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Does Derivatives Use Affect Firm's Debt Capacity? Evidence from China

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Abstract

This paper investigates the impact of derivatives use on firms' debt capacity based on Chinese listed firms. It is found that derivatives usage is significantly negatively associated with firms' new debt, and the results remain robust after controlling for endogeneity and replacing the measurement of debt capacity. Further analysis indicates that derivatives mainly reduce the ability borrow long-term debt, the negative relationship is mainly significant in non-SOEs, and the revision of relevant accounting standards help to ameliorate the unfavorable impact of derivatives use on debt capacity. This paper provides empirical support for further standardizing the use and disclosure of derivatives, and the revision and improvement of related accounting standards.

Keywords

Derivatives, Debt Capacity, Information Disclosure, Ownership, China

1. Introduction

According to MM theory, risk management coordinates the firm's financing and investment behaviors (Froot et al., 1993) and is an important factor affecting firm value. As an important instruments of hedging macroeconomic risks, the use of derivatives helps to reduce business and total risks, which in turn reduces the likelihood of corporate bankruptcy and default (Aretz & Bartram, 2010). At the same time, derivatives help to decrease the noise in corporate earnings, which in turn reduces the information asymmetry between external information users and the firm (Aretz & Bartram, 2010). However, the uncertainty of risk reducing effects, fragmented and missing disclosure, poor standardization and comparability of derivatives information (Ameer et al., 2011), make the economic results of derivatives use uncertain. Among external information users, creditors are more sensitive to risk information, determining whether to borrow

and the cost of borrowing based on the level of default risk of the debt issuer.

Based on this, scholars have investigated the impact of derivatives use on the cost of capital, especially the cost of debt capital. Using a sample of firms from developed countries such as the United States, the literature finds that derivatives use reduces bank borrowing spreads (Campello et al., 2011), the cost of bond (Chen & King, 2014), the cost of equity (Gay et al., 2011), and enhances a firm's borrowing capacity (Graham & Rogers 2002), and in the context of changes in the exchange rate regime, the use of foreign exchange derivatives enhances the firm's ability to finance debt in foreign currencies when there is a lack of resources in the domestic capital market (Berrospide et al., 2011). However, some scholars have questioned the positive role of derivatives hedging (Jin & Jorion, 2006; Belghitar et al., 2013). For example, Jin & Jorion (2006) and Belghitar et al. (2013) did not find a significant impact of derivatives use on firm value. Overall the effect of derivatives use on creditor behavior is an important research question that has not yet reached a consistent conclusion.

As the largest emerging economy, China is prominently represented in the history and current status of derivatives development. It attempted to develop a derivatives market in the early 1990s, and around 2005 the development was on track. The history of the use of derivatives by Chinese non-financial firms is even shorter, and the level of derivatives use by Chinese listed firms is lower, but it has been developing at a faster pace in recent years, and the literature on the use of derivatives by Chinese firms has been gradually increasing, focusing on the risk management effects of derivatives usage (Guo et al., 2021), and the influencing factors of derivatives usage (Shen et al., 2022). No research has been seen on the impact of derivatives use on creditor behavior in Chinese firms.

In China, the issuance of shares is strictly regulated. Listing to raise capital requires compliance with a number of requirements such as financial and non-financial performance, and multiple layers of approvals, which can take a long time from the application for listing to the final listing to raise capital. As a result, debts are the main source of corporate finance. In emerging market countries, interest rates are more regulated by the government, and the difference in interest rates between different companies is smaller, so firms are more concerned about whether they can obtain bank loans. Based on this, this paper investigates the impact of derivatives use on a firm's ability to raise debt and the factors that influence it. This paper finds that among companies with risk exposure, derivatives use is associated with the company's new debt level, and further research finds that derivatives use mainly reduces the company's new long-term borrowing and reduces the level of new debt of non-SOEs; and the reform of accounting standards related to derivatives in 2014 can help to mitigate the negative impact of derivatives use on the ability to raise debt.

The possible contributions of this paper are: first, based on the data of Chinese A-share listed companies, this paper investigates the effects of derivatives use on firms' ability to raise debt in emerging capital markets and derivatives markets, further enriching the literature on the economic consequences of derivatives use.

Second, it is found that derivatives mainly reduce the level of long-term debt, and debt capacity of non-SOEs; third, the relevant changes in accounting standards can help to mitigate the adverse effects of derivatives use.

This paper is organized as follows: the second part is theoretical analysis and hypothesis construction; the third part is research design, including sample selection, variable definition and model construction; the fourth part is empirical results, including descriptive statistics, regression results and robustness test; and the fifth part is conclusion.

2. Theoretical Analysis and Hypothesis Construction

On the one hand, based on the role of risk hedging, the use of derivatives helps to improve the company's ability to raise debt as follows:

Firstly, the use of derivatives helps to reduce business risks. Enterprises use derivatives to pre-lock the company's sales price, procurement costs, interest costs, exchange gains and losses, etc., to reduce the exchange rate, interest rates, commodity prices and other macroeconomic factors fluctuations on the impact of the enterprise's business activities, which helps to achieve sustainable development, the reduction of enterprise business risk, helps to reduce the risk of creditor (bank) borrowing and improve the ability of the enterprise to raise debt.

Secondly, the use of derivatives helps to reduce the possibility of corporate bankruptcy (Smith & Stuzl, 1985; Campello et al., 2011). When extreme fluctuations in exchange rates, interest rates or commodity prices threaten the sustainable operation of firms, the fluctuations in the value of the hedged object and the fluctuations in the value of the hedging instrument have the opposite effect on the enterprise, and the use of derivatives can to a large extent hedge the impact of the hedged object on the enterprise's business activities, which reduces the likelihood of bankruptcy and the cost of bankruptcy and financial crisis costs; at the same time, as the possibility of bankruptcy decreases, it also reduces the occurrence of risk transfer behavior of management under financial crisis (Campbell et al., 2019; Campello et al., 2011), which helps to improve the company's ability to raise debt.

Thirdly, derivatives use helps to mitigate the agency problem between management and creditors (Campbell et al., 2019; Campello et al., 2011). Derivatives use reduces the noise caused by macroeconomic factors such as interest rates, exchange rates and commodity prices that are not under the control of management in the company's cash flows and surpluses, improves the quality of information for external information users such as creditors, and more accurately reflects the ability of the company's management to create value, which helps to reduce the bandwagon between management and creditors, and thus enhances the company's ability to raise debt.

On the other hand, due to the high leverage, complexity, and risk characteristics of derivatives, the imperfect disclosure of derivatives, and the stage of development of the capital market, creditors may perceive derivatives as raising a

company's risk of insolvency, and thus may be reluctant to give the derivatives company a larger amount of debt, which in turn reduces the company's ability to raise debt. Specifically:

Firstly, the effect of high complexity of derivatives. The complexity of derivatives contracts and the complexity of accounting treatment increase the difficulty of regulators to supervise companies and provide space for management earnings management, Barton (2001), based on U.S. company data, found that management uses derivatives as a complementary means of accrual earnings management, and that the complexity of derivatives is positively correlated with the degree of earnings management. The increase in the degree of earnings management brought about by derivatives reduces the quality of corporate information and is not conducive to the enhancement of corporate debt raising ability.

Secondly, the impact of high risk and high leverage characteristics of derivatives. The capital market is changing rapidly, coupled with the deep development of the internationalization and integration of the capital market further aggravated the changes in exchange rates, interest rates and commodity prices, and the news of the manipulation of the international capital market by international capital predators has been heard from time to time. In addition, the occurrence of improper use of derivatives, lack of knowledge and experience, errors in judgment, and even speculation due to lax internal controls put the derivatives users at risk, which, coupled with the high leverage nature of derivatives, further amplified the impact of the unfavorable consequences of the use of derivatives. Creditors are reluctant to borrow from derivatives users out of concern for the high risk and high leverage of derivatives, which in turn reduces the ability of derivatives users to raise debt.

The impact of derivatives use on debt borrowing ability of Chinese firms becomes an issue that needs to be empirically tested. Based on this, the following opposing hypotheses are proposed:

Hypothesis 1a: Compared to firms that do not use derivatives, the debt capacity of derivatives users is higher.

Hypothesis 1b: Compared to firms that do not use derivatives, the debt capacity of derivatives users is lower.

3. Research Design

3.1. Sample Selection and Data Sources

In 2006, with the implementation of the China Accounting Standards, derivatives were included in the financial statements for the first time, which made large sample research on derivatives possible in Chinese listed firms. In order to exclude the impact of the financial crisis and the revision of the new round of Chinese accounting standards in 2017, following Zhang et al. (2023), we take A-share listed companies from 2010-2016 as the initial sample. Since derivatives use is mainly used to hedge the risk of exchange rate, interest rate, and commodity price fluctuations, drawing on Makar & Huffman (2001), Purnanandam

(2008), we remove firms without risk exposure during the sample period. Since financial sector firms are both users and providers of derivatives, thus we delete financial sector firms; ST firms are more likely to have financial anomalies, thus firms that are ST during the sample period are deleted, and this paper also deletes firms with missing data, resulting in a final total of 2083 firms and 10,710 samples.

The method of manually collecting data on the use of derivatives in the company's annual reports is as follows: search for keywords such as derivatives, hedging, forwards, futures, options, swaps, etc., and judge whether the company uses derivatives, the disclosure of derivatives, and the impact of the use of derivatives on the gain or loss on changes in fair value and investment income according to the context. The data on translation differences of foreign currency statements are from Resset Database, and other financial data are from Wind Database. Resset Database and Wind Database are leading data platforms that provides professional services for model validation, investment research, etc., and are widely used in financial and accounting empirical research in China setting.

3.2. Variable Definition and Model Construction

To test the effect of derivatives use on the ability to raise debt, drawing on Froot et al. (1993), Berrospide et al. (2011), we construct model (1):

$$\text{Debtchange}_{it+1} = \alpha_0 + \alpha_1 \text{DT}_{it} + \alpha_2 \text{Controls}_{it} + \sum \text{Industry} + \sum \text{Year}_{it} + \varepsilon_{it} \quad (1)$$

Graham & Rogers (2002), Zou & Adams (2008) use gearing ratios to measure the ability to raise debt, however, firms' gearing ratios are also an important factor affecting the use of firms' derivatives. In order to avoid the endogeneity problem of reverse causality and also to reflect the actual change in debt, drawing on Zou (2010) and Trapp & Weiβ (2016), we use the ratio of firm i's new debt in year $t+1$ to its total assets at the end of the period in year t (Debtchange$_{it+1}$), to measure firm's ability to raise debt in year t. when the company's debt level remains unchanged while the company's total assets change, the gearing ratio also changes, while the level of new debt remains unchanged, thus the level of new debt can more accurately reflect the actual change in debt. DT is a dummy variable for the use of derivatives. It takes the value of 1 if derivatives are used and 0 otherwise.

Drawing on Froot et al. (1993), Graham & Rogers (2002), Zou & Adams (2008), Berrospide et al. (2011), Bartram et al. (2011), Abdel-khalik & Chen (2015), etc., we select the following control variables that affecting the ability to raise debt in previous studies, including: firm size (Size), tangible assets percentage (PPE), profitability (ROA), gearing ratio (Debtratio), quick ratio (Quickratio), firm financial crisis likelihood (Z-value), and non-debt tax shield (SGA), Firm growth (MB), Overseas business share (Oversea), Dibble internal control index (Icindex), Nature of ownership (Ownership), Firm age (Age), Cash dividends per share (Divident), Net cash flow from operating activities as a percen-

tage of operating income (OCF). Industry and Year are respectively the industry control variables and year control variables. Specific variable definitions and measures are shown in Table 1.

4. Empirical Results

4.1. Descriptive Statistic

The results of descriptive statistics are shown in Table 2, from Panel A, it can be seen that the mean value of new debt as a percentage of total assets at the end of the previous period is 9.56%, the mean value of short-term borrowing as a percentage of total assets is 10.5%, and the mean value of long-term borrowing as a percentage of total assets is 3.63%. During the sample period, among the companies with risk exposure, those using derivatives accounted for 21.1%, which is much lower than the level of developed countries such as Europe and the United States, and also lower than developing countries such as South Africa and Malaysia (Bartram, 2019). In terms of control variables, on average, the percentage of fixed assets in total assets is 21.5%, the return on total assets is 5.64%, the mean leverage is 40.8%, the mean quick ratio is 2.267, the mean Z-value is 8.417, the sum of administrative and selling expenses as a percentage of operating income is 16.2%, the mean corporate MB is 2.802, the mean share of overseas business is 17.5%, the mean value of Dibo Internal Control Index is 607.6, 33.1% of companies are SOEs, the mean cash dividend per share is 0.119, and the mean value of the company's net cash flow from operating activities as a percentage of operating income is 7.59%.

From Panel B, it can be seen that the number of companies using derivatives has increased year by year, from 216 in 2010 to 431 in 2016, and the overall percentage of companies using derivatives has also been on an upward trend, from 12.4% to 16.2%. From Panel B, it can be seen that compared with non-users, the average value of the new debt of derivatives users are lower, the t-value of the difference in means is 1.7151, which is significant at the 10% level, which indicates that the level of the new debt of the derivatives users is lower, and to a certain extent, it supports the hypothesis H1b.

4.2. Analysis of Regression Results

To control for possible firm fixed effects and serial correlation problems, we employ the clustering regression method recommended by Petersen (2009) and Gow et al. (2010), with double clustering by firm and year.

To test hypothesis 1, model (1) is regressed, and the results are shown in column (1) of Table 3, the coefficient of DT is −0.0372, and significant at the 1% level, that is derivatives usage is negatively related to the level of firms' new debt. The results indicate that among firms with exposure, the level of new debt of derivatives users is lower compared with those who do not use derivatives, and hypothesis 1b is supported. That is, derivatives use reduces the level of firms debt raising ability of Chinese listed firms, which may be due to the fact that, on

Table 1. Variable definitions.

Variables	Define
	Explained Variable
Debtchange	Level of new debt, new debt in the year $t+1$ as a proportion of total assets at the end of year t.
Stloan	New short-term bank borrowings, new short-term bank borrowings as a proportion of total assets.
Ltloan	New long-term bank borrowings, new long-term bank borrowings as a percentage of total assets.
	Explanatory Variable
DT	The derivatives uses dummy variables. If the derivatives is used, it is set to 1; otherwise, to 0.
POST2014	Year 2014 and later is set to 1, 2010-2013 is set to 0.
Disclosure	The Disclosure quality of derivatives information dummy variable. If three key information, such as the derivatives table, the fair value of derivatives and the impact on profit and loss, are disclosed in the annual report, the disclosure is good, and the value of Disclosure is 1, otherwise it is 0.
	Control Variable
Size	Firm size, the natural logarithm of the company's total assets at the end of the period.
PPE	Proportion of fixed assets, the ratio of fixed assets to total assets at the end of the period.
ROA	Return on total assets, earnings before interest and tax/average of total assets at the beginning and end of the period.
Debtratio	Leverage, total liabilities at the end of the period/total assets at the end of the period.
Quickratio	Quick ratio, quick assets/current liabilities.
Z	Z value, the possibility of enterprise financial failure or bankruptcy, the lower the z value, the more likely the enterprise will go bankrupt.
SGA	Non-debt tax shield, (management expenses + sales expenses)/operating income.
MB	(Stock market value + book value of liabilities)/total assets.
Oversea	Proportion of overseas business income, proportion of overseas business income to operating income.
Icindex	Dibo Internal Control Index, the higher the internal control index, the better the internal control quality.
Ownership	State of ownership, dummy variable, for SOEs, it is set to 1, and 0 for non-SOEs.
Age	The establishment period of the company.
Divident	Cash dividend per share.

Continued

OCF	Proportion of net cash flow from operating activities to operating income.
Industry	Industry Control Variables.
Year	Industry Control Variables.

Table 2. Descriptive statistics of main variables. (a) Full sample descriptive statistics; (b) Analysis of variance for key variables.

(a)

Variable	N	mean	sd	min	p50	max
Debtchange	10710	0.0956	0.190	−0.233	0.0517	1.200
CAPX	10710	0.116	0.142	0.0009	0.0694	0.933
Stloan	10710	0.105	0.106	0	0.0765	0.435
Ltloan	10710	0.0363	0.0641	0	0.0027	0.380
TQA	10403	2.372	1.962	0.208	1.798	10.20
TQB	10403	2.780	1.865	0.918	2.180	10.45
RD	9170	0.0406	0.0394	0.0002	0.0333	0.253
DT	10710	0.211	0.408	0	0	1
DTratio	1823	0.0042	0.0143	0	0.0004	0.109
DTT	2261	0.722	0.448	0	1	1
Size	10710	22.04	1.279	19.74	21.82	25.96
PPE	10710	0.215	0.148	0.0024	0.186	0.720
ROA	10710	0.0564	0.0470	−0.0880	0.0502	0.226
Debtratio	10710	0.408	0.209	0.0462	0.398	0.861
Quickratio	10710	2.267	2.924	0.174	1.270	18.55
Z	10710	8.417	10.87	0.478	4.557	65.34
SGA	10710	0.162	0.115	0.0162	0.134	0.653
MB	10710	2.802	1.885	0.920	2.196	10.63
Oversea	10710	0.175	0.223	0	0.0813	0.876
Icindex	10710	607.6	212.9	0	673.0	905.5
Ownership	10710	0.331	0.471	0	0	1
Age	10710	15.19	5.338	4	15	28
Divident	10710	0.119	0.154	0	0.0700	0.810
OCF	10710	0.0759	0.156	−0.673	0.0691	0.690

(b)

DT = 0 (1)			DT = 1 (2)		Diff [(1) − (2)]		Diff [(1) − (2)]	
Variable	Mean	Median	Mean	Median	Mean	T-value	Median	Z-value
Debtchange	0.0972	0.0510	0.0895	0.0537	0.0077*	1.7151	−0.0027	0.464

Table 3. Derivatives use and firms' ability to raise debt.

VARIABLES	(1)	(2)
	Debtchange	Debtchange
DT	−0.0372***	−0.0040*
	(−3.16)	(−1.84)
Size	0.0036	0.0096***
	(0.40)	(2.90)
PPE	0.0689**	−0.0534***
	(2.55)	(−3.79)
ROA	−0.0910	0.0020
	(−0.41)	(1.21)
Debtratio	−0.3141***	0.0282
	(−5.04)	(0.76)
Quickratio	0.0101*	0.0053
	(1.96)	(1.16)
Z	0.0137***	−0.0029**
	(3.93)	(−1.97)
SGA	−0.2282**	−0.2214**
	(−2.00)	(−2.35)
MB	0.0149**	0.0205***
	(2.50)	(3.80)
Oversea	0.0664***	−0.0007
	(2.73)	(−0.06)
Icindex	0.0001**	0.0000
	(2.43)	(0.31)
Ownership	−0.0561***	−0.0223***
	(−3.31)	(−3.17)
Age	−0.0053**	−0.0014**
	(−2.55)	(−2.03)
Divident	−0.2421***	−0.0542**
	(−5.01)	(−2.52)
OCF	−0.2585***	−0.1031***
	(−3.70)	(−2.85)
Industry	Controlled	Controlled
Year	Controlled	Controlled

Continued

Constant	1.3949***	−0.2857***
	(4.75)	(−3.72)
Observations	10,710	3174
Adjusted R-squared	0.1067	0.0383
F	19.16	3.422

The figures in parentheses are T-values of the robust standard error for double clustering at the firm and year levels; *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

the one hand, derivatives use reduces the volatility of derivatives users' cash flows, which in turn reduces the demand for external funds; on the other hand, it may also be due to the fact that the high complexity, risk and leverage of derivatives increase the information asymmetry between derivatives users and their creditors, who perceive derivatives users as more risky and less solvent, and are therefore reluctant to lend.

In terms of control variables, consistent with previous studies, high liquidity, high proportion of tangible assets, low risk of bankruptcy, high growth, high proportion of income from overseas business, and good internal control are significantly and positively related to the level of new debt of the company; while current gearing ratio, non-debt tax shields, cash flow from internal operating activities, and dividend distributions are negatively related to the level of new debt.

4.3. Robustness Test

4.3.1. Endogeneity Test: Propensity Score Matching Method

To mitigate the effect of sample heterogeneity, drawing on Donohoe (2015) and Campbell et al. (2023), the propensity score matching method is used to control for the endogeneity problem of derivatives use, with the paired variables being factors related to factors affecting derivatives use as well as factors affecting the level of financing, including the firm's market value (MV), debt ratio (Debtratio), total return on assets (ROA), volatility of ROA (ROAVOL), volatility of cash flow (NCFVOL), Z-value of firm's probability of bankruptcy, firm's growth (MB), cash dividends per share (Divident), and cash flow from operating activities (OCF), controlling for industry and year effects. The propensity score matching method uses logit to estimate propensity scores, nearest neighbor one-to-one, and with put-back matching.

The difference of derivatives users and non-users in debt capacity before and after pairing is shown in **Table 4**, from which it can be seen that after pairing, the debt capacity of the derivatives users is weaker, with a T value of −1.96, the absolute value of which is equal to the critical level, and passes the test of significance, which indicates that the debt capacity of the derivatives users is lower, and to some extent indicates that the conclusions are robust.

Table 4. Differences in debt capacity before and after matching.

Variable Sample	Process Group	Control Group	Differences	Standard Error	T value
Before Matching	0.0872	0.0941	−0.0069	0.0046	−1.49
Estimated value after matching	0.0872	0.1006	−0.0135	0.0069	−1.96

We continue the regression after pairing, and the results are shown in column (2) of **Table 3**. Consistent with the results of the main regression, the use of derivatives is significantly negatively associated with the level of new debt level of the company after pairing, and the findings are robust.

4.3.2. Endogenous Test: Treatment Effect Model

Derivatives use is an endogenous choice of firms (Pincus & Rajgopal, 2002; Choi et al., 2015), firm size, gearing, exchange rate, interest rate and commodity price exposure all affect derivatives use, therefore we use Treatment Effect Model (TEM) to mitigate the sample self-selection problem. The specific process is as follows: construct model (2) to examine the impact of the factors influencing the use of derivatives and obtain λ_i, and add λ_i to model (1) for correcting the impact of the use of derivatives on firms' debt capacity, and carry out the second-stage regression, and if the coefficient of λ_i is significant, it indicates that there is indeed a sample selection bias, and that the use of the Treatment Effect Model is effective.

$$Pr\left(\mathrm{DT}_{it}=1\right)=\Phi\left(\alpha_i Z_i\right) \tag{2}$$

where Z_i is the influencing factor on the use of derivatives, drawing on Chang et al. (2015) and Campbell et al. (2023), we use firm size (Size), gearing ratio (Debtratio), exposure to exchange rate risk (Frisk), exposure to interest rate risk (Irisk), exposure to commodity price risk (Crisk), Financial Crisis Likelihood Z, Management Compensation Performance Sensitivity MI, Cash Effective Tax Rate (CETR), Growth (MB), Return on Total Assets Volatility (ROAVOL), and Cash Flow Volatility (CFVOL), and lagged one period of the variables except firm size (Size).

The results are shown in **Table 5**: column (1) presents the results of the first-stage regression, in which firms that are large and have high debt ratios are more likely to use derivatives. The results in (2) are the regression results of the use of derivatives on firms' debt capacity after adding λ_i, in which λ_i are all significant at the 1% level, indicating that there is a self-selection problem and the use of the treatment effect model is necessary; after considering the self-selection bias, the regression coefficients of the dummy variable DT is still negatively significant at the 1% level, which indicates that the debt capacity of derivatives users is significantly lower than that of firms that do not use derivatives, and the findings are robust.

Table 5. Regression results of the treatment effects model.

VARIABLES	(1)	(2)
	DT	Debtchange
Size	0.3023***	0.0043
	(17.48)	(1.59)
L. Debtratio	0.4993***	
	(4.20)	
L. Frisk	0.0014	
	(0.17)	
L. Irisk	0.0395	
	(0.42)	
L. Crisk	−0.0005	
	(−0.11)	
L. ROAVOL	0.0052	
	(1.06)	
L. NCFVOL	−0.7854***	
	(−4.18)	
L. Z	0.0046	
	(1.59)	
L. MI	0.0567	
	(1.44)	
L. CETR	−0.1745***	
	(−3.75)	
L. MB	−0.0841***	
	(−5.11)	
DT		−0.0551***
		(−3.10)
PPE		−0.0531***
		(−3.32)
ROA		0.1041*
		(1.81)
Debtratio		0.0281*
		(1.75)
Quickratio		0.0010
		(0.64)

Continued

Z		−0.0015***
		(−3.04)
SGA		−0.0896***
		(−4.34)
MB		0.0191***
		(8.56)
Oversea		0.0147
		(1.56)
Icindex		0.0001***
		(4.02)
Ownership		−0.0166***
		(−3.49)
Age		−0.0015***
		(−3.60)
Divident		−0.0420**
		(−2.52)
OCF		−0.0923***
		(−6.64)
λ_i		0.0281***
		(2.69)
Industry	Controlled	Controlled
Year	Controlled	Controlled
Constant	−7.2365***	−0.0573
	(−16.86)	(−0.91)
Observations	9581	9581

In column (1), figures in parentheses are Z-values. In column (2), the numbers in parentheses are T-values of the robust standard error for double clustering at the firm and year levels; *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

4.3.3. Replacement of Dependent Variable Metrics

In order to test the robustness of the findings, we replace the dependent variable measures, and for the level of new debt, two methods are used to measure it: firstly, the level of new debt in the current period is used, i.e., the effect of current derivatives use on the current period's new debt, Debtchange; secondly, drawing on Graham & Rogers (2002), Zou & Adams (2008), using the next period's gearing ratio ($Debtratio_{t+1}$) as a measure of debt raising capacity. The regression results are shown in **Table 6**, which finds that after replacing the new

Table 6. Replacement of dependent variable metrics.

VARIABLES	(1)	(2)
	Debtchange$_t$	Debtratio$_{t+1}$
DT	−0.0850***	−0.0034**
	(−3.70)	(−2.36)
Size	0.0353***	0.0088***
	(3.25)	(8.62)
PPE	−0.5537***	−0.0258***
	(−4.15)	(−3.21)
ROA	1.2516**	−0.0908***
	(2.05)	(−3.48)
Debtratio	0.2565**	0.8519***
	(2.03)	(85.19)
Quickratio	0.0141***	−0.0027***
	(2.72)	(−6.93)
Z	−0.0150***	0.0007***
	(−5.53)	(6.00)
SGA	0.1612	−0.0248***
	(1.40)	(−3.07)
MB	0.0804***	−0.0014*
	(3.91)	(−1.95)
Oversea	0.1760***	0.0042***
	(4.02)	(3.16)
Icindex	0.0003***	0.0000
	(5.07)	(0.73)
Ownership	−0.1669***	−0.0042
	(−9.11)	(−1.14)
Age	−0.0094***	−0.0004***
	(−4.10)	(−2.72)
Divident	−0.2357**	−0.0066
	(−2.27)	(−0.84)
OCF	−0.1611*	−0.0481***
	(−1.84)	(−6.95)
Industry	Controlled	Controlled
Year	Controlled	Controlled

Continued

Constant	−0.7920***	−0.0563**
	(−3.06)	(−2.06)
Observations	9958	10,710
Adjusted R-squared	0.0818	0.8544
F	17.55	21.96

The figures in parentheses are the T-values of the robust standard error for double clustering at the firm and year levels; *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

debt level indicator, the dummy variable for derivatives use, DT, is still significantly negatively correlated with debt capacity, and both of them are significant at the 1% or 5% level, indicating that the results of this paper are not affected by the choice of the dependent variable indicator.

4.4. Further Analysis

4.4.1. Impact of Derivatives Use on Debt Structure

Previous studies have found that derivatives are usually of short maturity and can only hedge risks within their limitation period, and that firms use derivatives mainly to reduce the risks associated with short-term contracts (Stulz, 2004; Chen & king, 2014). Based on this, this paper takes the new short-term bank borrowing Stloan and the new long-term bank borrowing Ltloan as examples to study the impact of the use of derivatives on the new debt of different maturities. Where Stloan is the proportion of new short-term bank borrowings to total assets and Ltloan is the proportion of new long-term bank borrowings to total assets.

On the basis of model (1), we replace Debtchange by new short-term bank borrowing Stloan and new long-term bank borrowing Ltloan, the results are shown in columns (1) and (2) of **Table 7**, and it is found that DT is positively correlated with the company's new short-term borrowing, which does not pass the significance test; however, DT is significantly negatively correlated with the company's new long-term borrowing at the 5% level, indicating that derivatives mainly reduce the company's ability to borrow long-term debt and have no significant effect on the ability to borrow short-term debt, which is consistent with the fact that the use of derivatives is mainly used to hedge short-term risks.

4.4.2. Impact of the Nature of Ownership

Due to the differences in the nature of property rights, SOEs have a stronger debt financing ability, while non-SOEs have long had difficulties in borrowing. Based on this, this paper continues to examine the differences in the impact of derivatives use on debt capacity among firms with different ownership. The results are shown in columns (3) and (4) of **Table 7**, and it is found that in non-SOEs, the use of derivatives is significantly negatively correlated with the ability

Table 7. Impact of derivatives use on debt structure, the effect of ownership and the reform of accounting standards.

VARIABLES	(1)	(2)	(3) Non-SOEs	(4) SOEs	(5)
	Stloan	Ltloan	Debtchange	Debtchange	Debtchange
DT	0.0023	−0.0055**	−0.0113*	−0.0059	−0.0109**
	(0.59)	(−2.55)	(−1.69)	(−0.67)	(−2.15)
					0.0034
					(0.68)
					0.0047*
					(1.89)
Size	−0.0153***	0.0117***	0.0093	0.0002	0.0019
	(−6.84)	(8.20)	(1.51)	(0.05)	(0.55)
PPE	0.0842***	0.0709***	0.0355	−0.0345	−0.0511***
	(5.95)	(6.51)	(0.39)	(−0.96)	(−3.78)
ROA	0.0449*	0.0073	0.1827*	0.1185	0.1576*
	(1.65)	(0.34)	(1.66)	(1.00)	(1.89)
Debtratio	0.3292***	0.0967***	−0.0013	0.0828***	0.0242
	(14.42)	(13.03)	(−0.08)	(3.54)	(1.50)
Quickratio	−0.0031***	0.0035***	0.0008	0.0040	−0.0001
	(−5.45)	(5.15)	(1.10)	(1.37)	(−0.08)
Z	0.0014***	−0.0004*	−0.0013***	−0.0031***	−0.0013***
	(6.29)	(−1.77)	(−8.49)	(−2.64)	(−6.34)
SGA	−0.0846***	0.0217***	−0.0864***	−0.0076	−0.0771***
	(−6.20)	(2.65)	(−3.70)	(−0.11)	(−3.35)
MB	−0.0065***	0.0028***	0.0197***	0.0227***	0.0184***
	(−6.40)	(3.20)	(9.61)	(8.04)	(9.00)
Oversea	0.0013	0.0179***	0.0033	0.0049	0.0120
	(0.20)	(4.71)	(0.44)	(0.78)	(1.63)
Icindex	−0.0000	−0.0000	0.0000***	0.0000	0.0000***
	(−1.24)	(−1.18)	(3.70)	(0.43)	(4.66)
Ownership	−0.0263***	−0.0041*			−0.0173***
	(−5.54)	(−1.78)			(−3.35)
Age	−0.0006**	0.0004**	−0.0018***	−0.0015*	−0.0019***
	(−1.97)	(2.22)	(−4.35)	(−1.83)	(−3.87)
Divident	−0.0493***	−0.0311***	−0.0721***	0.0126	−0.0478***
	(−5.09)	(−5.17)	(−3.58)	(0.66)	(−3.08)

Continued

OCF	−0.0628***	−0.0086	−0.1238***	−0.0699**	−0.0968***
	(−6.69)	(−0.95)	(−7.49)	(−2.39)	(−5.16)
Industry	Controlled	Controlled	Controlled	Controlled	Controlled
Year	Controlled	Controlled	Controlled	Controlled	Controlled
Constant	0.3629***	−0.2167***	−0.1287	0.0149	0.4076***
	(7.74)	(−3.78)	(−1.10)	(0.24)	(3.47)
Observations	10,710	10,710	7162	3548	10,710
Adjusted R-squared	0.4137	0.3423	0.0380	0.0167	0.0407
F	203.6	90.97	19.09	5.333	10.18

The figures in parentheses represent the T-values of the robust standard error for double clustering at the firm and year levels; *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

to raise debt at the 10% level, while in SOEs, the use of derivatives is also negatively correlated with the ability to raise debt but fails to pass the significance test, that is the effect of the derivatives use in reducing the company's debt capacity is mainly manifested in non-SOEs. The effect of the use of derivatives on the ability of non-SOEs to raise new debt is "adding insult to injury" rather than "sending charcoal in snow".

4.4.3. Impact of Changes in Accounting Standards Related to Derivatives

In 2014, the Ministry of Finance of China revised the Guidelines on Presentation of Financial Instruments and issued the Guidelines on Fair Value Measurement, which were implemented in that year. The Presentation of Financial Instruments (revised in 2014) specifies the objectives of the presentation of financial instruments: to facilitate a reasonable evaluation of the significance of the impact of financial instruments on the financial position and operations results, and the nature and extent of the risks related to financial instrument. As the Fair Value Measurement standard emphasizes the recognition of derivatives based on "the terms of the contract and the economic substance reflected therein" rather than "legal form alone", we further examine the impact of the reform in accounting standards on the ability derivatives users to raise debt. Therefore, this paper further examines the impact of the relevant accounting standard changes on the ability of derivatives users to raise debt. Therefore, on the basis of model (1), model (3) is constructed.

$$\begin{aligned}\text{Debtchange}_{it+1} = {} & \alpha_0 + \alpha_1 \text{DT}_{it} + \alpha_2 \text{DT}_{it} * \text{POST2014} + \alpha_3 \text{POST2014} \\ & + \alpha_4 \text{Controls}_{it} + \sum \text{Industry} + \sum \text{Year} + \varepsilon_{it}\end{aligned} \tag{3}$$

where the treatment group is derivatives users (DT = 1) and the control group is firms that do not use derivatives (DT = 0). POST2014 takes the value of 0 for the years 2010-2013 and POST2014 takes the value of 1 for the years 2014-2016. Controls_{it} is control variables, consistent with model (1).

The Regressing results of model (3) are shown in column (5) of Table 7: the coefficients of DT is significantly negative, suggesting that the level of new debt added by derivative users was lower prior to the 2014 accounting standard reform for derivatives; the POST2014 coefficient is insignificant, suggesting that there is no significant difference in the level of new debt added by firms that did not use derivatives before and after 2014; the cross-multiplier DT* POST2014 coefficient is significantly positive, indicating that the level of new debt by derivatives users is higher after the 2014 compared to firms that do not use derivatives, suggesting that the 2014 standard reform related to derivatives has improved the recognition of the positive effects of derivatives by capital market participants, which in turn has ameliorated the negative impact of derivatives on debt capacity.

5. Conclusion

In the process of global economic integration and in-depth development of financial innovation, accompanied by international political strife, increased trade friction, coupled with the relaxation of China's capital controls and the deepening of interest rate and exchange rate market-oriented reforms, the fluctuations in exchange rates, interest rates and commodity prices are becoming more and more intense, and companies are facing an increasing exposure to risk. Derivatives as a risk management tool can reduce the impact of exchange rate, interest rate and commodity price fluctuations on the business activities, and lock the future sales price, purchase price, and interest cost in advance, so as to ensure the sound operation of enterprises. However, although the proportion of the use of derivatives in China has been on the rise year by year, the overall proportion of users is relatively low, and research on the economic consequences of the use of derivatives by Chinese enterprises is also relatively rare.

Based on this, we investigate the impact of derivatives use on a firm's debt capacity, and finds that derivatives use is significantly negatively associated with a firm's level of new debt, that is among firms with risk exposure, derivatives users have lower levels debt capacity compared to firms that do not use derivatives, and the results remain robust after replacing the new debt level metric and controlling for endogeneity. It is further found that derivatives mainly reduce the ability of firms to raise long-term debt, mainly for non-state listed firms. The derivatives related accounting standards reform in 2014 mitigates the negative impact of derivatives on the debt capacity.

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Conflicts of Interest

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

References

Abdel-Khalik, A. R., & Chen, P. C. (2015). Growth in Financial Derivatives: The Public Policy and Accounting Incentives. *Social Science Electronic Publishing, 34,* 291-318. https://doi.org/10.1016/j.jaccpubpol.2015.01.002

Ameer, R., Isa, R. B. M., & Abdullah, A. B. (2011). A Survey on the Usage of Derivatives and Their Effect on Cost of Equity Capital. *Journal of Derivatives, 19,* 56-71. https://doi.org/10.3905/jod.2011.19.1.056

Aretz, K., & Bartram, M. S. (2010). Corporate Hedging and Shareholder Value. *Journal of Financial Research, 33,* 317-371. https://doi.org/10.1111/j.1475-6803.2010.01278.x

Barton, J. (2001). Does the Use of Financial Derivatives Affect Earnings Management Decision. *The Accounting Review, 76,* 1-26. https://doi.org/10.2308/accr.2001.76.1.1

Bartram, M. S. (2019). Corporate Hedging and Speculation with Derivatives. *Journal of Corporate Finance, 57,* 9-34. https://doi.org/10.1016/j.jcorpfin.2017.09.023

Bartram, S. M., Brown, G. W., & Jennifer, C. (2011). The Effects of Derivatives on Firm Risk and Value. *Journal of Financial and Quantitative Analysis, 46,* 967-999. https://doi.org/10.1017/S0022109011000275

Belghitar, Y., Clark, E., & Mefteh, S. (2013). Foreign Currency Derivative Use and Shareholder Value. *International Review of Financial Analysis, 29,* 283-293. https://doi.org/10.1016/j.irfa.2012.02.004

Berrospide, J. M., Purnanandam, A., & Rajan, U. (2011). *Corporate Hedging, Investment and Value.* Working Paper. https://doi.org/10.2139/ssrn.1009657

Campbell, J. L., Mauler, L. M., & Pierce, S. R. (2019). A Review of Derivatives Research in Accounting and Suggestions for Future Work. *Journal of Accounting Literature, 42,* 44-60. https://doi.org/10.1016/j.acclit.2019.02.001

Campbell, J. L., Cao, S. S., Chang, H. S., & Chiorean, R. (2023). The Implications of Firms' Derivative Usage on the Frequency and Usefulness of Management Earnings Forecasts. *Contemporary Accounting Research, 40,* 2409-2445. https://doi.org/10.1111/1911-3846.12883

Campello, M., Lin, C., & Zou, Y. M. (2011). The Real and Financial Implications of Corporate Hedging. *The Journal of Finance, 66,* 1615-1647. https://doi.org/10.1111/j.1540-6261.2011.01683.x

Chang, H. S., Donohoe, M., & Sougiannis, T. (2015). Do Analysts Understand the Economic and Reporting Complexities of Derivatives? *Journal of Accounting & Economics, 61,* 584-604. https://doi.org/10.1016/j.jacceco.2015.07.005

Chen, J., & King, T. H. D. (2014). Corporate Hedging and the Cost of Debt. *Journal of Corporate Finance, 29,* 221-245. https://doi.org/10.1016/j.jcorpfin.2014.09.006

Choi, J. J., Mao, C. X., & Upadhyay, A. (2015). Earnings Management and Derivative Hedging with Fair Valuation: Evidence from the Effects of FAS 133. *Accounting Review, 90,* 1437-1467. https://doi.org/10.2308/accr-50972

Donohoe, M. P. (2015). The Economic Effects of Financial Derivatives on Corporate Tax Avoidance. *Journal of Accounting & Economics, 59,* 1-24. https://doi.org/10.1016/j.jacceco.2014.11.001

Froot, K. A., Scharfstein, D. S., & Stein, J. C. (1993). Risk Management: Coordinating Corporate Investment and Financing Policies. *Journal of Finance, 48,* 1629-1658.

https://doi.org/10.1111/j.1540-6261.1993.tb05123.x

Gay, G. D., Lin, C. M., & Smith, S. D. (2011). Corporate Derivatives Use and the Cost of Equity. *Journal of Banking & Finance, 35,* 1491-1506. https://doi.org/10.1016/j.jbankfin.2010.10.033

Gow, I. D., Ormazabal, G., & Taylor, D. J. (2010). Correcting for Cross-Sectional and Time-Series Dependence in Accounting Research. *The Accounting Review, 85,* 483-512. https://doi.org/10.2308/accr.2010.85.2.483

Graham, J. R., & Rogers, D. A. (2002). Do Firms Hedge in Response to Tax Incentives? *The Journal of Finance, 57,* 815-839. https://doi.org/10.1111/1540-6261.00443

Guo, H., Pan, Z., & Tian, G. (2021). State Ownership and the Risk-Reducing Effect of Corporate Derivative Use: Evidence from China. *Journal of Business Finance and Accounting, 48,* 1092-1133. https://doi.org/10.1111/jbfa.12510

Jin, Y., & Jorion, P. (2006). Firm Value and Hedging: Evidence from U.S. Oil and Gas Producers. *Journal of Finance, 61,* 893-919. https://doi.org/10.1111/j.1540-6261.2006.00858.x

Makar, S. D., & Huffman, S. P. (2001). Foreign Exchange Derivatives, Exchange Rate Changes, and the Value of the Firm: US Multinationals' Use of Short-Term Financial Instruments to Manage Currency Risk. *Journal of Economics and Business, 53,* 421-437. https://doi.org/10.1016/S0148-6195(01)00039-X

Petersen, M. A. (2009). Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches. *Review of Financial Studies, 22,* 435-480. https://doi.org/10.1093/rfs/hhn053

Pincus, M., & Rajgopal, S. (2002). The Interaction between Accrual Management and Hedging: Evidence from Oil and Gas Firms. *The Accounting Review, 77,* 127-160. https://doi.org/10.2308/accr.2002.77.1.127

Purnanandam, A. (2008). Financial Distress and Corporate Risk Management: Theory and Evidence. *Journal of Financial Economics, 87,* 706-739. https://doi.org/10.1016/j.jfineco.2007.04.003

Shen, H., Cheng, X., Ouyang, C. et al. (2022). Does Share Pledging Affect Firms' Use of Derivatives? Evidence from China. *Emerging Markets Review, 50,* Article ID: 100841. https://doi.org/10.1016/j.ememar.2021.100841

Smith, C. W., & Stulz, R. M. (1985). The Determinants of Firms' Hedging Policies. *Journal of Financial and Quantitative Analysis, 20,* 391-405. https://doi.org/10.2307/2330757

Stulz, R. M. (2004). Should We Fear Derivatives? *Journal of Economic Perspectives, 18,* 173-192. https://doi.org/10.1257/0895330042162359

Trapp, R., & Weiß, G. N. F. (2016). Derivatives Usage, Securitization, and the Crash Sensitivity of Bank Stocks. *Journal of Banking & Finance, 71,* 183-205. https://doi.org/10.1016/j.jbankfin.2016.07.001

Zhang, G., Guo, Z., Liu, J., & Wang, Z. (2023) Does the Derivatives Usage Affect Corporate Capital Expenditure? Evidence from China. *American Journal of Industrial and Business Management, 13,* 1256-1277. https://doi.org/10.4236/ajibm.2023.1311069

Zou, H., & Adams, M. B. (2008). Debt Capacity, Cost of Debt, and Corporate Insurance. *Journal of Financial and Quantitative Analysis, 43,* 433-466. https://doi.org/10.1017/S0022109000003586

Zou, H. (2010) Hedging Affecting Firm Value via Financing and Investment: Evidence from Property Insurance Use. *Financial Management, 39,* 965-995. https://doi.org/10.1111/j.1755-053X.2010.01101.x