

COVID-19, Supply Chain Finance and the Speed of Leverage Adjustment: Evidence from Chinese Listed Firms

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How to cite this paper: Xie, L. X., Wang, J. J., & Xu, L. M. (2026). COVID-19, Supply Chain Finance and the Speed of Leverage Adjustment: Evidence from Chinese Listed Firms. *American Journal of Industrial and Business Management*, 16, 1474-1487. <https://doi.org/10.4236/ajibm.2026.1610071>

Received: September 29, 2026

Accepted: October 18, 2026

Published: October 21, 2026

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Abstract

This paper investigates the impact of the COVID-19 pandemic on the speed of corporate leverage adjustment, with a particular focus on the moderating role of supply chain finance (SCF), using a sample of Chinese A-share listed firms from 2016 to 2022. Employing a standard partial adjustment model, it finds that COVID-19 significantly slows down the speed of leverage adjustment, and this inhibitory effect is more pronounced for underleveraged firms than for overleveraged firms. Moreover, SCF effectively mitigates the negative impact of the pandemic, with a much greater mitigating effect for underleveraged firms than for overleveraged firms. Our findings remain robust after addressing endogeneity and random factor concerns. This study provides new evidence on the economic consequences of COVID-19 from a capital structure dynamics perspective, and offers practical insights for SCF development and corporate capital structure optimization amid external shocks.

Keywords

COVID-19, Capital Structure, Leverage Adjustment, Supply Chain Finance, Dynamic Capital Structure

1. Introduction

The outbreak of the COVID-19 pandemic has caused unprecedented systemic shocks to the global economy (Zhang et al., 2020), attracting widespread scholarly attention. Recent literature has conducted in-depth research on the economic consequences of the COVID pandemic, such as stock returns (Bansal et al., 2022; Albuquerque et al., 2020), international marketing strategies (Behl et al., 2023), government support (Telg et al., 2023), digital innovation (Klößner et al., 2023;

Zheng et al., 2024), CSR performance (Albuquerque et al., 2020; Ding et al., 2021), and financial performance (Klößner et al., 2023; Xie, 2025; Xie, 2026).

The extant studies on the relationship between COVID-19 and financial performance mainly involve financial distress (Archanskaia et al., 2023; Leng & Sun, 2024; Xie, 2026), financing constraints (Xie, 2025), corporate earnings management (Aljughaiman et al., 2023), and financial leverage adjustment (Vo et al., 2022; Rehman et al., 2024). Capital structure adjustment is a crucial issue in capital structure decisions. The dynamic capital structure theory indicates that firms have a target leverage to realize their maximum market value. Various reasons, especially systemic or specific shocks, cause companies to deviate from their target. But enterprises will ultimately adjust their capital structure in a timely manner to reach the target level (Flannery & Rangan, 2006). Therefore, it is interesting and important to investigate how the speed of corporate leverage adjustment changes under the impact of the COVID-19 pandemic. However, to the best of our knowledge, besides Vo et al. (2022), who explore the impact of COVID-19 on the speed of leverage adjustment using an international sample, and Rehman et al. (2024), who examine the differential influence of COVID-19 and further explore the mechanism using American stock market data, there are few papers focusing on this topic. In this paper, we attempt to investigate the relationship between COVID and the leverage adjustment rate from the perspective of supply chain finance (hereafter, SCF).

It is well known that the impact of COVID-19 has fully exposed the fragility of industrial chains and magnified the financing difficulties of small and medium-sized enterprises (SMEs) in China. Luckily, SCF is a key tool that can simultaneously address these two pain points. Firstly, it can help core enterprises stabilize upstream and downstream cooperation relationships by activating the flow of funds in the industrial chain, enhancing the resilience of industrial and supply chains. In addition, supply chain finance relies on the credit of core enterprises and transaction data to provide financing for SMEs in the chain, effectively alleviating their financing constraints due to a lack of collateral (Lou et al., 2024). Moreover, as a new financing tool, it extends individual credit to transaction credit, improves financing accessibility, and reduces the financing costs of enterprises in the supply chain, inevitably affecting the company's capital structure and the speed of adjustment toward the target leverage. Then, whether SCF affects the speed of leverage adjustment during the pandemic and what is the direction? In this paper, therefore, we not only explore the effect of COVID on the rate of leverage adjustment, but also further analyze the role of SCF in this causal relation using a partial-adjustment model and Chinese listed firm data.

This paper may contribute to the literature in three ways. First, it adds to the existing literature on the relation between the COVID-19 pandemic and financial performance (Vo et al., 2022; Aljughaiman et al., 2023; Rehman et al., 2024; Xie, 2025, 2026) by studying the change of leverage adjustment speed under the influence of COVID-19. Second, unlike the extant literature, this paper introduces SCF as a novel contextual factor in the causal relation between COVID and the capital

structure adjustment. The extant literature has established a relation between the rate of leverage adjustment and firm- and sector-specific characteristics (Strebulaev, 2007; Rehman et al., 2024; Abdullah et al., 2023; Ke et al., 2026). As an emerging financing method, it is particularly important to establish the connection between SCF and capital structure decisions and demonstrate how it shapes firms' capital structure decisions under external shocks. Third, this paper adds empirical evidence to the work of Rehman et al. (2024) by demonstrating that the sudden shock caused by COVID-19 has an asymmetric negative effect on the speed of capital structure adjustment.

The remainder of this study is arranged as follows. Section 2 presents the research design, including the data source, sample selection and model design. Section 3 analyzes the empirical results; Section 4 conducts robustness tests using the GMM method and placebo test, and Section 5 draws a simple conclusion.

2. Research Design

2.1. Model Design

To test the influence of COVID-19 on the speed of corporate capital structure adjustment, following Flannery and Rangan (2006), Çolak et al. (2018), and Rehman et al. (2024), we use the classical partial adjustment model to estimate how quickly companies converge towards their target leverage ratio. The model is expressed as follows:

$$Lev_{i,t} - Lev_{i,t-1} = v(Lev_{i,t}^* - Lev_{i,t-1}) + F_i + \tau_t + \varepsilon_{i,t} \quad (1)$$

where $Lev_{i,t}^*$ is the target leverage ratio of firm i at year t , while $Lev_{i,t}$ refers to the book leverage ratio of firm i at year t . v denotes the leverage adjustment speed, measuring the percentage of the deviation from the target level that firms offset within a year. f_i and $year_t$ represent firm and time fixed effects, respectively. $\varepsilon_{i,t}$ is a residual term.

We rearrange Equation (1) as follows:

$$Lev_{i,t} = vLev_{i,t}^* + (1-v)Lev_{i,t-1} + F_i + \tau_t + \varepsilon_{i,t} \quad (2)$$

We construct a multivariable regression model to estimate the target leverage, expressed as:

$$Lev_{i,t} = \lambda X_{i,t-1} + f_i + \tau_t + \varepsilon_{i,t} \quad (3)$$

Because the target leverage is unobservable, the fitted value of Equation (3) is used as an indicator to measure the target, which is expressed as Equation (4).

$$Lev_{i,t}^* = \lambda X_{i,t-1} \quad (4)$$

where $X_{i,t}$ is a matrix of control variables affecting financial leverage choices. Among the control variables, we use the level of supply chain finance (SCF). Following Lou et al. (2024), we measure it by the ratio of the sum of short-term loans, notes payable and accounts receivable to total assets, because as a novel financing method, SCF may affect the speed of leverage adjustment by alleviating financial constraints. As an essential factor in leverage decisions, firm size (Size) is also in-

cluded. We consider enterprises' profitability (ROA) because firms' leverage has a negative connection with their profitability when their debt exceeds the optimal level (Zhou et al., 2016). Asset tangibility (Tang) denotes the ratio of net fixed assets to total assets; enterprises with more fixed assets possess higher credit and better access to financing in the financial market (Devos et al., 2017). Finally, growth potential (Growth), which is the growth rate of total operating revenue over total assets, the non-debt tax shield ratio (Dep), and the median of industry leverage (Median) are all controlled. Specific definitions of these main variables are presented in **Table 1**.

With Equation (4) submitted into Equation (2), the final partial-adjustment model is constructed as follows:

$$Lev_{i,t} = \lambda X_{i,t-1} + (1-\nu) Lev_{i,t-1} + F_i + \tau_t + \varepsilon_{i,t} \quad (5)$$

Our focus is the coefficient of $Lev_{i,t-1}$, because subtracting it from 1 yields the speed of leverage adjustment (SOA).

Table 1. Definitions of variables.

Variables	Descriptions	Definitions
Lev	Book leverage ratio	Sum of long- and short-term debt divided by the total book assets.
Lev*	Target leverage ratio	The optimal leverage ratio firms pursuing to realize their maximum market value. It's estimated according to Equation (4).
SOA	Speed of leverage adjustment	The adjustment speed of a company toward target level, measuring by the percentage of the deviation between target level and current leverage that firms offset during a certain period.
SCF	Supply chain finance	Used to measure the level of SCF. Computing formula is (short term loans + notes payable + accounts receivable)/total book assets.
Size	Firm size	The natural logarithm of the total book assets
ROA	Operating profitability	Earnings before interest, taxes, depreciation, and amortization divided by the total book assets.
Growth	Total revenue growth	(Total Operating Revenue in the Current Period—Total Operating Revenue in the Prior Period)/Total Operating Revenue in the Prior Period
Tang	Asset tangibility	The ratio of net fixed assets to total book assets.
Dep	Non-debt tax shields	The ratio of depreciation and amortization of fixed assets over the total book assets
MIL	Median industry leverage	Median leverage ratio across firms in the same industry

2.2. Data Source and Sample Selection

All sample companies are A-share firms listed on the Shanghai and Shenzhen

Stock Exchanges. The sample period covers 2016 to 2022, with 2016-2019 defined as the pre-COVID period and 2020-2022 as the during-COVID period. All data used in this paper are obtained from the CSMAR database.

The data are processed as follows: (1) firms in the financial industry and in the information transmission, software, and information technology service industry are removed, because these industries primarily provide financing services and information technology for SCF; (2) firms with debt ratios greater than 1 or less than 0 are excluded; (3) ST and *ST firms are deleted; (4) firms with fewer than seven observations for key variables are dropped; (5) all continuous variables are winsorized at the 1% level in both tails to avoid the influence of extreme values on the scientific validity of the empirical results.

3. Empirical Result Analysis

3.1. Descriptive Statistics

Table 2 presents the descriptive statistics of main variables. As shown, only the leverage ratio (Lev) and firm size (Size) increased significantly during the COVID-19 period compared with the pre-COVID period. In contrast, other variables, such as SCF, ROA, Growth, and Tang, all declined considerably. This suggests that production and business operations were severely damaged, resulting in lower revenue. The change in SCF is particularly noteworthy. During COVID-19, many policies were introduced in China to encourage the development of SCF. In practice, however, the level of SCF decreased. During the pandemic, supply chains were disrupted, undermining the real transaction background and closed-loop risk control on which SCF depends. At the same time, banks actively contracted their business because of declining profits and rising costs. These factors may explain the decline in SCF during the epidemic.

Table 2. Descriptive statistics.

Variable	Pre-COVID			During-COVID			Diff
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	
	(1)	(2)	(3)	(4)	(5)	(6)	(5)-(2)
Lev	3588	0.509	0.17	2691	0.535	0.162	0.026***
SCF	3588	0.321	0.16	2691	0.303	0.153	-0.018***
Size	3588	22.999	1.295	2691	23.317	1.304	0.318***
ROA	3588	0.032	0.042	2691	0.023	0.06	-0.009***
Growth	3588	0.195	0.329	2691	0.116	0.301	-0.079***
Tang	3588	0.222	0.152	2691	0.214	0.147	-0.008*
Dep	3588	0.021	0.014	2691	0.021	0.013	-0.000
MIL	3588	0.489	0.093	2691	0.488	0.093	-0.001

***, **, and * represent rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively. The same applies to the tables below.

3.2. Effect of COVID-19 on Leverage Adjustment Speed

We first conduct regressions based on Equation (5) for the full, pre-COVID and during-COVID samples separately. The regression results are reported in **Table 3**. As shown, the coefficients of $Lev_{i,t-1}$ are both positive and significant at the 1% level. The SOA during COVID-19 (71.190%) is lower than that in the pre-pandemic period (83.900%). To examine whether the difference in the $Lev_{i,t-1}$ coefficient between columns (1) and (2) is significant, we manually compute the Z-statistic for the coefficients of $Lev_{i,t-1}$ across the two regressions, and the result is presented at the end of the table. The Z-statistic is 3.026, indicating that the difference in the $Lev_{i,t-1}$ coefficient between the two columns is statistically significant. These findings suggest that the COVID-19 pandemic slowed down the speed of leverage adjustment, which is consistent with [Rehman et al. \(2024\)](#).

In addition, we note that the coefficient of SCF is significantly positive at the 1% level, suggesting that SCF is one of the determinants of capital structure decisions.

Table 3. The speed of leverage adjustment before and during COVID-19.

	Pre-COVID	During-COVID
	(2)	(3)
L.Lev	0.16100*** (0.01534)	0.28810*** (0.02018)
SOA	83.900%	71.190%
SCF	0.34313*** (0.01804)	0.28754*** (0.02053)
Size	0.11907*** (0.00624)	0.06063*** (0.00658)
ROA	−0.47028*** (0.02689)	−0.53512*** (0.02633)
Growth	0.01175*** (0.00315)	0.02482*** (0.00392)
Tang	0.07859** (0.02726)	0.05957* (0.02981)
Dep	−0.78532*** (0.23765)	−1.43839*** (0.27611)
MIL	−0.11434 (0.05993)	0.00312 (0.08762)
_cons	−2.35734*** (0.14922)	−1.09343*** (0.16060)
Firm FE	YES	YES
Year FE	YES	YES

Continued

N	2691	2691
Adjusted R ²	0.95155	0.93774
$\Delta\text{Coef}(Lev_{i,t-1})$	12.710*** (34.727)	

Note: The parentheses indicate robust standard errors, besides the value at the end table is the Z-statistics. The same applies to the tables below.

3.3. Asymmetric Effect of COVID on Leverage Adjustment Speed

The literature shows that leverage adjustment speeds are asymmetric between overleveraged and underleveraged firms, with overleveraged firms tending to adjust faster than underleveraged firms (Byoun, 2008; Faulkender et al., 2012). Dang et al. (2014) and Rehman et al. (2024) find that the uncertainty caused by sudden shocks, such as the 2008 financial crisis and COVID-19, significantly reduces the capital structure adjustment speed of leveraged firms.

In this section, the entire sample is divided into overleveraged and underleveraged firms. We define the difference between target leverage and actual leverage as the deviation of actual leverage from the target level. Firms with a deviation greater than 0 are classified as overleveraged, while those with a deviation less than 0 are classified as underleveraged. The split-sample results are reported in Table 4. It can be seen that all coefficients of $Lev_{i,t-1}$ are significantly positive at the 1% level. The leverage adjustment speed of overleveraged firms is higher than that of underleveraged firms for pre- and during-COVID periods, respectively, which is consistent with Byoun (2008) and Faulkender et al. (2012).

Importantly, for underleveraged firms, the leverage adjustment speed decreases from 78.547% in the pre-COVID period to 59.931% during the pandemic, a decline of 18.616%. As the method in Section 3.2, we also manually compute the Z-statistics to test whether the difference in the coefficient of $Lev_{i,t-1}$ between columns (1) and (2) is significant. The results at the bottom of the table indicate that the coefficient difference is significant. Similarly, for overleveraged firms, the adjustment speed decreases significantly by 13.039%. These results suggest that underleveraged firms seeking to add leverage are more severely affected by the COVID epidemic than overleveraged firms in terms of capital structure adjustment speed.

Table 4. Asymmetric leverage adjustment speed (underleveraged versus overleveraged firms).

	Underleveraged		Overleveraged	
	(1)	(2)	(3)	(4)
	Pre-COVID	During-COVID	Pre-COVID	During-COVID
	LEV	LEV	LEV	LEV
L.Lev	0.21453*** (0.03074)	0.40069*** (0.03751)	0.20122*** (0.02394)	0.33261*** (0.03132)

Continued

SOA	78.547%	59.931%	79.878%	66.739%
SCF	0.26876*** (0.02747)	0.22580*** (0.02950)	0.36278*** (0.02595)	0.38248*** (0.03223)
_cons	-0.91901*** (0.23078)	-0.75438** (0.27333)	(0.20481) -3.64347***	-1.88506*** (0.25029)
Controls	YES	YES	YES	YES
Firm FE	NO	YES	YES	YES
Year FE	NO	YES	YES	YES
N	1058	1177	1401	1302
Adjusted R ²	0.90322	0.88683	0.95349	0.94264
$\Delta\text{coef}(Lev_{i,t-1})$	18.616%*** (23.850)		13.139%*** (20.485)	

Note: The fixed effect requires at least two observations per firm; otherwise, the firm is omitted. Since some firms have fewer than two observations after grouping, the total number of observations before and during COVID in this table is smaller than the 2691 reported in **Table 3**. The same applies to the tables below.

3.4. Further Analysis

In this section, we attempt to explore the asymmetric effect identified in Section 3.3 from the perspective of SCF. For underleveraged companies, the objective is to increase leverage, and SCF may directly raise the debt ratio through new loans, bill financing, or other debt arrangements. For overleveraged companies, the goal is to deleverage, and SCF may indirectly reduce short-term debt repayment pressure through accounts receivable realization, cash flow improvement, and debt replacement. Therefore, we conjecture that SCF promotes corporate capital structure adjustment and alleviates the negative impact of COVID-19 on leverage adjustment speed for both under- and over-leveraged firms.

We divide the underleveraged and overleveraged firms into two groups, respectively, by the median of SCF. **Table 5** reports the regression results for the full sample and the split samples according to Equation (5). For the full sample, the speed of leverage adjustment in the low-SCF group significantly decreases by 15.639%, while that in the high-SCF group significantly decreases by 11.323%. For the underleveraged group, the low-SCF firms substantially decrease the speed of leverage adjustment by 31.740%, while the high-SCF firms only decrease by 11.243%. For overleveraged firms, the low- and high-SCF firms decrease the leverage adjustment speed notably by 19.147% and 10.994%, respectively. These results show that the adjustment speed of firms with low SCF declined more than that of firms with high SCF; Notably, the low-SCF underleveraged firms' adjustment speed drops sharply by 31.740%, more severely than that of other group firms. These findings also suggest that SCF mitigates the decline in leverage adjustment speed for both underleveraged and overleveraged firms during the pandemic, and the mitigating effect is greater for underleveraged firms.

Table 5. The leverage adjustment speed in pre- and during-COVID periods, group by SCF and leverage ratio.

Panel A: Full sample, including underleveraged and overleveraged firms				
	Low SCF		High SCF	
	(1)	(3)	(2)	(4)
	Pre-COVID	During-COVID	Pre-COVID	During-COVID
L.Lev	0.09238*** (0.02324)	0.24877*** (0.02848)	0.24185*** (0.02422)	0.35508*** (0.03065)
SOA	90.762%	75.123%	75.815%	64.492%
_cons	-2.99837*** (0.23331)	-1.56962*** (0.22762)	-1.91560*** (0.25280)	-0.53861* (0.24745)
Controls	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	1254	1248	1252	1261
Adjusted R ²	0.95928	0.95265	0.92872	0.91466
$\Delta\text{coef}(Lev_{i,t-1})$	15.639%*** (24.319)		11.323%*** (25.603)	
Panel B: underleveraged sample				
	Low SCF		High SCF	
	(1)	(3)	(2)	(4)
	Pre-COVID	During-COVID	Pre-COVID	During-COVID
L.Lev	0.12149* (0.04931)	0.43889*** (0.05597)	0.24301*** (0.04511)	0.35544*** (0.05044)
SOA	87.851%	56.111%	75.699%	64.456%
_cons	-1.66717*** (0.42634)	-0.99084* (0.48313)	-1.05607* (0.45590)	-0.47082 (0.35807)
Controls	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	457	509	492	560
Adjusted R ²	0.89702	0.89939	0.91921	0.90801
$\Delta\text{coef}(Lev_{i,t-1})$	31.740%*** (7.617)		11.243%*** (8.339)	
Panel C: Overleveraged sample.				
	Low SCF		High SCF	
	(1)	(3)	(2)	(4)
	Pre-COVID	During-COVID	Pre-COVID	During-COVID
L.Lev	0.09440* (0.03752)	0.28587*** (0.04368)	0.29128*** (0.03868)	0.40122*** (0.05702)

Continued

SOA	90.560%	71.413%	70.872%	59.878%
_cons	-3.53253*** (0.29453)	-1.24370** (0.40797)	-4.09208*** (0.39487)	4.46220 (2.49415)
Controls	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	654	628	620	578
Adjusted R ²	0.96507	0.97002	0.91337	0.87021
$\Delta\text{coef}(Lev_{i,t-1})$	19.147%*** (16.995)		10.994%*** (7.954)	

4. Robustness Test

Following [Faulkender et al. \(2012\)](#) and [Vo et al. \(2022\)](#), we conduct a robustness test using the GMM method to address endogeneity issues. **Table 6** reports the regression results for the full, pre-COVID, and during-COVID samples. The AR test and Hansen *P*-value for the full sample indicate that there is no autocorrelation in the residuals of the difference equation and that the instrumental variables are exogenous in Equation (5). The results in columns (2) and (3) are consistent with the baseline specification in **Table 3**, suggesting that the main findings of the benchmark regression remain unchanged.

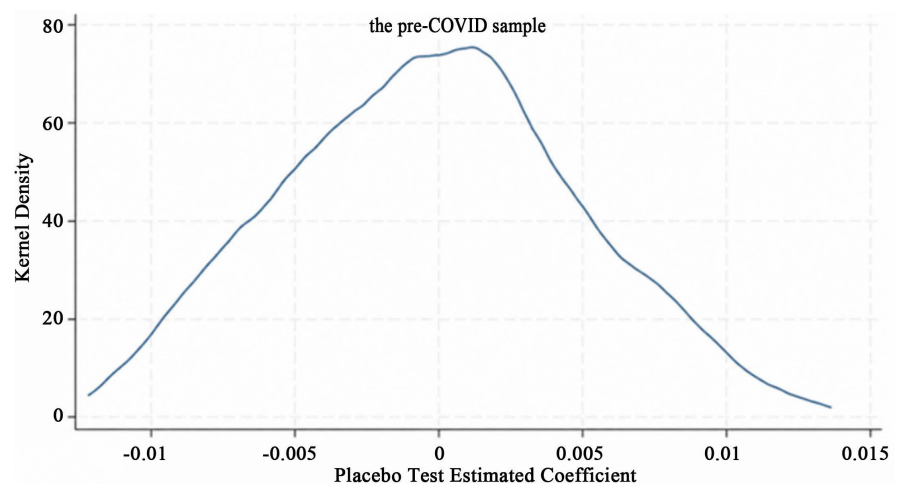
Table 6. Robustness test (GMM method).

	Full sample	Pre-COVID-19	COVID-19
	(1)	(2)	(3)
	Lev	Lev	Lev
L.Lev	0.557*** (7.52)	0.346*** (3.50)	0.562*** (2.63)
SOA	44.3%	65.4%	44.8%
SCF	0.167*** (2.60)	0.396*** (3.94)	0.200 (1.27)
Size	0.0255** (2.41)	0.00871 (0.49)	0.0338 (1.32)
ROA	-0.645*** (-14.93)	-0.466*** (-7.00)	-0.717*** (-5.35)
Growth	0.0288*** (5.41)	0.00325 (0.36)	0.0277*** (3.06)
Tang	-0.0509	-0.0407	-0.0982

Continued

	(-0.93)	(-0.44)	(-0.94)
Dep	-1.489*** (-2.72)	-1.657* (-1.78)	2.383 (1.60)
MIL	-0.0335 (-0.16)	-0.392 (-0.91)	-0.0527 (-0.07)
_cons	-0.335 (-1.45)	0.259 (0.62)	-0.599 (-0.83)
<i>N</i>	5382	2691	2691
Ar(1)	-7.2269***	-3.0750***	-2.5303**
Ar(2)	-0.2410		
Hansen P	0.1710	0.7745	0.5841

In addition, to eliminate the interference of random factors on the benchmark results, this study randomly shuffles the core explanatory variable *L. Lev* in the pre-pandemic, and during-pandemic samples and repeats the regression 500 times. **Figure 1** reports the kernel density distribution of the 500 random regression coefficients. As shown, the randomized coefficients are concentrated around 0, exhibiting an approximately normal distribution with a range of $[-0.015, 0.014]$ for the pre-COVID sample and $[-0.015, 0.017]$ for the during-COVID sample. The actual benchmark regression coefficients for pre-pandemic and during-pandemic samples are 0.161 and 0.288, respectively, both of which fall completely outside the distribution of random coefficients. The p-value calculated from this distribution is 0.000, indicating rejection of the null hypothesis that the true coefficients are generated by random factors. Therefore, the benchmark regression results are robust.



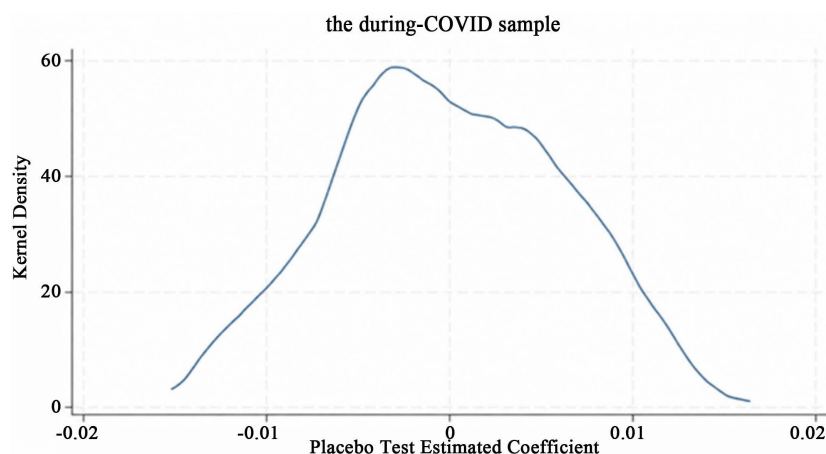


Figure 1. The placebo test.

5. Conclusion

In this study, we empirically examine the influence of the COVID-19 pandemic on the speed of corporate leverage adjustment and the moderating role of SCF, using a sample of Chinese A-share listed firms from 2016 to 2022. Based on a standard partial adjustment model, we find that: (1) COVID-19 significantly slows down the speed of leverage adjustment; (2) the negative impact of COVID-19 on adjustment speed is significantly asymmetric, that is, underleveraged firms seeking to increase leverage experience a more pronounced decline (18.62%) than overleveraged firms (13.14%); (3) SCF plays a significant mitigating role in the negative impact of COVID-19 on leverage adjustment speed, mitigating the decline for both underleveraged and overleveraged firms during the pandemic, with a greater mitigating effect for underleveraged firms. These findings remain robust after addressing endogeneity issues using the GMM method and considering random factors using a placebo test.

This paper highlights the importance of promoting the development of SCF as an effective policy tool to enhance firms' resilience against external shocks, especially for underleveraged firms that face greater financing constraints. It also emphasizes the strategic value of SCF in optimizing capital structure decisions, as SCF helps firms alleviate financing constraints, reduce adjustment costs, and maintain the flexibility to adjust leverage toward target levels even under uncertain external environments.

Despite these significant applications, this paper has certain limitations that suggest directions for future research. First, our sample is limited to Chinese listed firms, and future research could extend to unlisted firms. Second, we only study the asymmetric effects of COVID on under- and over-leveraged firms; future studies could explore the heterogeneous effects of different types of firms, such as firm size, region, and register.

Funding

This work is supported by Anhui Province Philosophy and Social Science Plan-

ning Project [grant number AHSKQ2020D12].

Author Contributions

Conceptualization, Xie Lixu; methodology, Xie Lixu; validation, Xie Lixu, Wang Junjie; formal analysis, Xie Lixu; investigation, Xie Lixu; data curation, Xu liang-ming; writing—original draft preparation, Xie Lixu, Wang Junjie; writing—review and editing, Xie Lixu, Wang Junjie; visualization, Xie Lixu, Wang Junjie; supervision, Xie Lixu; project administration, Xie Lixu. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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