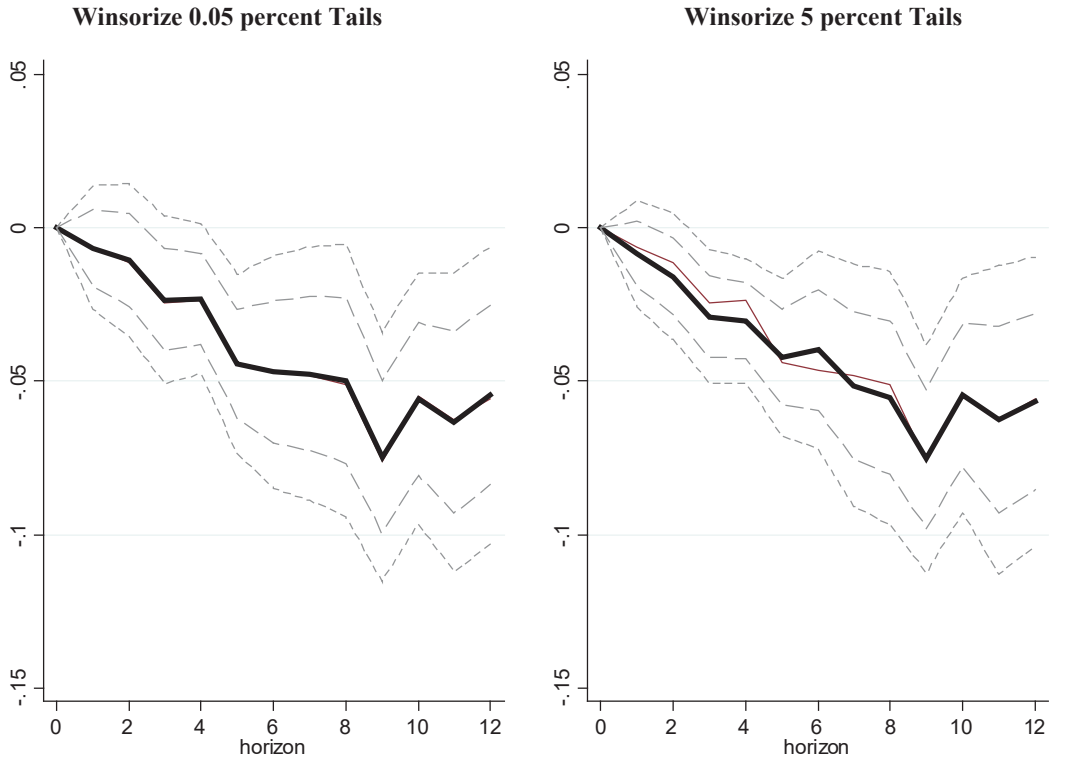


Figure B5 Robustness: different winsorizing schemes.
Note: Left panel winsorizes 0.05 percent tails of the dependent variable while the right panel winsorizes 5% tails of the dependent variable (compared to the baseline which winsorizes 1 percent tails). Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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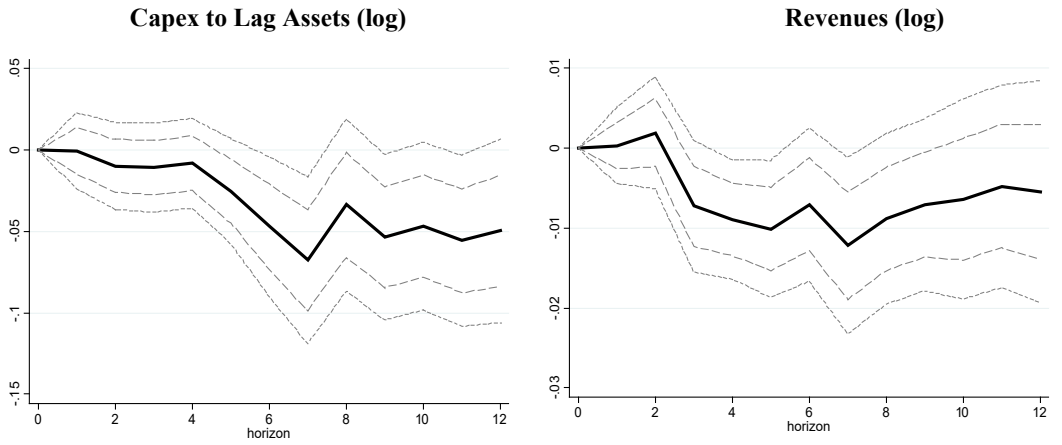


Figure B6. Robustness: different dependent variables.

Note: Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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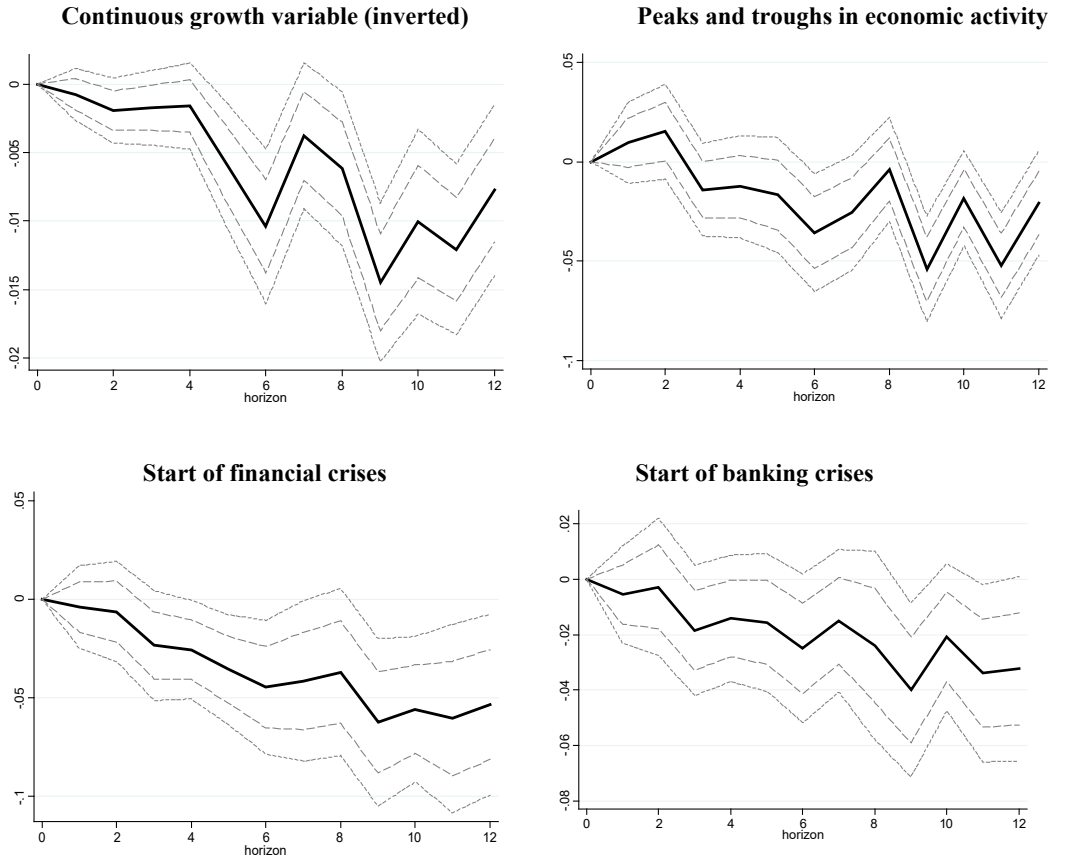


Figure B7. Robustness: alternate recessions variables.

Note: Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 to denote a recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level. Periods of banking crises are identified as the quarters during which a banking crisis-led recession occurred. Periods of peaks and troughs in economic activity are identified using the Harding-Pagan algorithm applied to real GDP. Periods of negative growth correspond to those where quarterly real GDP growth was negative.

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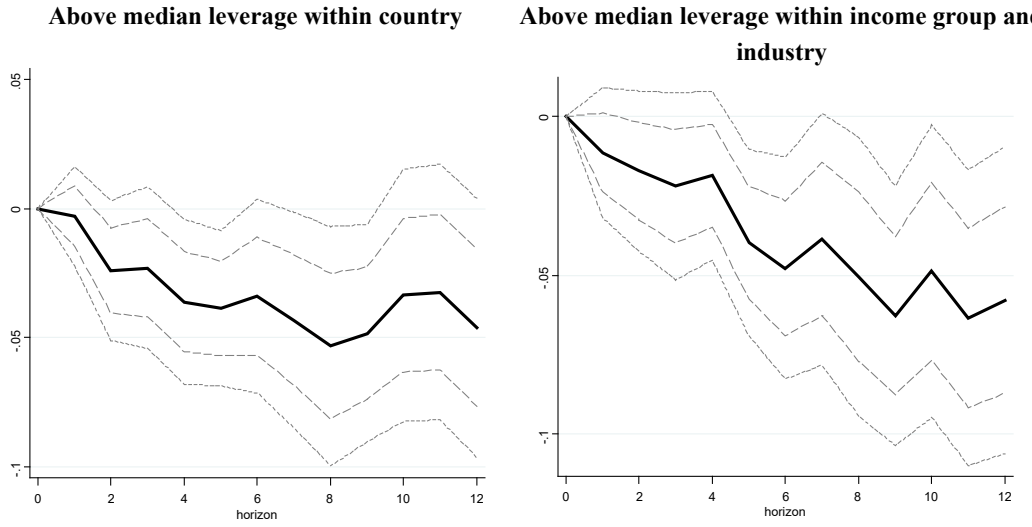


Figure B8. Robustness: alternate debt dummies.
Note: Impulse response functions based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 to denote a recession, D_n is a dummy variable if company *n* is a high-debt company. A high-debt company is identified if its leverage is above the median leverage within country (left-hand graph), or above the median leverage within countries that are advanced economies or EMDEs respectively (right-hand graph). γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

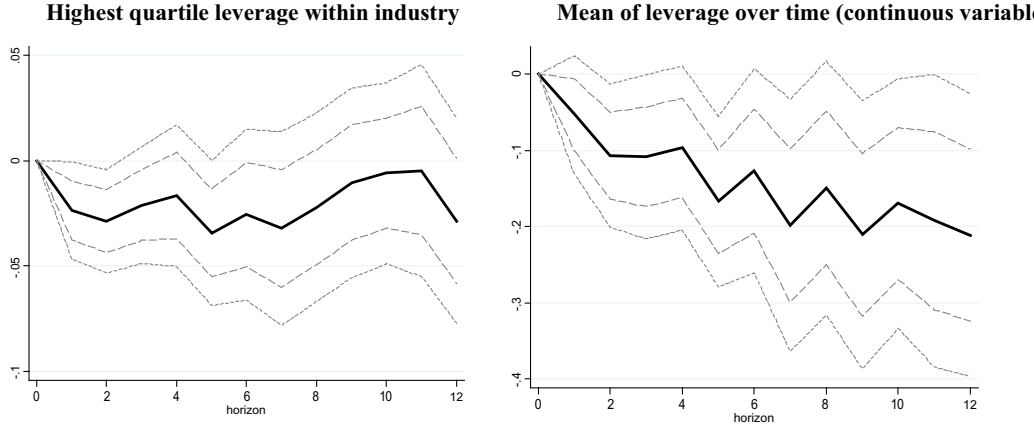


Figure B9. Robustness: alternate specifications for high-debt dummies II.
Note: Impulse response functions based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 to denote a recession, D_n is a dummy variable if company *n* is a high-debt company. A high-debt company is identified if its leverage is above the highest tercile (quartile) leverage within industry. γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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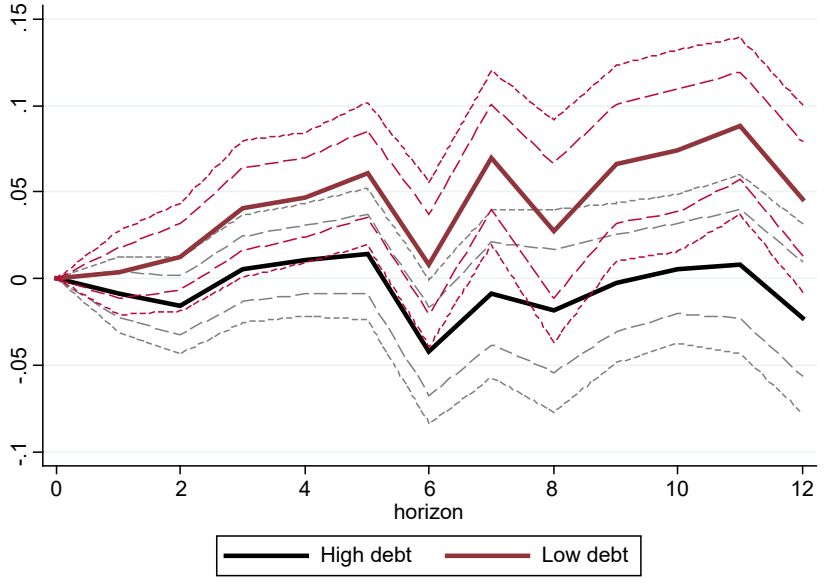


Figure B10. Alternative high-debt specification: companies in the 2nd quartiles vs companies in the 4th quartile.
Note: Impulse response functions based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 to denote a recession, D_n is a dummy variable if company n is a high-debt company. A high (low) debt company is identified if its leverage is above (below) the highest (second) quartile leverage within industry. γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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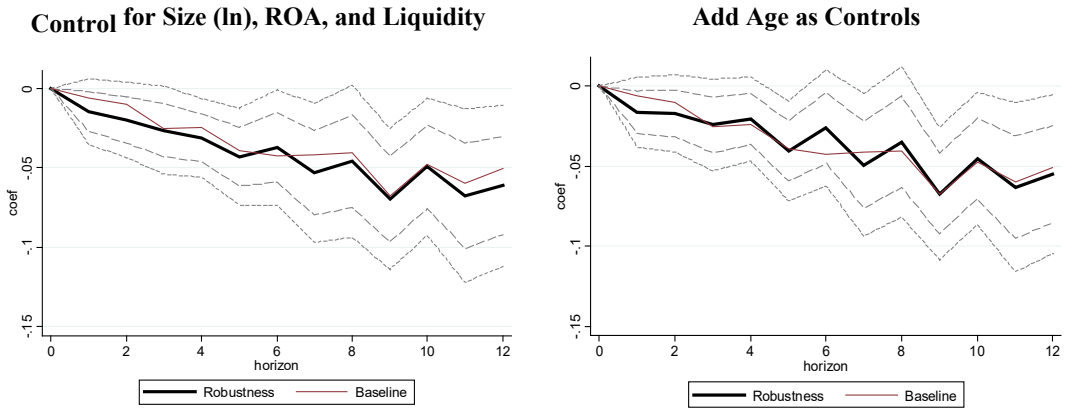


Figure B11. Robustness: additional firm-level controls.

Note: Robustness to adding firm level controls to the baseline. Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \sum_{j=1}^{4} \theta^k_j x_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. $x_{n,i,t}$ are additional firm level controls. Left panel includes lags of firm size (ln assets), return on assets, and a measure of liquidity (current assets minus liabilities as a share of assets) as additional controls. The right panel also adds log revenues and the firms age as controls. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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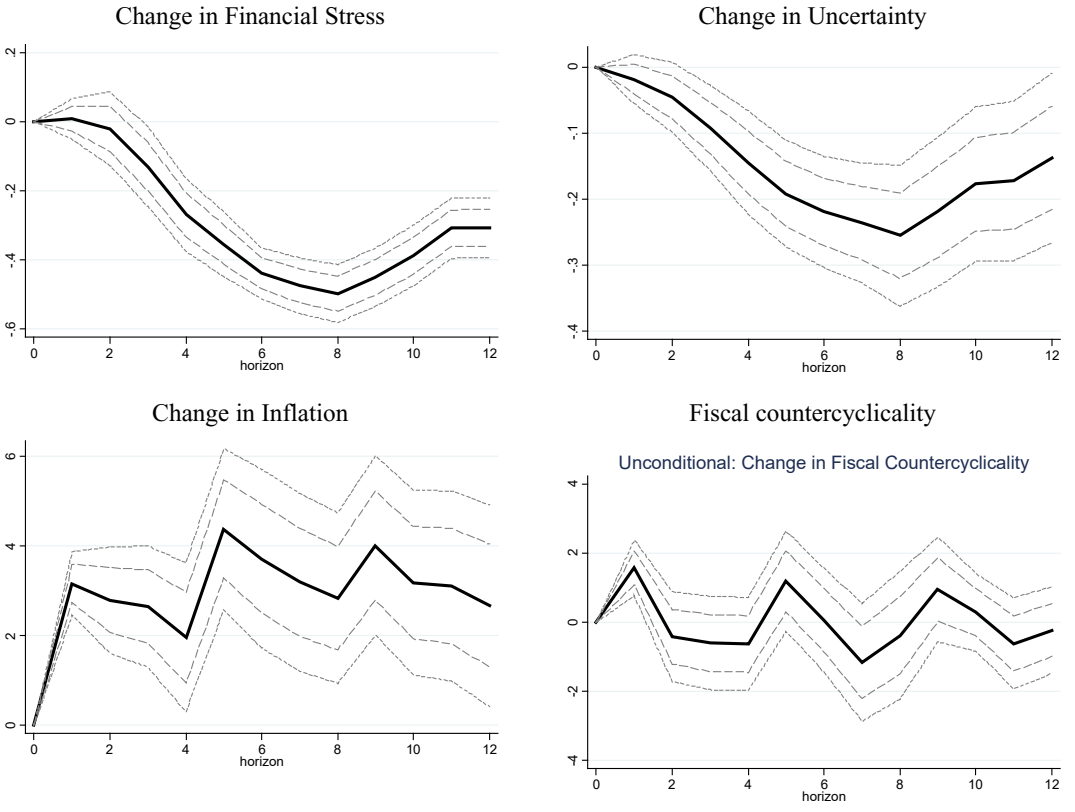


Figure B12. Unconditional response of log (investment) to macro variables.
Note: Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha_{is}^{k} + \gamma_{nq}^{k} + \sum_{j=0}^{4} \beta_{j}^{k} M_{i,t-j} + \sum_{j=1}^{4} \theta_{j}^{k} y_{n,i,t-j} + \varepsilon_{n,i,t}^{k}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $M_{i,t-j}$ is different macro variable in different panels, γ_{nq}^{k} are firm-quarters fixed effects, and α_{is}^{k} are country-sector fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for β_{0}^{k} for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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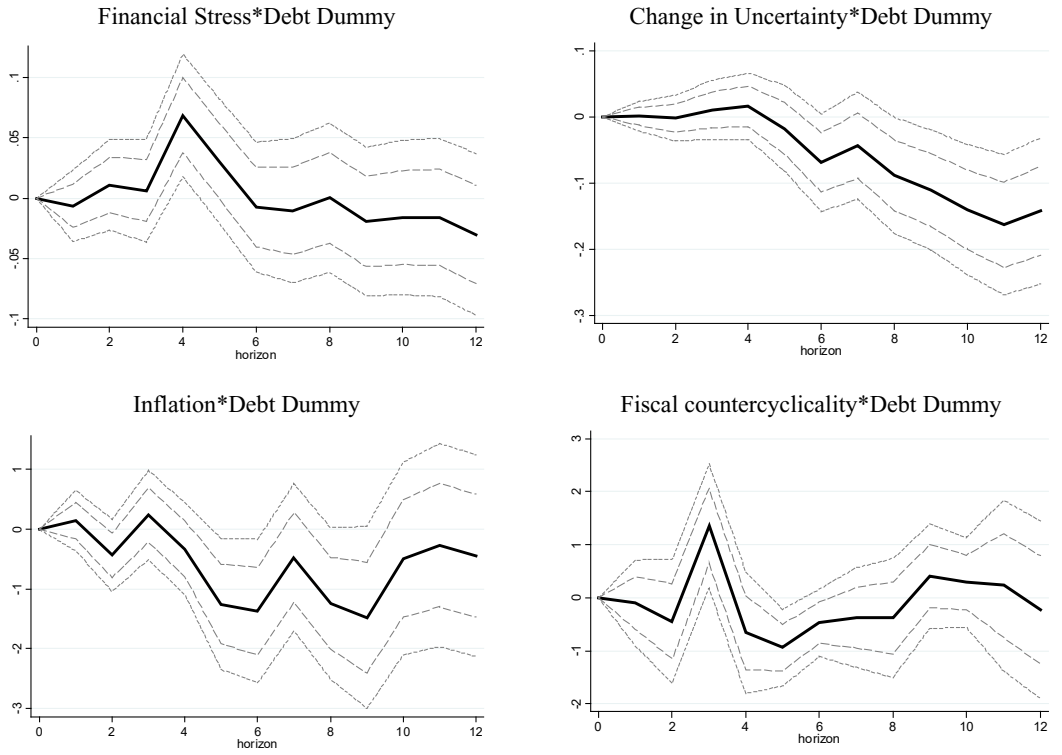


Figure B13. Coefficients on interaction of macro variables with high-debt dummy as controls.

Note: Robustness check where interaction of macro variables with high-debt dummy are included as controls. Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum \nu^k_j M_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage in non-recession years within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. Interaction of various macro variable $M_{i,t-j}$ with the high-debt dummy are included as controls. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for ν^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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Figure B14. Robustness: coefficient on interaction of recession dummy with firm characteristic dummies.
Note: Robustness check where interaction of dummy variables for various firm characteristics and the recession variable are included as controls. Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum \nu^k_j R_{i,t-j} * F_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is a dummy which takes value 1 at the start of a technical recession, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. F_n is a dummy variable defined analogously to the high-debt dummy but for different firm characteristics i.e. firm classified as 1 if it is above the median as per the characteristic when averaged across the entire sample. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for ν^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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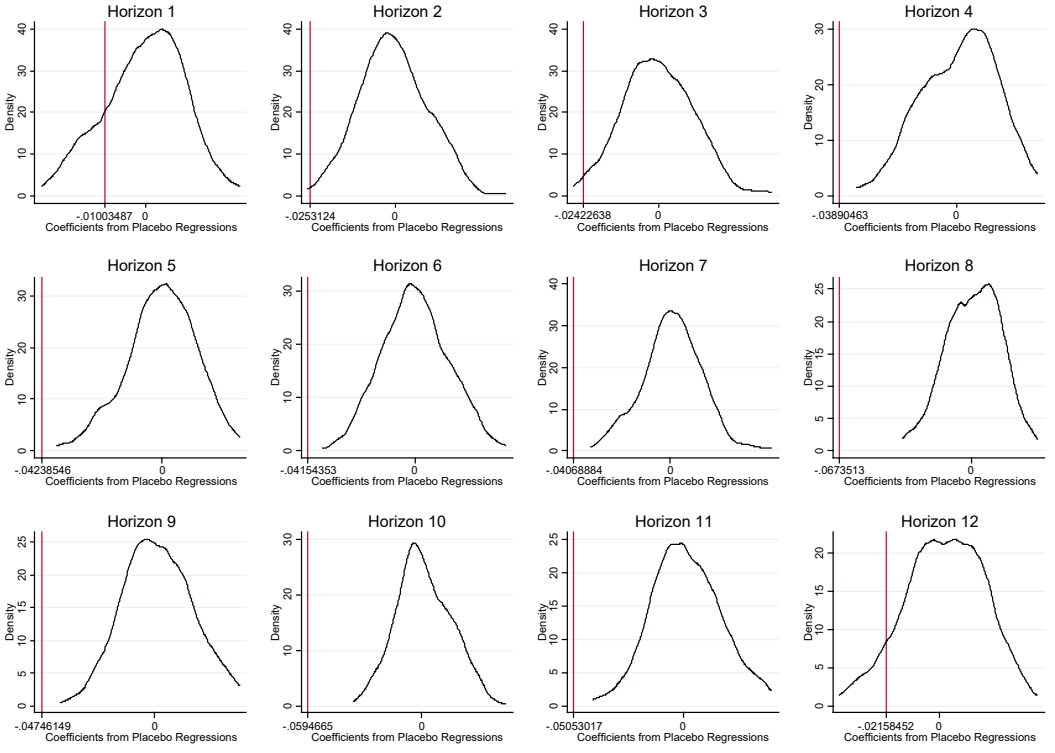


Figure B15. Robustness: placebo test.

Note: Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha^k_{ist} + \gamma^k_{nq} + \sum_{j=0}^{4} \mu^k_j R_{i,t-j} * D_n + \sum_{j=1}^{4} \theta^k_j y_{n,i,t-j} + \varepsilon^k_{n,i,t}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $R_{i,t-j}$ is our random recession dummy, D_n is a dummy variable if company n is a high-debt company (above median leverage within industry), γ^k_{nq} are firm-quarters fixed effects, and α^k_{ist} are country-sector-time fixed effects. The regression is estimated separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for μ^k_o for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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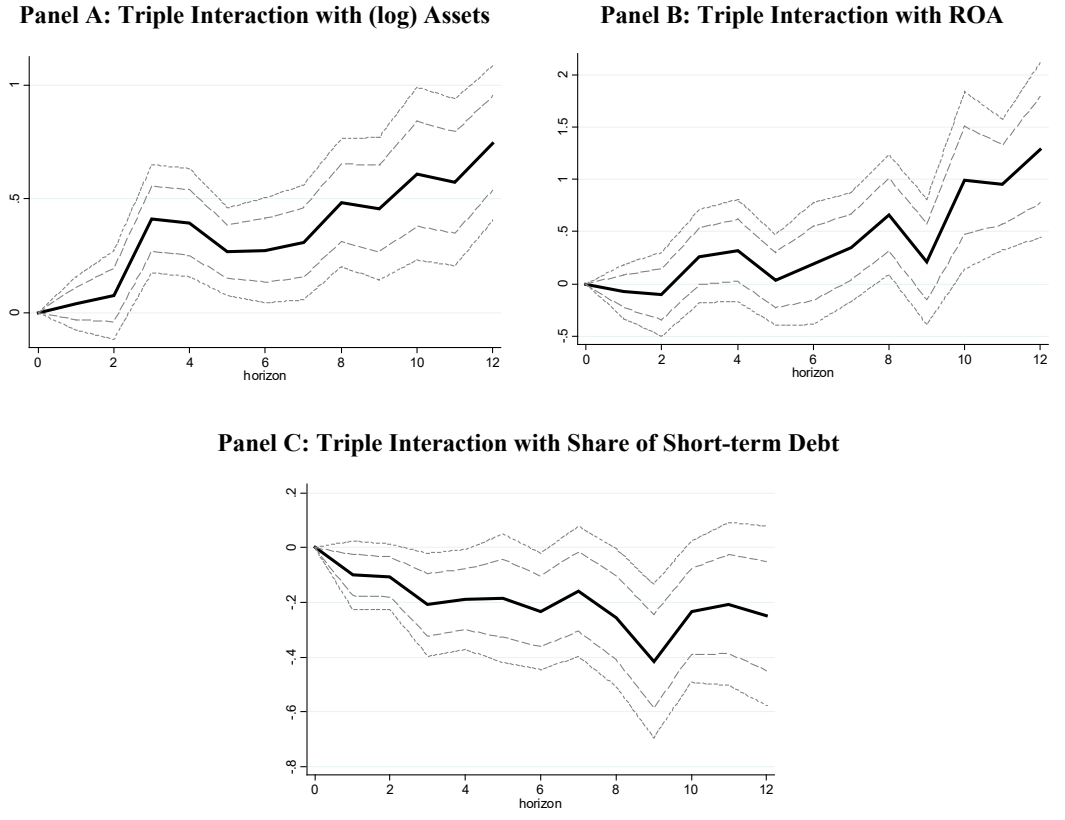


Figure B16. Nonlinear effects with triple interaction using smooth transition functions.
Note: Impulse response function based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on equation 3 for different horizons 'k', where the firm level characteristic $X_{n,i,t}$ is transformed using a smooth transition function $G\left(X_{n,i,t}\right) = \frac{1}{1+\exp\left(-X_{n,i,t}\right)}$ before interacting with the debt and recession dummies. The solid line shows the point estimate for ν_o^k, the coefficient on the triple interaction term, for different horizons k, while the dotted lines are the 68 and 90% confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

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