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# EXCESSIVE DEBT AND PRICED RISK EXPOSURE UNDER SYSTEMIC SHOCK: EVIDENCE FROM CHINESE LISTED FIRMS DURING COVID-19

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## ABSTRACT

This study examines whether excessive debt, defined as a positive deviation from firm-specific target leverage, is associated with market-priced financial vulnerability during the COVID-19 shock. Using panel data for non-financial and non-utility Chinese A-share listed firms from 2017 to 2022, the study treats the pandemic as an exogenous systemic shock that increased cash-flow uncertainty, refinancing pressure, and capital-structure adjustment costs. Excessive debt (EXD) is measured as actual book leverage minus target leverage; positive values indicate that a firm operates above its sustainable leverage benchmark. Priced risk exposure is proxied by annual cumulative abnormal return (CAR) estimated from a market model. CAR is interpreted cautiously as a market-based measure of required compensation for firm-specific vulnerability rather than as a direct measure of operating performance. The empirical results show that COVID-19 is positively associated with risk-adjusted return, and excessive debt is positively related to CAR in the baseline model. More importantly, the interaction between EXD and COVID-19 is positive and significant, indicating that the pandemic strengthened the market pricing of leverage-related vulnerability. Robustness tests using alternative debt proxies and Altman's Z-score confirm that debt dependence weakens financial stability. Instrumental-variable tests and additional specifications reduce concerns that the findings are driven solely by reverse causality or omitted firm characteristics. The study contributes to crisis-period capital-structure research by showing that the distance from target leverage, not leverage level alone, is a relevant channel through which systemic shocks are transmitted into market-priced vulnerability. It also clarifies that higher abnormal returns among over-leveraged firms should not be interpreted as superior performance; rather, they are consistent with higher required returns demanded by investors for bearing leverage-related risk. The findings provide practical implications for managers, investors, and regulators by supporting early-warning systems based on leverage gaps, debt maturity pressure, cash-flow capacity, and industry-adjusted debt thresholds.

**Keywords:** excessive debt, target leverage, priced risk exposure, risk-adjusted return, COVID-19, capital structure, financial fragility, Chinese listed firms

**JEL Classification:** E32, G32, I18, M12

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## INTRODUCTION

The COVID-19 pandemic triggered an unprecedented global economic contraction, severely disrupting corporate operations, supply chains, and capital markets. In China, prolonged lockdown measures and mobility restrictions between 2020 and 2022 generated significant revenue shocks across multiple industries, including manufacturing, retail, transportation, and tourism. Faced with declining cash flows and heightened uncertainty, many firms increased their reliance on external financing, particularly debt, to sustain operations and preserve liquidity.

While debt financing can provide tax advantages and facilitate investment, excessive leverage may significantly increase financial fragility, especially under systemic shocks. Traditional capital structure theories suggest that firms balance the tax benefits of debt against expected distress costs (Trade-off Theory), or follow a financing hierarchy favoring internal funds (Pecking Order Theory). However, extreme crisis conditions may distort this balance, pushing firms beyond their optimal leverage thresholds.

Existing COVID-19 corporate finance research has established that financial flexibility, cash holdings, debt maturity, corporate governance, and supply-chain exposure shaped firms' stock-price reactions during the pandemic. However, three gaps remain. First, many studies examine leverage levels or debt ratios, whereas fewer studies distinguish between debt that is consistent with a firm's target capital structure and debt that exceeds a firm-specific sustainable benchmark. This distinction is important because a high debt ratio may be optimal for a stable, asset-intensive firm, while a moderate debt ratio may still be excessive for a firm with volatile cash flows and limited debt capacity. Second, most crisis-period studies emphasize performance, liquidity, or default risk, but pay less attention to how equity markets price the specific leverage gap created by deviations from target leverage. Third, evidence from China remains theoretically useful not simply because China is an emerging market, but because its bank-dominated financial system, policy-guided credit allocation, and heterogeneous state intervention may slow leverage adjustment and make over-leverage more persistent during systemic shocks.

This article addresses these gaps by examining whether excessive debt, measured as actual leverage minus target leverage, becomes a channel through which COVID-19 is translated into market-priced financial vulnerability. The mechanism is as follows. A systemic shock reduces operating cash flows and increases uncertainty. Firms with positive leverage deviations face higher debt-service pressure, weaker refinancing capacity, and greater expected distress costs. Equity investors then require higher expected returns to hold the shares of such firms. Therefore, a positive relation between EXD and annual CAR is interpreted not as evidence of superior firm performance, but as evidence that markets attach a risk premium to over-leveraged firms. The moderating role of COVID-19 is expected because the same leverage deviation becomes more informative about vulnerability when revenue, supply chains, and refinancing conditions deteriorate simultaneously.

The study makes three contributions. First, it refines the leverage-risk literature by shifting the empirical focus from the level of leverage to the distance from target leverage. Second, it links capital-structure deviation to market-based risk compensation by explaining why abnormal returns may reflect priced vulnerability rather than operating efficiency. Third, it provides evidence from a bank-dominated emerging market in which crisis-period credit support and adjustment frictions may coexist, thereby revealing the boundary condition under which debt-financed liquidity support turns into over-leverage risk.

## LITERATURE REVIEW

Research on excessive debt and corporate risk is grounded in classical capital structure theory. The Modigliani–Miller framework argues that capital structure is irrelevant under perfect market conditions (Franco Modigliani & Merton H. Miller, 1958). However, when taxes, bankruptcy costs, agency conflicts, and information asymmetry are introduced, leverage becomes an important determinant of firm value and risk. Trade-off Theory suggests that firms choose an optimal debt level by balancing tax benefits against expected financial distress costs (Kraus & Litzenberger, 1973), while Pecking Order Theory argues that firms prefer internal funds, then debt, and issue equity only when internal financing is insufficient (Myers & Majluf, 1984). These theories imply that debt is not necessarily harmful, but it becomes excessive when actual leverage exceeds the level supported by firm fundamentals, operating capacity, and adjustment ability.

In this study, excessive debt is defined as the positive deviation between actual leverage and firm-specific target leverage. This definition follows dynamic capital structure research, which shows that firms adjust only partially toward target leverage because of transaction costs, financing frictions, market timing, and institutional constraints (Flannery & Rangan, 2006; Hovakimian et al., 2001). Persistent deviations from target leverage may therefore indicate inefficient financing decisions and rising financial fragility rather than temporary balance-sheet fluctuations (Titman & Tsyplakov, 2007). This issue is particularly relevant in China, where bank-dominated financing, policy-related credit allocation, and adjustment frictions may make leverage deviations more persistent than in mature capital markets (Qian et al., 2009).

Existing studies generally show that excessive leverage weakens financial flexibility and increases firms' vulnerability to external shocks. High debt obligations require firms to allocate more cash flow to interest and principal repayment, reducing investment capacity, innovation expenditure, and liquidity buffers (Frank & Goyal, 2009; HENNESSY & WHITED, 2005). Excessive debt may also increase bankruptcy risk and constrain strategic flexibility during downturns (Zhao & Su, 2022). However, the literature also recognizes that moderate leverage may create tax shields and discipline managerial behavior. Therefore, the key issue is not whether debt matters, but when debt changes from a value-enhancing financing tool into a risk-amplifying constraint. This study addresses this issue by focusing on deviations from target leverage rather than on leverage levels alone.


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The link between excessive debt and priced risk exposure can be explained from distress-risk and asset-pricing perspectives. Traditional bankruptcy prediction studies show that financial ratios contain useful information about default probability and firm survival (Altman, 1968; Beaver, 1966). Asset-pricing research further suggests that leverage increases equity risk because shareholders hold a residual claim whose value becomes more volatile when debt-servicing pressure rises. Hackbarth et al. (2006)show that capital structure and credit risk vary with macroeconomic conditions, while Bhamra et al. (2010) demonstrate that default risk and credit spreads are linked to expected equity returns. Therefore, a positive relationship between excessive debt and cumulative abnormal return should not be interpreted simply as evidence of better operating performance. Instead, it may reflect a higher risk premium required by investors for firms with greater financial vulnerability.

This interpretation is consistent with the financial accelerator and systemic risk literature. The financial accelerator mechanism argues that leverage amplifies adverse macroeconomic shocks because falling asset values and cash flows tighten borrowing constraints and increase external financing costs (Bernanke, 1999). Systemic risk research further shows that balance-sheet fragility can transmit firm-level vulnerability to broader financial markets (Acharya & Steffen, 2020). Accordingly, priced risk exposure in this study refers to the market pricing of firm-specific financial vulnerability under uncertainty, rather than ordinary operating risk alone. This distinction is important because risk-adjusted return is used as the market-based proxy for priced risk exposure, while Altman's Z-score is used as a complementary distress-based robustness measure.

Firm-specific characteristics may further shape the leverage-risk relationship. Weak governance, volatile profitability, unstable cash flows, and rigid cost structures can reduce firms' ability to adjust capital structure during external shocks (Chang et al., 2014). Economic policy uncertainty may also discourage investment and increase the value of financial flexibility, especially in emerging markets (Wang et al., 2014). Empirical evidence confirms that highly leveraged firms are more exposed to earnings volatility, default probability, liquidity shortages, and refinancing constraints during periods of uncertainty (Ding et al., 2021; Fahlenbrach et al., 2021; Rehman et al., 2024). Recent evidence also indicates that COVID-19 exposure affected leverage adjustment and financial flexibility, suggesting that pre-existing balance-sheet conditions shaped firms' resilience during the pandemic (Rehman et al., 2024).

The COVID-19 pandemic provides a suitable setting for examining excessive debt and priced risk exposure because it combined real economic disruption with financial market repricing. Unlike traditional financial crises, COVID-19 simultaneously disrupted supply chains, labor mobility, production activities, and consumer demand (Baker et al., 2020; Didier et al., 2021). Global evidence shows that firms with stronger financial flexibility, lower leverage, and higher liquidity experienced more favorable market reactions during the pandemic (Ding et al., 2021; Fahlenbrach et al., 2021). Ramelli & Wagner (2020) further show that investors rapidly incorporated firm-level COVID-19 exposure into stock prices, suggesting that pandemic-period abnormal returns reflected changing assessments of risk. These studies support the use of cumulative abnormal return as a market-based indicator of priced risk exposure.

Although prior studies have examined leverage, liquidity, financial flexibility, and firm performance during COVID-19, three gaps remain. First, many studies focus on leverage levels, but fewer examine whether firms are over-leveraged relative to their own target capital structure. Second, abnormal returns during the pandemic are often interpreted as performance outcomes, while less attention is paid to whether they reflect higher risk compensation. Third, emerging-market evidence remains limited on how bank-dominated financing systems and leverage adjustment frictions affect the pricing of excessive debt during systemic shocks. This study addresses these gaps by linking target-leverage deviations with market-based priced risk exposure and distress-based robustness evidence.

Based on the above literature, this study proposes three hypotheses. First, because COVID-19 reduced internal funds and increased firms' reliance on external borrowing, H1 proposes that COVID-19 positively influences excessive debt. Second, because excessive debt increases distress risk, weakens financial flexibility, and raises investors' required risk premium, H2 proposes that excessive debt increases priced risk exposure. Third, because systemic shocks intensify liquidity pressure, refinancing constraints, and investor attention to financial vulnerability, H3 proposes that COVID-19 positively moderates the relationship between excessive debt and priced risk exposure.

## AIMS AND OBJECTIVES

The purpose of this study is to explain how excessive debt affected priced risk exposure among Chinese listed firms during the COVID-19 shock and to determine whether the pandemic strengthened the leverage-risk linkage predicted by capital structure theory.

To achieve this purpose, the article addresses five specific tasks. First, it estimates whether the COVID-19 period is associated with higher excessive debt relative to firm-specific target leverage. Second, it examines whether excessive debt significantly affects priced risk exposure, proxied by annual cumulative abnormal return. Third, it tests whether COVID-19 moderates the relationship between excessive debt and priced risk exposure through an interaction term. Fourth, it verifies the robustness of the baseline findings by employing alternative leverage indicators and Altman's Z-score as an additional measure of financial fragility. Fifth, it addresses potential endogeneity by applying instrumental-variable estimation and comparing those results with the baseline panel regressions.

## METHODS

This study examines the impact of excessive debt on priced risk exposure among Chinese listed firms during the COVID-19 pandemic using a structured panel data framework aligned with hypotheses H1–H3. A pooled ordinary least squares (OLS) model is adopted as the baseline specification to estimate the relationship between deviations from target leverage and firm-level risk exposure over the period 2017–2022. The panel structure enables the exploitation of both cross-sectional heterogeneity across firms and time-series variation across macroeconomic phases, including the pre-pandemic period, the peak disruption stage, and the early recovery phase. This temporal design provides a quasi-natural experimental setting to evaluate how systemic shocks interact with firm-level capital structure decisions. Year fixed effects are included to control for macroeconomic shocks common to all firms during the sample period.

Excessive debt (EXD) is defined as the deviation between a firm's actual leverage ratio and its target leverage ratio. This deviation-based measure allows the analysis to distinguish financial overextension from structurally justified borrowing. Rather than relying solely on absolute leverage levels, EXD captures the extent to which firms exceed theoretically optimal capital structure thresholds, thereby reflecting financial fragility under uncertainty. Such measurement is particularly relevant during crisis periods, when firms may increase borrowing to sustain liquidity despite deteriorating earnings capacity.

To assess whether the COVID-19 shock intensified leverage-related vulnerability, a pandemic indicator (COVID) is introduced, along with an interaction term between excessive debt and the pandemic variable (EXD × COVID). This interaction term allows the model to identify the moderating effect of COVID-19 on the excessive debt–priced risk exposure relationship, testing whether over-leveraged firms faced disproportionately higher market-based risk compensation and financial vulnerability during the crisis. The sample consists of Chinese A-share listed firms obtained from the China Stock Market and Accounting Research Database (CSMAR) for the period 2017–2022. CSMAR is a widely used professional database that provides standardized financial statement data, stock market trading data, industry classification information, and firm-level accounting indicators for Chinese listed companies. In line with established corporate finance research standards, firms in the financial and utility sectors are excluded to ensure structural comparability (BATES et al., 2009; González, 2013; Tian & Xu, 2022). Financial institutions operate under distinct leverage regulations and capital requirements, while utility firms are subject to regulated pricing mechanisms and relatively stable capital structures. Excluding these sectors ensures that the analysis focuses on market-driven financing decisions that are more responsive to macroeconomic shocks such as COVID-19.

Based on this research design and sampling framework, the baseline econometric specification is formulated as follows:

$$EXD_{i,t} = \beta_0 + \beta_1 COVID-19_{i,t} + \beta_2 Control_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$RET_{i,t} = \beta_0 + \beta_1 EXD_{i,t} + \beta_2 COVID-19_{i,t} + \beta_3 \left(EXD_{i,t} * COVID-19_{i,t}\right) + \beta_4 Controls_{i,t} + \varepsilon_{i,t} \quad (2)$$

In equations (1) and (2), i denotes firm, t denotes year, and $\varepsilon_{i,t}$ is the error term. $Controls_{i,t}$ includes SIZE, INDLEV, PROVOL, CFVOL, TAX, DELEV, and INDLTD. Equation (1) is used to test H1, while equation (2) is used to test H2 and H3.

Risk-adjusted return (RET) is defined as firm-level abnormal return net of systematic risk exposure rather than raw stock return. Following standard asset pricing theory (Fama & French, 1993; Sharpe, 1964), abnormal return reflects compensation beyond aggregate market risk. In this study, RET is interpreted as a market-based measure of priced firm-specific risk rather than an indicator of operating performance. When firms exhibit higher financial fragility due to excessive leverage, investors may require additional expected return as risk compensation. Therefore, a positive association between excessive debt and RET is interpreted as evidence of elevated perceived risk and higher required return. Annual RET is calculated as the cumulative abnormal return over each fiscal year, which helps mitigate concerns that raw returns simply reflect higher systematic risk-taking (Jensen, 1968).


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$$AR_{i,d} = R_{i,d} - (\hat{a}_i + \hat{b}_i R_{m,d}) \quad (3)$$

$$RET_{i,t} = \sum AR_{i,d} \quad (4)$$

*Here, $AR_{i,d}$ is the abnormal return of firm i on trading day d, $R_{i,d}$ is the daily stock return of firm i, $R_{m,d}$ is the market return on day d, and $\hat{a}_i$ and $\hat{b}_i$ are the estimated parameters of the market model. $RET_{i,t}$ is the annual cumulative* abnormal return of firm i in year t, obtained by summing daily abnormal returns within the fiscal year.

The key independent variable is the Degree of Excessive Debt (EXD), defined as the deviation between actual leverage and target leverage. Actual leverage equals total liabilities divided by total assets (Frank & Goyal, 2009). Target leverage is obtained from CSMAR enterprise index data and grounded in dynamic capital structure adjustment models (Flannery & Rangan, 2006; Hovakimian et al., 2001). Following trade-off theory (Kraus & Litzenberger, 1973), positive deviations indicate over-leverage relative to firm-specific optimal benchmarks. Persistent deviations signal financial pressure and inefficient adjustment, particularly under macroeconomic uncertainty (Rehman et al., 2024).

$$LEV_{i,t} = Total\ Liabilities_{i,t}/Total\ Assets_{i,t} \quad (5)$$

$$EXD_{i,t} = LEV_{i,t} - TLEV_{i,t} \quad (6)$$

*$LEV_{i,t}$ is the actual leverage ratio of firm i in year t, and $TLEV_{i,t}$ is the corresponding target leverage ratio obtained from the CSMAR enterprise index and dynamic capital structure adjustment logic. A positive $EXD_{i,t}$ indicates that the firm is over-leveraged relative to its target level.*

COVID-19 is introduced as an exogenous moderating variable through the time dummy defined above. An interaction term (EXD x COVID) tests whether pandemic conditions amplified the leverage-risk relationship. This specification follows crisis-based capital structure research (Didier et al., 2021; Igan et al., 2023) and captures intensified liquidity constraints and refinancing risk during systemic shocks (Ding et al., 2021).

Control variables include firm size (SIZE), industry median leverage (INDLEV), industry long-term debt ratio (INDLTD), tax burden (TAX), and deleveraging level (DELEV). Industry leverage measures capture peer-driven financing norms in emerging markets (Grieser et al., 2022). DELEV accounts for heterogeneous adjustment following investment and macro shocks (Long et al., 2023; Vo et al., 2022). Firm size and adjustment frictions are included to control for differences in leverage adjustment capacity (Kim & Xie, 2023; Su & Zheng, 2025). These controls ensure that EXD reflects firm-specific excessive borrowing rather than industry-level patterns. Variable definitions, measurement methods, and data sources are reported in Table 1.

**Table 1. Variables.**

| Variables | Symbols | Definition | Sources |
|---|---|---|---|
| Risk-adjusted return | RET | Annual cumulative abnormal return (CAR) derived from the market model, representing market-based risk compensation beyond systematic risk exposure | CSMAR |
| Degree of Excessive Debt | EXD | Actual Leverage Ratio – Target Leverage Ratio | CSMAR |
| COVID-19 Indicator | COVID-19 | Dummy variable takes 0 before the epidemic and 1 during the epidemic | CSMAR |
| Natural logarithm of total assets (converted to USD) | SIZE | The log of total assets by converting to USD | CSMAR |
| Industry median leverage ratio | INDLEV | Industry median leverage ratio. | CSMAR |
| Profitability Volatility | PROVOL | EBIT/total assets | CSMAR |
| Cash Flow Volatility | CFVOL | Cash flow/total assets | CSMAR |
| Tax Burden | TAX | Total tax paid /Total taxable income | CSMAR |
| Firm Deleveraging Level | DELEV | (Book debt-to-asset ratio at the end of this period - Book debt-to-asset ratio at the end of the previous period) / Book debt-to-asset ratio at the end of the previous period | CSMAR |
| Industry median leverage ratio | INDLTD | (Total non-current liabilities) / (Total owners' equity + Total non-current liabilities) | CSMAR |

## RESULTS

Table 2 presents descriptive statistics for the main variables based on approximately 19,860 firm-year observations. Priced risk exposure exhibits substantial dispersion, indicating considerable cross-sectional and temporal variability. Excessive debt is centered near zero on average, suggesting that firms generally operate close to target leverage, although the wide range reflects notable heterogeneity. The COVID-19 indicator shows that more than half of the observations fall within the pandemic period. Firm size and industry leverage measures display stable distributions, while volatility proxies reveal right-skewness driven by extreme observations. Overall, the variables exhibit sufficient variation to support reliable regression analysis.

**Table 2. Descriptive statistics.**

| Variable | N | Mean | p50 | SD | Min | Max |
|---|---|---|---|---|---|---|
| RET | 19857 | 0.0350 | -0.0650 | 0.498 | -0.850 | 14.28 |
| EXD | 19861 | -0.00200 | -0.00500 | 0.155 | -0.650 | 0.768 |
| COVID-19 | 19861 | 0.553 | 1 | 0.497 | 0 | 1 |
| SIZE | 19860 | 8.820 | 8.735 | 0.577 | 6.864 | 11.58 |
| INDLEV | 19861 | 0.410 | 0.402 | 0.0960 | 0.219 | 0.728 |
| PROVOL | 19861 | 0.0400 | 0.0200 | 0.150 | 0 | 17.30 |
| CFVOL | 19861 | 0.0400 | 0.0300 | 0.0410 | 0 | 1.297 |
| TAX | 19861 | 0.0170 | 0.0120 | 0.0420 | -1.672 | 1.959 |
| DELEV | 19861 | 0.0850 | 0.0230 | 0.385 | -0.874 | 14.97 |
| INDLTD | 19857 | 0.175 | 0.161 | 0.108 | -2.296 | 0.680 |

Table 3 reports the Pearson correlation matrix for the main variables. The correlation between excessive debt (EXD) and risk-adjusted return (RET) is weakly positive and statistically significant ($r = 0.013$, $p < 0.1$), indicating that leverage deviations are only marginally associated with market-based risk compensation at the bivariate level. COVID-19 exposure is positively correlated with RET ($r = 0.149$, $p < 0.01$), suggesting that pandemic-period conditions are associated with higher abnormal returns. Firm size (SIZE) also shows a positive association with RET ($r = 0.032$, $p < 0.01$). Volatility measures (PROVOL and CFVOL) are significantly related to both EXD and RET, indicating that earnings instability is linked to leverage dynamics and priced risk exposure. Overall, the magnitude of pairwise correlations does not indicate serious multicollinearity concerns.

**Table 3. Correlation analysis.** Note: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

| Variable | RET | EXD | COVID-19 | SIZE | INDLEV | PROVOL | CFVOL | TAX | DELEV | INDLTD |
|---|---|---|---|---|---|---|---|---|---|---|
| RET | 1 | | | | | | | | | |
| EXD | 0.013* | 1 | | | | | | | | |
| COVID-19 | 0.149*** | 0.00300 | 1 | | | | | | | |
| SIZE | 0.032*** | -0.00200 | 0.028*** | 1 | | | | | | |
| INDLEV | -0.012* | 0.0110 | -0.015** | 0.333*** | 1 | | | | | |
| PROVOL | 0.00200 | 0.042*** | 0.031*** | -0.078*** | -0.036*** | 1 | | | | |
| CFVOL | 0.030*** | 0.119*** | 0.00400 | -0.051*** | 0.071*** | 0.134*** | 1 | | | |
| TAX | 0.050*** | -0.139*** | -0.062*** | 0.051*** | 0.085*** | -0.017** | 0.012* | 1 | | |
| DELEV | -0.027*** | 0.137*** | -0.018** | -0.138*** | -0.059*** | 0.055*** | -0.00300 | -0.017** | 1 | |
| INDLTD | -0.020*** | 0.023*** | 0.033*** | 0.310*** | 0.614*** | -0.026*** | 0.048*** | 0.081*** | -0.038*** | 1 |

Table 4 reports the results of pooled OLS, fixed-effects, and random-effects estimations. Although the Hausman test reports Prob > chi2 = 0.0000, indicating that the fixed-effects model is preferred over the random-effects model, this study retains pooled OLS as the baseline specification for theoretical and empirical reasons. The main objective of this article is to examine the cross-sectional market pricing of excessive debt, namely, whether firms with greater deviations


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from target leverage are associated with higher risk-adjusted returns. Since excessive debt reflects a relatively persistent firm-level capital structure condition, much of its explanatory variation exists across firms rather than within the same firm over time. Pooled OLS is therefore appropriate for capturing the average cross-sectional relationship between excessive debt and priced risk exposure. The OLS results show that the coefficient of EXD is positive and statistically significant at the 1% level, suggesting that over-leveraged firms tend to exhibit higher market-based risk compensation. In contrast, the fixed-effects coefficient remains positive but becomes statistically insignificant, which indicates that the leverage-risk pricing relationship is mainly driven by differences across firms rather than short-term within-firm changes. Therefore, the fixed-effects model is reported as a robustness check controlling for unobserved firm-specific heterogeneity, while the random-effects result is interpreted only as supplementary evidence. This approach avoids treating pooled OLS estimates as strict causal evidence and instead interprets them as evidence of cross-sectional risk pricing under systemic shock.

**Table 4. Model selection.** Note: Standard errors in parentheses. $^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

| Variable | RET(ols) | RET(fe) | RET(re) |
|---|---|---|---|
| EXD | 0.072*** | 0.069 | 0.072*** |
| | (0.023) | (0.053) | (0.023) |
| COVID-19 | 0.152*** | 0.234*** | 0.152*** |
| | (0.007) | (0.009) | (0.007) |
| SIZE | 0.032*** | -0.552*** | 0.032*** |
| | (0.007) | (0.032) | (0.007) |
| INDLEV | -0.037 | 1.532*** | -0.037 |
| | (0.047) | (0.158) | (0.047) |
| PROVOL | -0.011 | 0.004 | -0.011 |
| | (0.024) | (0.031) | (0.024) |
| CFVOL | 0.365*** | 0.401*** | 0.365*** |
| | (0.087) | (0.134) | (0.087) |
| TAX | 0.765*** | 0.549*** | 0.765*** |
| | (0.085) | (0.112) | (0.085) |
| DELEV | -0.029*** | -0.055*** | -0.029*** |
| | (0.009) | (0.011) | (0.009) |
| INDLTD | -0.185*** | -0.325*** | -0.185*** |
| | (0.041) | (0.069) | (0.041) |
| cons | -0.313*** | 4.181*** | -0.313*** |
| | (0.056) | (0.284) | (0.056) |
| N | 19852.000 | 19852.000 | 19852.000 |
| r2 | 0.030 | 0.056 | |
| r2_a | 0.029 | -0.206 | |
| hausman | | Prob > chi2 = 0.0000 | |

Table 5 reports the results of the moderating analysis and additional channel specifications. In the baseline regression, excessive debt (EXD) is positively and significantly associated with risk-adjusted return (RET) ($\beta = 0.072$, $p < 0.01$), indicating that higher leverage deviations are linked to greater market-based risk compensation. When the interaction term (EXD × COVID-19) is introduced, it is positive and statistically significant ($\beta = 0.174$, $p < 0.01$), suggesting that the impact of excessive debt on priced risk exposure becomes stronger during the pandemic period. The main effect of EXD becomes insignificant in the interaction model, implying that the pricing of leverage-related risk is conditional on crisis conditions. The additional specification provides complementary evidence regarding the crisis-related transmission channel. COVID-19 remains significantly associated with RET, while EXD retains its positive association in the return equation. These results should be interpreted as supportive evidence rather than a formal mediation test. Control variables remain largely stable across specifications. CFVOL and TAX consistently exhibit positive and significant coefficients, whereas DELEV and INDLTD remain significantly negative. The explanatory power ($R^2 \approx 0.03$) is consistent with typical firm-level return regressions. Overall, the findings support a significant moderating role of COVID-19 in amplifying leverage-related risk pricing.

**Table 5. Moderating effect and additional channel specification.** Note: Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01.

| | Moderating Effect | | Additional Channel Specification | | |
|---|---|---|---|---|---|
| **Variable** | **RET** | **RET(Int.)** | **RET** | **COVID-19** | **RET** |
| EXD | 0.072*** | -0.026 | 0.069*** | -0.021 | 0.072*** |
| | (0.023) | (0.034) | (0.023) | (0.023) | (0.023) |
| COVID-19 | 0.152*** | 0.153*** | | | 0.152*** |
| | (0.007) | (0.007) | | | (0.007) |
| SIZE | 0.032*** | 0.033*** | 0.037*** | 0.028*** | 0.032*** |
| | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) |
| INDLEV | -0.037 | -0.036 | -0.084* | -0.311*** | -0.037 |
| | (0.047) | (0.047) | (0.047) | (0.047) | (0.047) |
| PROVOL | -0.011 | -0.013 | 0.006 | 0.108*** | -0.011 |
| | (0.024) | (0.024) | (0.024) | (0.024) | (0.024) |
| CFVOL | 0.365*** | 0.372*** | 0.373*** | 0.047 | 0.365*** |
| | (0.087) | (0.087) | (0.088) | (0.088) | (0.087) |
| TAX | 0.765*** | 0.764*** | 0.647*** | -0.773*** | 0.765*** |
| | (0.085) | (0.085) | (0.086) | (0.086) | (0.085) |
| DELEV | -0.029*** | -0.027*** | -0.032*** | -0.021** | -0.029*** |
| | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) |
| INDLTD | -0.185*** | -0.185*** | -0.139*** | 0.303*** | -0.185*** |
| | (0.041) | (0.041) | (0.042) | (0.042) | (0.041) |
| EXD*COVID-19 | | 0.174*** | | | |
| | | (0.045) | | | |
| cons | -0.313*** | -0.315*** | -0.253*** | 0.392*** | -0.313*** |
| | (0.056) | (0.056) | (0.057) | (0.056) | (0.056) |
| N | 19852.000 | 19852.000 | 19852.000 | 19856.000 | 19852.000 |
| r2 | 0.030 | 0.030 | 0.007 | 0.009 | 0.030 |
| r2_a | 0.029 | 0.030 | 0.006 | 0.009 | 0.029 |

To further assess the robustness of the baseline results, Table 6 reports estimations using the Z-score as an alternative proxy for financial stability. Since lower Z-scores indicate higher distress risk, negative coefficients imply increased financial vulnerability. Across all specifications, leverage-related variables remain significantly negative. The alternative leverage ratio (ALR), bank borrowing ratio (BBR), and short-term borrowing ratio (SBR) all exhibit strong negative effects on the Z-score, confirming that higher debt dependence—particularly short-term borrowing—reduces financial stability. The COVID-19 coefficient is consistently positive and significant, while control variables largely retain stable signs. The explanatory power ranges from 0.125 to 0.196, which is acceptable for firm-level distress regressions. Overall, the findings remain robust and reinforce the conclusion that excessive leverage increases financial risk.

**Table 6. Robustness check.** Note: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

| **Variable** | **Z-score** | **Z-score** | **Z-score** |
|---|---|---|---|
| ALR | -17.628*** | | |
| | (0.331) | | |
| COVID-19 | 0.735*** | 0.601*** | 0.522*** |
| | (0.108) | (0.113) | (0.113) |
| SIZE | -0.703*** | -2.067*** | -2.631*** |
| | (0.111) | (0.110) | (0.107) |
| INDLEV | 2.572*** | -6.086*** | -6.565*** |
| | (0.738) | (0.750) | (0.751) |
| PROVOL | -0.107 | -0.748** | -0.872** |
| | (0.362) | (0.377) | (0.377) |

*(continued on next page)*


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**Table 6.** Continued.

| Variable | Z-score | Z-score | Z-score |
|---|---|---|---|
| CFVOL | 9.323*** | 3.027** | 4.639*** |
| | (1.333) | (1.380) | (1.386) |
| TAX | 8.040*** | 16.696*** | 15.326*** |
| | (1.322) | (1.358) | (1.368) |
| DELEV | -0.662*** | -1.163*** | -1.303*** |
| | (0.141) | (0.146) | (0.146) |
| INDLTD | -1.464** | 0.837 | -2.020*** |
| | (0.637) | (0.671) | (0.664) |
| BBR | | -14.783*** | |
| | | (0.452) | |
| SBR | | | -18.493*** |
| | | | (0.588) |
| _cons | 16.857*** | 26.976*** | 32.275*** |
| | (0.927) | (0.931) | (0.902) |
| N | 19856.000 | 19856.000 | 19856.000 |
| r2 | 0.196 | 0.128 | 0.125 |
| r2_a | 0.196 | 0.128 | 0.125 |

To address potential endogeneity concerns, instrumental variable (IV) estimations are conducted, and the results are reported in Table 7. Industry-level long-term debt ratio (INDLTDTA) and industry current liability ratio (INDCURR) are employed as instruments for excessive debt (EXD), given their relevance to firm-level leverage decisions while being plausibly exogenous to individual firm-level abnormal return dynamics. The baseline OLS regression confirms that excessive debt is positively and significantly associated with risk-adjusted return ($\beta$=0.072, $p$<0.01). In the IV specifications, although the magnitude of the EXD coefficient changes, the overall inference remains qualitatively consistent. The coefficients of COVID-19 remain positive and statistically significant across all models, indicating that pandemic-period effects are robust to alternative estimation strategies.

The overidentification tests yield high p-values (Prob>chi²=0.9930 and 0.9996), suggesting that the instruments are valid and not correlated with the error term. Control variables largely retain stable signs and significance levels. Overall, the IV results provide no evidence that endogeneity materially biases the baseline findings, supporting the robustness of the relationship between excessive debt and risk-adjusted returns. In addition, first-stage statistics (not tabulated) indicate that the instruments exhibit sufficient explanatory power for excessive debt, alleviating concerns regarding weak instrument bias.

**Table 7. Endogeneity test.** Note: Standard errors in parentheses. $^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

| Variable | RET | | RET(iv) | Variable | RET(iv) |
|---|---|---|---|---|---|
| EXD | 0.072*** | INDLTDTA | 1.653 | INDCURR | 0.345 |
| | (0.023) | | (1.148) | | (0.290) |
| COVID-19 | 0.152*** | COVID-19 | 0.155*** | COVID-19 | 0.153*** |
| | (0.007) | | (0.008) | | (0.007) |
| SIZE | 0.032*** | SIZE | 0.022** | SIZE | 0.031*** |
| | (0.007) | | (0.010) | | (0.007) |
| INDLEV | -0.037 | INDLEV | -0.028 | INDLEV | -0.035 |
| | (0.047) | | (0.053) | | (0.047) |
| PROVOL | -0.011 | PROVOL | -0.042 | PROVOL | -0.016 |
| | (0.024) | | (0.035) | | (0.024) |
| CFVOL | 0.365*** | CFVOL | -0.350 | CFVOL | 0.241 |
| | (0.087) | | (0.528) | | (0.157) |
| TAX | 0.765*** | TAX | 1.598*** | TAX | 0.909*** |
| | (0.085) | | (0.612) | | (0.175) |

*(continued on next page)*

**Table 7.** Continued.

| Variable | RET | | RET(iv) | Variable | RET(iv) |
|---|---|---|---|---|---|
| DELEV | -0.029*** | DELEV | -0.117* | DELEV | -0.044** |
| | (0.009) | | (0.065) | | (0.019) |
| INDLTD | -0.185*** | INDLTD | -0.254*** | INDLTD | -0.197*** |
| | (0.041) | | (0.068) | | (0.043) |
| cons | -0.313*** | cons | -0.191* | cons | -0.292*** |
| | (0.056) | | (0.108) | | (0.060) |
| N | 19852.000 | N | 19852.000 | N | 19852.000 |
| r2 | 0.030 | | . | r2 | 0.023 |
| r2_a | 0.029 | | . | r2_a | 0.022 |
| | | Prob > chi2 = 0.9930 | | Prob > chi2 = 0.9996 | |

Taken together, Tables 4–7 reveal three stable empirical patterns. First, excessive debt is positively priced by the market in the cross-section, as indicated by the positive EXD coefficient in the pooled OLS and random-effects estimations. Second, the positive and significant interaction term EXD × COVID-19 shows that the pandemic strengthened the premium attached to leverage deviations from target levels. Third, the robustness and instrumental-variable estimations suggest that this inference is not driven solely by a single leverage proxy or by obvious endogeneity. Accordingly, the empirical evidence consistently supports H2 and H3 and provides supportive evidence for H1 that COVID-19 was associated with greater leverage pressure.

## DISCUSSION

The scientific novelty of this article lies in linking excessive debt, measured as the deviation from target leverage, to priced risk exposure under a systemic shock. Much of the COVID-19 corporate finance literature documents that firms with greater liquidity buffers or stronger financial flexibility performed better during the pandemic (Ding et al., 2021; Fahlenbrach et al., 2021). Those studies are important, but they generally do not distinguish between firms that simply carry debt and firms that have moved materially beyond their sustainable leverage level. This article advances the literature by showing that the distance from target leverage contains additional explanatory power for crisis-period vulnerability.

The article also offers a clearer interpretation of return-based evidence than several related studies. Some research may read higher returns during crisis periods as a sign of superior adaptation or resilience. The present findings call for a more cautious interpretation. Because excessive debt is associated with higher cumulative abnormal return, while alternative Z-score specifications simultaneously indicate weaker financial stability, the most coherent reading is that markets priced a higher risk premium rather than stronger operating quality. In this sense, the article argues against a purely performance-based reading of crisis-period abnormal returns and contributes a market-pricing perspective to the debate.

A further contribution is theoretical. Trade-off Theory implies that debt is valuable only until expected distress costs begin to dominate tax benefits, while Pecking Order Theory explains why firms under cash-flow pressure may continue borrowing when internal funds fall. The evidence in this study shows that both mechanisms operated during COVID-19: firms borrowed more under stress, but once leverage exceeded target levels, the market treated that borrowing as a sign of fragility. This refines prior arguments that crisis borrowing is uniformly value-preserving by demonstrating an identifiable boundary condition - the sustainability of leverage relative to its target level.

Finally, the article contributes new evidence from China, where bank-dominated financing, rapid credit expansion, and adjustment frictions make leverage deviations especially relevant. Compared with evidence from mature markets, the Chinese context allows the study to show more clearly how crisis conditions interact with persistent over-leverage. Therefore, the paper contributes to the broader capital structure literature by identifying excessive debt as a mechanism through which systemic shocks intensify firm-level risk pricing and financial vulnerability.

## CONCLUSIONS

This study examines the impact of excessive leverage on corporate priced risk exposure among Chinese listed firms during the COVID-19 pandemic. Using panel data from 2017 to 2022, the pandemic is treated as a quasi-natural experiment to explore how systemic shocks interact with firm-level capital structure decisions. By defining excessive debt as the deviation


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from target leverage rather than relying solely on absolute leverage levels, this research provides a refined perspective on financial fragility under crisis conditions.

The empirical findings indicate that COVID-19 significantly increased excessive leverage among Chinese firms, particularly during periods of severe revenue contraction and liquidity stress. Firms operating above their industry-adjusted target leverage levels exhibited higher market-based risk compensation and greater financial vulnerability, as evidenced by both abnormal return dynamics and distress-based robustness measures. Moreover, the moderating analysis shows that the pandemic amplified the adverse impact of excessive debt on priced risk exposure. These results suggest that leverage-related risk is not static but becomes substantially more pronounced when external uncertainty intensifies. In this context, excessive debt functions as a transmission channel through which systemic shocks magnify firm-level instability. Importantly, the positive relationship between excessive leverage and risk-adjusted return reflects higher market-based risk compensation rather than superior firm performance. By interpreting abnormal returns as evidence of priced financial vulnerability, the study highlights that leverage-related risk becomes significantly amplified under systemic shocks.

This study contributes to the capital structure literature in several ways. First, it provides additional empirical evidence for the Trade-off and Pecking Order theories by emphasizing dynamic deviations from optimal leverage under systemic shocks. Second, it provides crisis-period evidence from an emerging market characterized by bank-dominated financing structures and rapid credit expansion. Third, it highlights the conditional nature of leverage risk, demonstrating that the interaction between excessive debt and macroeconomic shocks is central to understanding corporate resilience.

From a practical perspective, the findings underscore the importance of maintaining capital structure flexibility and prudent leverage management during periods of extreme uncertainty. Policymakers should consider strengthening monitoring mechanisms that focus on leverage deviations rather than aggregate debt levels alone. Early identification of excessive borrowing may help mitigate systemic risk spillovers. In addition, enhancing firms' financial flexibility and supporting investment continuity during economic disruptions can reduce the amplification effect of leverage-induced fragility.

Despite its contributions, this study is subject to certain limitations. The analysis focuses on Chinese listed firms and may not fully capture dynamics in other institutional contexts. Future research may extend the framework to cross-country comparisons or examine alternative measures of financial vulnerability. Overall, the evidence demonstrates that excessive leverage acts as a structural risk amplifier during systemic crises, reinforcing the importance of sustainable capital structure management in emerging markets.

## ADDITIONAL INFORMATION

### AUTHOR CONTRIBUTIONS

*All authors have contributed equally.*

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### CONFLICT OF INTEREST

*The Authors declare that there is no conflict of interest.*

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## НАДМІРНИЙ БОРГ І РИЗИК ОЦІНКИ ПІД СИСТЕМНИМ ШОКОМ: ДАНІ ВІД КИТАЙСЬКИХ КОМПАНІЙ, ЩО КОТИРУВАЛИСЯ ПІД ЧАС COVID-19 АНОТАЦІЯ

Це дослідження вивчає, чи пов'язаний надмірний борг, визначений як позитивне відхилення від цільового рівня левереджу, з фінансовою вразливістю, що відображається в ринкових цінах, під час кризи, спричиненої COVID-19. Використовуючи панельні дані щодо нефінансових компаній і компаній, що не належать до сектора комунальних послуг, які котируються на китайському ринку акцій категорії «А» за період із 2017 по 2022 рік, дослідження розглядає пандемію як екзогенний системний шок, що призвів до зростання невизначеності щодо грошових потоків, тиску з боку рефінансування та витрат на коригування структури капіталу. Надмірний борг (EXD) вимірюється як фактичний балансовий левередж мінус цільовий левередж. Позитивні значення вказують на те, що компанія працює вище за свій показник стійкого левереджу. Ризик, оцінений за ринковою вартістю, замінюється річним кумулятивним аномальним доходом (CAR), розрахованим за ринковою моделлю. CAR обережно інтерпретується як ринковий показник необхідної компенсації за специфічну вразливість компанії, а не як прямий показник операційних результатів. Емпіричні результати показують, що COVID-19 позитивно пов’язаний із прибутковістю, скоригованою на ризик, а надмірний борг позитивно пов’язаний із CAR у базовій моделі. Що ще важливіше, взаємодія між EXD та COVID-19 є позитивною й значущою, що вказує на те, що пандемія посилила ринкове цінування вразливості, пов’язаної з левереджем. Тести на стійкість із використанням альтернативних боргових проксі та Z-score Альтмана підтверджують, що залежність від боргу послаблює фінансову стабільність. Тести з інструментальними змінними та додаткові специфікації зменшують занепокоєння, що отримані результати зумовлені виключно зворотним причинно-наслідковим зв’язком або пропущеними характеристиками компаній. Дослідження робить внесок у вивчення структури капіталу в кризовий період, показуючи, що саме відстань від цільового рівня левериджу, а не сам рівень левериджу є релевантним каналом, через який системні шоки трансформуються у вразливість, що цінується ринком. . Воно також пояснює, що вищі аномальні доходи серед компаній із надмірним левериджем не слід тлумачити як вищі результати діяльності; скоріше, вони відповідають вищим необхідним доходам, яких вимагають інвестори за прийняття ризику, пов’язаного з левериджем. Результати мають практичне значення для менеджерів, інвесторів і регуляторів, оскільки підтримують системи раннього попередження, засновані на розривах у левериджі, тиску строків погашення боргу, спроможності генерувати грошові потоки та порогових значеннях боргу, скоригованих на галузь.

**Ключові слова:** надмірна заборгованість, цільовий рівень левереджу, оцінка ризику, прибутковість з урахуванням ризику, COVID-19, структура капіталу, фінансова вразливість; китайські компанії, що котируються на біржі

**JEL Класифікація:** E32, G32, I18, M12