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Loan loss provisions and return predictability: A dynamic perspective

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ABSTRACT

This paper examines the impact of loan loss provisions (LLPs) on return predictability during 1994–2017. We find that on average, LLPs are negatively associated with one year ahead stock returns. This effect is particularly significant during the global financial crisis but much weaker during the Basel II and III periods. Consistent with these findings, a long–short trading strategy based on LLPs generates positive abnormal returns during the Basel II and III periods but negative abnormal returns during the financial crisis. Cross-sectional tests show that this effect is more pronounced among banks with greater information asymmetry. Decomposition of LLPs suggests that these findings are driven mainly by nondiscretionary LLPs. Overall, our results suggest that the relationship between LLPs and future stock returns is not linear but contingent on bank regulations and macroeconomic conditions.

1. Introduction

Banks act primarily as financial intermediaries in the economic system. Loans constitute the largest proportion of assets held by banks (64.7% in our sample), and loan loss provisions (LLPs) represent the largest single accrual by banks (Beatty and Liao, 2014). Consequently, LLPs have long been an important topic of bank accounting research. Although studies suggest that LLPs are associated with contemporaneous stock returns (e.g., Beaver and Engel, 1996; Ahmed et al., 1999), little is known about whether LLPs can predict future stock

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returns. Our study attempts to fill this gap in the literature by examining whether LLPs are associated with future stock returns and, if so, whether this relationship is homogenous across time and banks.

Using data on 1751 unique U.S. banks from 1994 to 2017, we find that on average, LLPs are significantly negatively associated with one year ahead stock returns. This is consistent with banks' use of LLPs for earnings and capital management, which causes opacity in their financial statements (e.g., Ahmed et al., 1999; Kanagaretnam et al., 2009; Perez et al., 2011). As a result, the stock market overreacts to the LLP information that year, leading to a downward correction in future stock returns.

There is considerable variation in the recognition of LLPs over time (Beatty and Liao, 2011), and we expect the relationship between LLPs and future stock returns to vary accordingly. To test this conjecture, we disaggregate our sample period into five subperiods and repeat the main regression. The first subperiod is 1994–2003, before the adoption of Basel II. Basel II enhanced the Basel regulatory framework with three pillars of capital adequacy requirements, supervisory review and market discipline. Although the ordinary least squares (OLS) regression results show a significantly negative relationship between LLPs and future stock returns in this subperiod, this relationship becomes insignificant when using the Fama–Macbeth regression. The second subperiod is 2004–2006, during which Basel II was adopted. Basel II requires banks to disclose the credit risk model used to estimate loan losses, which enhances the transparency of their financial statements. Consistent with our expectation, both the OLS and Fama–Macbeth regressions reveal a positive association between LLPs and future stock returns in this subperiod. The third subperiod covers the 2007–2009 subprime financial crisis, during which banks had stronger incentives to manipulate their reported earnings via LLPs. In this subperiod, our OLS and Fama–Macbeth regressions consistently show a significantly negative relationship between LLPs and future stock returns. The fourth subperiod is the 2010–2015 post-financial crisis period, during which LLPs remain significantly negatively associated with future stock returns. The last subperiod is 2016–2017, during which Basel III was proposed. During this subperiod, LLPs are positively (though not statistically significantly) associated with future stock returns.

To reinforce the above regression results, we examine whether trading strategies based on LLPs generate abnormal stock returns. Specifically, we focus on the value-weighted returns of quarterly rebalanced quintile LLP portfolios. The results show that firms in the lowest quintile portfolio significantly outperform those in the highest quintile, reaffirming the negative association between LLPs and future stock returns. In the subperiod analysis, during the financial crisis period, taking long positions in the quintile with the highest LLPs and short positions in the quintile with the lowest LLPs generates a significantly negative abnormal return of 19.3% per year. In contrast, during the Basel II subperiod, taking long positions in the quintile with the highest LLPs and short positions in the quintile with the lowest LLPs generates a significantly positive abnormal return of 2.5% per year. These findings are consistent with the regression results.

Collectively, our findings suggest that the market does not fully incorporate LLP information. Such mispricing is contingent on bank regulations and macroeconomic conditions. Furthermore, the effects of LLP on stock returns vary between banks according to their characteristics. We hypothesize that the relationship between LLPs and future stock returns exists mainly for banks with an opaque information environment, as such banks tend to have the strongest incentives to use LLPs to manipulate reported earnings. Following the literature (e.g., Kanagaretnam et al., 2004), we measure information transparency using book-to-price ratio, firm size and analyst coverage. Consistent with our prediction, we find that the mispricing of LLPs primarily occurs among banks with greater information asymmetry.

Our study contributes to the literature in several ways. First, we offer insights into the valuation of LLPs. Early studies focus primarily on the relationship between LLPs and contemporaneous stock prices or returns (i.e., the value relevance of LLPs) (e.g., Beaver et al., 1989; Wahlen, 1994; Beaver and Engel, 1996). Beaver et al. (1989) document a positive relationship between loan loss reserves and market value using a 1979–1983 sample period. Consistent with Beaver et al. (1989), Wahlen (1994) finds a positive relationship between the discretionary portion of LLPs and stock returns after controlling for changes in nonperforming loans and loan charge-offs. However, to the best of our knowledge, few studies consider the return predictability of LLPs. One exception is Hwang and Kim (2017). Using a full sample of U.S. banks during 1994 to 2010, they find that LLPs are negatively related to one year ahead future returns. Our study differs from Hwang and Kim (2017) in two important respects. First, whereas Hwang and Kim (2017) consider the mispricing of LLPs to be homogenous across time, we examine how the return predictability of LLPs is conditional on bank regulations and macroeconomic shocks. Second, using more recent data, our study has potential policy implications for the adoption of Basel III, which aims to strengthen banks' transparency. Moreover, our study adds to understanding of how components of LLPs influence valuation. The literature yields mixed findings in this regard. Some research documents a positive relationship between discretionary LLPs (DLLPs) and bank stock returns (e.g., Beaver et al., 1989; Wahlen, 1994; Liu and Ryan, 1995; Kanagaretnam et al., 2004), suggesting that the discretionary component of LLPs conveys favorable information that is incrementally positively priced (Kanagaretnam et al., 2009). However, other studies (e.g., Hwang and Kim, 2017) document that nondiscretionary LLPs (NLLPs) are the main driver of the return predictability of LLPs. In this study, we provide new evidence that NLLPs exhibit a pattern similar to that of LLPs in terms of return predictability.

The remainder of this paper is organized as follows. Section 2 discusses the institutional background of bank regulations. Section 3 provides a literature review and develops our hypotheses. Section 4 presents the empirical models for hypothesis testing. Section 5 describes the empirical results. Section 6 concludes the paper.

2. Institutional background

The bank regulations pertinent to our study are the Basel capital regulations and accounting standards for loan losses. In the U.S., accounting standards are promulgated by the Financial Accounting Standards Board (FASB). The FASB issued Statement of Financial Accounting Standards (SFAS) 114 *Accounting by Creditors for Impairment of a Loan*, which is the accounting standard for credit losses for loans (uncollateralized and collateralized), except for large groups of loans that are collectively evaluated for impairment, loans that are measured at fair value, leases and debt securities as defined in SFAS 115 *Accounting for Certain Investments in Debt and Equity Securities.* SFAS 114 amends SFAS 5 to specify how a creditor should evaluate the collectability of the contractual interest and principal of receivables when assessing the need for a loss accrual. SFAS 114 is effective for fiscal year-ends beginning after 15 December 1994.

The accounting model under SFAS 114 is called the incurred loan loss model. This model requires a loan's loss probability to meet the threshold of "probable" before it can be recognized as an expense on a bank's income statement. The incurred loan loss model is severely criticized for delaying the recognition of loan losses, particularly during the global financial crisis that started in 2008, as incurred loan losses are considered not sufficiently forward-looking (López-Espinosa et al., 2021). The application of the incurred loan loss model varies, as it requires bank managers to use their judgment and discretion to decide whether the "probable" threshold has been met.

In response to criticisms of the incurred loan loss model, the FASB recommended using the expected credit loss model in Accounting Standards Update (ASU) 2016–13 as a replacement for the incurred loan loss model. The expected credit loss model requires banks to estimate future credit losses from the reporting date until loan maturity according to borrowers' probabilities of default. The expected credit loss model is intended to remedy the weaknesses of the incurred loan loss model and make loan loss estimates more forward-looking. ASU 2016–13 is effective for fiscal years ending after 15 December 2019. The banks in our sample follow SFAS 114 and the incurred loan loss model. However, some banks may have changed their loan provisioning practices to align with the new measure of expected credit losses when ASU 2016–13 was issued in 2016.

Banks are highly leveraged entities, and the banks in our sample have an average book-to-market ratio of 0.07%. Given banks' high leverage and pivotal role in the financial stability of economies, central bankers around the world impose capital adequacy requirements based on Bank for International Settlements (BIS) guidelines. The Basel Committee on Banking Supervision (BCBS) of the BIS is the global standard setter for the prudential regulation of banks. Its 45 members are central bankers and bank supervisors from 28 jurisdictions. The first BCBS document to set out agreement between the G-10 central bankers on minimum capital requirements for their banking industries was the Basel Capital Accord (BCBS, 1988), which was to be implemented by year-end 1992. The U.S. government adopted these capital requirements in the Basel Capital Accord. Banks were governed by the Basel Capital Accord until 2003.

In June 1999, the BCBS published the first round of proposals for replacing the Basel Capital Accord with Basel II. The BCBS subsequently released additional proposals for consultations in January 2001 and April

2003 and conducted three quantitative impact studies related to the proposals. Basel II has three pillars aimed at enhancing banks' risk management: minimum capital requirements, supervisory review and market discipline. The revised framework includes the Market Risk Amendment, which considers market risks in trading activities, counterparty credit risks and the risk of both borrower and guarantor defaulting on the same obligation. Basel II allows banks with sophisticated risk management systems to use the inputs generated by their internal systems for capital calculations, an internal ratings based approach, as an alternative to the broad standardized approach. The overall objective of the revised framework is to set capital requirements that are more risk sensitive than those in the Basel Capital Accord. The revised framework contains changes to the treatment of expected losses, unexpected losses, securitization exposures, credit risk mitigation and qualifying revolving retail exposures. The BCBS also clarified the incorporation of economic downturns in calculations of loss-given-defaults in the internal ratings based approach (BCBS, 2004). We consider 2004 the year of implementation of Basel II.

In 2006, U.S. housing prices started to falter. In February 2007, Freddie Mac announced that it would no longer purchase risky subprime mortgage loans. Subsequently, fund redemptions were halted by Bear Stearns in June 2007 and by BNP Paribas in August 2007. The following month, Northern Rock, the U.K.'s fifth largest mortgage lender, suffered a bank run after its money market funding was cut. In the first quarter of 2008, the U.S. Federal Reserve slashed the federal funds rate by 75 basis points and announced it would loan US $200 billion in Treasury securities to prop up the mortgage-backed securities market. In September 2008, the U.S. government had to bail out Fannie Mae and Freddie Mac, and then Lehman Brothers filed for bankruptcy. A credit crunch gripped the market. The U.S. government bailed out American International Group. The U.S. banks Washington Mutual and Wachovia went under. The U.S. Treasury secretary announced the Troubled Asset Relief Program to buy bad assets and support the financial sector. The Fed introduced quantitative easing in November 2008. The 2007–2009 period is considered a major pre-crisis/crisis period that saw significant changes to banks' loan provisions and market reactions to them.

The global financial crisis provided the impetus for the BCBS to accelerate the development of the Basel III framework. The Basel III framework was designed to address vulnerabilities in the pre-crisis regulatory framework. Basel III enhanced the risk sensitivity of standardized approaches to credit risk, credit valuation adjustment risk and operational risk. An example of enhanced risk sensitivity is the use of mortgages' loan to value ratios to assign mortgage risk weights, instead of the flat risk weights used under Basel II. Basel III revised the internal ratings based approach in Basel II. The Basel III framework specifies supplementary requirements for risk-weighted capital ratios, one of which is a leverage ratio requirement to constrain excessive risk-taking. A leverage ratio buffer is an additional requirement for systemically important banks. Other requirements are liquidity coverage and net stable funding ratios to mitigate excessive liquidity risk (BCBS, 2010).

Compared with Basel II, Basel III places greater emphasis on loss-absorbing capital in the form of common equity Tier 1 (CET1) capital. Its increased capital requirements are designed to ensure that banks are sufficiently resilient to withstand losses in times of stress. The minimum Tier 1 ratio requirement was raised in phases, from 4.0% in 2012 to 4.5% in 2013, 5.5% in 2014 and 6% in 2015. Basel III incorporated macroprudential elements with the introduction of capital buffers that can be built in good times and drawn down in times of stress to mitigate cyclicality. Capital conservation buffers were phased in, increasing from 0.625% in 2016 to 1.25% in 2017, 1.875% in 2018 and 2.5% in 2019. The minimum total capital remains 8% under Basel III. The sum of minimum total capital and the capital conservation buffer was increased to 8.625% in 2016 (BCBS, 2010). Thus, 2016 is considered the beginning of the post-Basel III period. In the next section, we review the literature pertinent to our study and detail our contributions to it.

3. Literature review and hypothesis development

There is a large body of literature on loan loss accounting. One stream of the literature considers the use of LLPs for earnings management (Ma, 1988; Beatty et al., 1995; Kanagaretnam et al., 2004; Fonseca and Gonzalez, 2008) and regulatory capital management (Moyer, 1990), because LLPs involve considerable managerial estimation of future loan defaults and such estimations inevitably contain errors. Moreover, banks recognize loan losses according to their policies and the state of the economy. As a result, it is difficult for users of financial information to estimate bank loan losses. Ma (1988) provides early evidence that banks use LLPs to smooth income by increasing (decreasing) LLPs when their operating income is high (low). Banks also target certain LLP levels to meet regulatory capital requirements by increasing LLPs when current loan charge-offs are high. Collins et al. (1995) investigate how banks' capital, earnings and tax decisions affect their seven capital raising options: securities gains and losses, LLPs, loan charge-offs, capital notes, common stock, preferred stock and dividends. They estimate bank-specific regressions for each capital raising option on the regulatory capital, earnings and marginal tax rates and provide evidence that banks differ in their responsiveness to capital, earnings and tax incentives. They also provide evidence that U.S. banks use LLPs to manage earnings and capital. Beatty et al. (1995) differ from Collins et al. (1995) by using simultaneous equations to investigate five capital raising options: LLPs, loan loss charge-offs, pension settlements, miscellaneous gains and losses and the issuance of new securities. They document banks' use of LLPs, loan loss charge-offs and new securities issuances to manage regulatory capital.

Moyer (1990) hypothesizes that banks with capital below the regulatory minimum seek to reduce their regulatory costs by adjusting their LLPs to increase capital and finds evidence to support this hypothesis. Ahmed et al. (1999) use the 1990 change in US bank capital regulations to test US banks' use of LLPs to manage capital and earnings. In 1990, the bank capital regulations were changed such that LLPs are no longer Tier 1 capital but still count as total capital, and they are limited to 1.25% of risk-weighted assets. Ahmed et al. (1999) hypothesize that this regulation change reduced (increased) the incentive to use LLPs to manage capital (earnings) and find strong evidence to support their capital management hypothesis but no evidence to support their earnings management hypothesis. Kanagaretnam et al. (2004) examine various situations in which LLPs are used for earnings management. They hypothesize and find that bank managers with pre-managed earnings that deviate more (less) from the median are more (less) likely to use LLPs to smooth earnings. These studies show that LLPs are related to bank opacity. Blau et al. (2017) provide evidence that bank opacity is related to stock price delays and affects stock price efficiency.

Studies of the relationship between LLPS and stock returns include Kanagaretnam et al. (2009) and Liu et al. (1997). Kanagaretnam et al. (2009) find a significant positive association between the discretionary component of LLPs and stock returns for banks audited by Big 5 auditors. Liu et al. (1997) find a statistically significant positive association between bank stock returns and LLPs in the fourth fiscal quarter among banks with low regulatory requirements. Evidence of the return predictability of LLPs is mixed. Marton and Runesson (2017) find that during International Financial Reporting Standards (IFRS) bank years, LLPs are less predictive of future credit losses than local GAAP, although the benefits of local GAAP are limited to high-enforcement regimes. However, Gebhardt and Novotny-Farkas (2018) report that the predictive ability of LLPs improved following IFRS adoption in the European Union. López-Espinosa et al. (2021) report that LLPs under the expected credit loss model, compared with those under the incurred loan loss model, are more predictive of future bank risk. Beatty and Liao (2021) document that analyst provision forecasts incrementally predict future nonperforming loans (NPLs) and market returns, suggesting that incurred LLPs do not incorporate all available future loss information. In contrast with these studies, we examine the relationship between LLPs and one year ahead stock returns over time. We contribute to the literature by providing evidence to support the hypothesis that the relationship between LLPs and future stock returns is not linear but contingent on bank regulations and macroeconomic conditions.

The literature indicates that LLPs may be difficult to decipher, leading to the possibility that equity investors cannot correctly price LLPs and thus overreact to the information they contain (Wahlen, 1994). Accordingly, the overpricing of LLPs in a current period will be corrected downward in future periods. Thus, we propose the following hypothesis:

*H1***:** *On average, LLPs are negatively associated with future stock returns.*

The literature documents that during the financial crisis period, banks tended to overstate the value of their assets and regulatory capital (Huizinga and Laeven, 2012; Cohen et al., 2014). Using a sample of U.S. banks in the 2001–2009 period, El Sood (2012) finds that banks used LLPs more aggressively during the crisis period to smooth income upward. That is, banks experienced more pressure to use LLPs for earnings or capital management during the financial crisis period than during non-crisis periods. Therefore, we hypothesize as follows:

H2: The negative relationship between LLPs and future stock returns is more pronounced during the financial crisis period than during other periods.

As documented in the literature, changes in banking or accounting regulations that affect banks' provisioning practices tend to affect the informativeness of banks' LLPs and their market valuation (Kim and Kross, 1998; Hamadi et al., 2016). For example, under Basel I, reducing LLPs allowed managers to inflate earnings and regulatory capital and thereby obscure the value of their banks (Kim and Kross, 1998). Basel II requires banks to compute a forward-looking measure of expected loss on their loan portfolios and to deduct the difference between this expected measure and the actual (accounting) LLPs from their regulatory capital (BCBS, 2004). Thus, Basel II reduces banks' incentive to smooth income by opportunistically using income-increasing LLPs (Hamadi et al., 2016). As discussed in Section 2, Basel III improves on Basel II by introducing a loan loss provisioning system that requires banks to set aside specific provisions on newly originated loans according to individual borrower characteristics that drive loan performance (Wezel et al., 2012). The Basel III framework prescribes more common equity, creates a capital buffer and introduces leverage, liquidity coverage and net stable funding ratios. These tighter capital and liquidity regulations constrain the use of LLPs for earnings management (Lim et al., 2021). During the Basel III period, the use of LLPs to signal positive private information (Wahlen, 1994) is likely to dominate earnings management incentives. However, if banks increase capital by reducing LLPs (i.e., manage capital) because of the stringent Basel III capital requirements (Lim et al., 2021), future stock returns will react negatively to the decrease in current-period LLPs. Based on these arguments, we hypothesize the following

H3: The negative relationship between LLPs and future stock returns is weaker during the Basel II and III periods than during non-Basel II and III periods.

4. Data and methodology

4.1. Data sources

We collect banks' fundamental data from Compustat, which provides information on banks' quarterly LLPs, nonperforming loans, net charge-offs, total loans, Tier 1 risk-adjusted capital ratio, earnings, total assets, and total equity. Similar to Beatty and Liao (2011), we scale LLPs, nonperforming loans and net charge-offs by lagged total loans. The equity returns, share price and shares outstanding data are downloaded from the Center for Research in Security Prices (CRSP) database. We construct risk-adjusted return (*ARET*) as quarterly returns adjusted for the value-weighted returns of all the banks in the same quarter. *ARET1* is risk-adjusted quarterly returns from the following month of the reporting quarter. The analyst coverage data are from the Institutional Brokers Estimate System (IBES) database. After merging the data from Compustat, CRSP and IBES, our sample contains 51,743 bank-year observations, covering 1751 unique banks from January 1994 to December 2017.

4.2. Methodology

To link LLPs to bank opacity, we first conduct a mediation analysis following Blau et al. (2017). We use the turnover ratio to measure bank opacity and run an OLS regression on the following models:

$$ARET_{i,t} = \alpha + \beta_1 LLP_{i,t-1} + Controls_{i,t-1} + \epsilon \quad (1)$$

$$TURN_{i,t-1} = \alpha + \beta_1 LLP_{i,t-1} + Controls_{i,t-1} + \varepsilon \quad (2)$$

$$ARET_{i,t} = \alpha + \beta_1 LLP_{i,t-1} + TURN_{i,t-1} + Controls_{i,t-1} + \varepsilon \quad (3)$$

For bank i in quarter t, $LLP_{i,t-1}$ is lagged LLPs divided by lagged total loans. *Controls* includes the following: $Lag(dNPL_{i,t-1})$ is $NPL_{i,t-2}$minus$NPL_{i,t-3}$; $dNPL_{i,t-1}$ equals $NPL_{i,t-1}$minus$NPL_{i,t-2}$; $NPL_{i,t-1}$ is lagged nonperforming loans divided by lagged total loans; $NCO_{i,t-1}$ is net charge-offs divided by lagged total loans;

$TLTA_{i,t-1}$ is lagged total loans divided by total assets; $SIZE_{i,t-1}$is the log of banks' market capitalization. $CAPR1Q_{i,t-1}$ is the Tier 1 risk-adjusted capital ratio; $EBP_{i,t-1}$ is earnings before LLPs; $MB_{i,t-1}$is market capitalization divided by total equity; $ARET_{i,t-1}$ is risk-adjusted returns and $TURN_{i,t-1}$ is the turnover ratio calculated as trading volume divided by shares outstanding. By observing a statistically significant natural indirect effect, we can link LLPs to bank opacity.

In our main analysis, we test the ability of LLPs to predict returns with the OLS regression as model [1]. Equation (1) is run for the entire sample and each subsample period. To study investors' perceptions of the return predictability of LLPs over time, we divide the sample into Basel II and Basel III subsamples. The first subsample covers 1994 to 2003, which is the pre-Basel II period. The second subsample is from 2004 to 2006 and covers the Basel II policy implementation period. The third subsample is from 2007 to 2009, which is before the financial crisis. The fourth subsample is from 2010 to 2015, which is the pre-Basel III period. The fifth subsample is from 2016 to 2017,[1] during which Basel III was proposed.[2]

As a robustness check, we report the panel regression results using year fixed effects in the following model:

$$ARET_{i,t} = \alpha + \beta_1 LLP_{i,t-1} + Controls_{i,t-1} + YearFE + \varepsilon \quad (4)$$

As a second robustness check, we report the estimates from a multivariate Fama and MacBeth (1973) regression of the following model:[3]

$$ARET_{i,t} = \alpha + \beta_1 LLP_{i,t-1} + Controls_{i,t-1} + \varepsilon \quad (5)$$

We calculate the standard errors of the slope coefficients in equation (5) using the Newey–West (1987) adjustment for serial correlations.

As a third robustness check, we report the estimates from a generalized method of moments (Hansen, 1982) regression of the following model:

$$ARET_{i,t} = \alpha + \beta_1 LLP_{i,t-1} + Controls_{i,t-1} + \varepsilon \quad (6)$$

Our generalized method of moments (Hansen, 1982) uses heteroskedasticity-robust weight matrix in the estimation of the regression coefficients. We also run equations (4), (5) and (6) for the entire sample and each subsample period. We report the estimated coefficients with their standard errors clustered by GICS industry for all of the regression models, except the Fama–Macbeth regression, in which we compute Newey–West standard errors. This follows the finding of Hrazdil and Scott (2013) that GICS results in more reliable industry groupings for industry analysis and research, compared with the three alternatives: the Standard Industrial Classification codes, North American Industry Classification System and Fama–French classification. In our sample, the GICS industries include banks, thrifts, and mortgage finance, diversified financial services, capital markets and consumer finance. As our sample comprises U.S. listed banks, using GICS helps us further classify their business models to be controlled by fixed effects. The fixed effects include banks, thrifts and mortgage finance, diversified financial services, capital markets and consumer finance. By controlling the sub-industry fixed effects, our estimated coefficients of regression are less likely to be biased due to omitted factors that vary across the business models of our sample.

As a fourth robustness check, we report the estimates from an OLS regression of the following equation using an alternate measure of risk-adjusted return:

[1] A study on the effect of Basel II on the market valuation of discretionary LLPs also uses a short 3-year period (Hamadi et al., 2016). The use of short 2-year and 3-year subsample periods is a potential shortcoming.

[2] The literature and regulatory documents provide the timelines that mark the key events. The initial Basel II policy implementation period is defined as the period after the Basel II policy document were released but before Basel II was effective and before the financial crisis, i.e., 2004–2006 (BCBS, 2004). The financial crisis period (2007–2009) follows Cohen et al. (2014). Lim and Ow Yong (2016) document an initially negative market reaction to the Basel II regulatory announcements, with the reaction weakening over time. We define the post-Basel II and post-financial crisis period as 2010–2015. The Basel III period is defined as 2016–2017, when the capital conservation buffers were added.

[3] Fama and MacBeth's (1973) estimation approach is commonly used in the return prediction literature. Following this stream of the literature, our estimation involves the following steps. We (1) regress each stock return against the control variables to determine that bank's beta for that risk factor; (2) regress all stock returns for a fixed period against the estimated betas to determine the risk premium; and (3) report the model estimates and t-statistics with standard errors adjusted for serial correlations, with up to four lags (Newey and West, 1987).

$$ARET_{i,t} = \alpha + \beta_1 LLP_{i,t-1} + Controls_{i,t-1} + \varepsilon \tag{7}$$

We calculate risk-adjusted returns following Fama and French (2015), including market premium, size (SMB), growth (HML), profitability (RMW) and investment (CMA) factors.

To decompose the return predictability of LLPs, we perform OLS regression analysis for each year and report the coefficient estimates on LLP, discretionary LLPs ($DLLP$) and non-dictionary LLPs ($NDLLP$). We decompose LLP into $DLLP$ and $NDLLP$ using the following equation:

$$LLP_{i,t} = \alpha + \beta_1 NPL_{i,t-1} + \beta_2 dNPL_{i,t-1} + \beta_3 Lag(dNPL_{i,t-1}) + \beta_4 Future(dNPL_{i,t+1}) + \beta_5 NCO_{i,t-1} + \beta_6 TLTA_{i,t-1} + \varepsilon \tag{8}$$

where $DLLP$ is discretionary LLPs, calculated as the residuals of equation (8). $NDLLP$ is nondiscretionary LLPs, calculated as the fitted value of equation (8). $NDLLP$ behaves similarly to LLP in predicting future returns because of the design of the decomposition. One concern regarding the decomposition is that it incorporates future changes in NPL, which can only be observed in the next quarter, t. Therefore, the significant coefficient estimates in the OLS regression do not translate into a meaningful trading strategy.

5. Empirical results

5.1. Summary statistics and correlations

Table 1 presents the descriptive statistics for the variables in our analyses. The mean LLP for the firms in our sample is 0.001, and the mean $DLLP$ ($NDLLP$) is 0.000 (0.001). Nonperforming loans account for 1.9% of total loans on average, and net charge-offs account for 0.1%.

Table 2 presents the correlation matrix. LLP is significantly negatively associated with one-quarter ahead stock returns, lending initial support to H1, which predicts that LLPs are overvalued in the current period. Decomposing LLP suggests that both $DLLP$ and $NDLLP$ have negative relationships with future stock returns. Furthermore, the correlation between $DLLP$ and $NDLLP$ is negative.

Table 1
Summary statistics. This table reports the descriptive statistics of the main variables in the regression analysis. We obtain quarterly U.S. bank data from CRSP and Compustat for the 1 January 1994 to 30 June 2017 sample period. There are 1751 unique banks in the sample. *LLP* is loan loss provisions, calculated as loan loss provisions (Compustat "pllq") divided by lagged total loans (Compustat "lntalq"). *NPL* is nonperforming loans, calculated as nonperforming loans (Compustat "npatq") divided by lagged total loans (Compustat "lntalq"). *NCO* is net charge-offs, calculated as net charge-offs divided by lagged total loans (Compustat "lntalq"). *TLTA* is total loans calculated as lagged total loans (Compustat "lntalq") divided by total asset. *SIZE* is the log of market capitalization. *CAPR1Q* is the Tier 1 risk-adjusted capital ratio (Compustat "capr1q") at the beginning of the quarter. *EBP* is earnings before loan loss provisions, calculated as (Compustat "piq" plus Compustat "pllq" scaled by lagged Compustat "lntalq"). *MB* is market-to-book ratio. *DLLP* is discretionary loan loss provision, calculated as the residuals of the regression of *LLP* on *NPL*, changes in *NPL* from the last quarter, lagged changes in *NPL* and future changes in *NPL*, *NCO* and *TLTA*. *NDLLP* is nondiscretionary loan loss provision, calculated as the fitted value of the regression of *LLP* on *NPL*, changes in *NPL* from the last quarter, one quarter lagged changes in *NPL*, changes in *NPL* in the coming quarter, *NCO* and *TLTA*. *ARET* is risk-adjusted quarterly returns calculated as quarterly returns minus the value-weighted returns of all of the banks in the same quarter.

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
LLP	57,115	0.001	0.003	−0.008	0.043
DLLP	51,776	0.000	0.003	−0.126	0.131
NDLLP	51,776	0.001	0.016	−0.853	0.123
NPL	56,740	0.019	0.031	0.000	0.949
NCO	56,954	−0.001	0.003	−0.046	0.007
TLTA	58,241	0.648	0.134	0.012	0.927
SIZE	59,822	11.918	1.764	7.432	19.471
CAPR1Q	57,348	11.746	4.021	−0.700	70.370
EBP	57,112	0.006	0.009	−0.062	0.489
MB	57,870	1.432	0.705	−0.211	6.398
ARET	59,520	−0.003	0.093	−0.574	0.968

Table 2

Correlation matrix. This table reports the cross-sectional correlations for the entire sample period. *LLP* is loan loss provisions scaled by lagged total loans. *NPL* is nonperforming loans scaled by lagged total loans. *NCO* is net charge-offs scaled by lagged total loans. *TLTA* is lagged total loans scaled by total assets. *SIZE* is the log of market capitalization. *CAPR1Q* is the Tier 1 risk-adjusted capital ratio. *EBP* is earnings before loan loss provisions scaled by lagged total loans. *MB* is market-to-book ratio. *DLLP* is discretionary loan loss provision, calculated as the residuals of the regression of *LLP* on *NPL*, changes in *NPL* from the last quarter, lagged changes in *NPL* and future changes in *NPL*, *NCO* and *TLTA*. *NDLLP* is nondiscretionary loan loss provision, calculated as the fitted value of the regression of *LLP* on *NPL*, changes in *NPL* from the last quarter, one quarter lagged changes in *NPL*, changes in *NPL* in the coming quarter, *NCO* and *TLTA*. *ARET* is risk-adjusted quarterly returns calculated as quarterly returns minus the value-weighted returns of all of the banks in the same quarter. *ARET1* is risk-adjusted quarterly returns from the last month of the reporting quarter. All of the variables are winsorized at 0.5% and 99.5% by year.

Variable	*ARET1*	*LLP*	*DLLP*	*NDLLP*	*NPL*	*NCO*	*TLTA*	*SIZE*	*CAPR1Q*	*EBP*	*MB*	*ARET*
ARET1	1.000											
LLP	−0.075	1.000										
DLLP	−0.015	0.545	1.000									
NDLLP	−0.016	0.120	−0.005	1.000								
NPL	−0.032	0.383	−0.006	−0.084	1.000							
NCO	0.039	−0.629	−0.286	0.058	−0.484	1.000						
TLTA	−0.020	0.027	0.020	0.087	−0.088	0.063	1.000					
SIZE	−0.020	−0.031	−0.023	−0.018	−0.159	0.044	−0.180	1.000				
CAPR1Q	−0.001	−0.073	−0.041	−0.018	0.019	0.049	−0.216	0.002	1.000			
EBP	0.032	−0.095	−0.036	−0.085	0.067	−0.013	−0.305	0.271	0.121	1.000		
MB	−0.056	−0.183	−0.018	−0.021	−0.320	0.174	−0.091	0.449	−0.036	0.314	1.000	
ARET	0.011	−0.133	−0.062	−0.022	−0.054	0.069	−0.017	−0.015	0.004	0.065	−0.048	1.000

5.2. Baseline regression results

We conduct a mediation analysis to link LLPs to bank opacity, which is a price efficiency channel. Following Blau et al. (2017), we measure bank opacity using the stock turnover ratio (*TURN*), calculated as trading volume divided by total shares outstanding, and find that the mediation effect is significant.

Panel A of Table 3 presents the OLS regression estimates. In column (1), we predict risk-adjusted stock return using *LLP* and *Lag(dNPL)*, *dNPL*, *NPL*, *NCO*, *TLTA*, *SIZE*, *CAPR1Q*, *EBP*, *MB* and *ARET*. In column (2), we predict the quarterly turnover ratio, which represents bank opacity, using *LLP* and *Lag (dNPL)*, *dNPL*, *NPL*, *NCO*, *TLTA*, *SIZE*, *CAPR1Q*, *EBP*, *MB* and *ARET*. In column (3), we predict quarterly returns using *LLP* and *Lag(dNPL)*, *dNPL*, *NPL*, *NCO*, *TLTA*, *SIZE*, *CAPR1Q*, *EBP*, *MB*, *ARET* and the mediating factor *TURN*. In columns (1) and (2), we find that *LLP* is significant in explaining both future stock returns and concurrent period turnover ratios, but the significance level drops in column (3) when we include turnover ratio. To further check the mediation effect, we report the natural direct effect, natural indirect effect and total effect in Panel B. We find that although the magnitude of the drop is small, the *t*-statistic is −5.14, which is statistically significant at the 1% level.

Panel A of Table 4 presents the OLS results for the multivariate regression analysis. In column (1) the entire sample is tested, and the coefficient on *LLP* is significantly negative at the 1% level. This is consistent with H1 that *LLP* has a negative effect on future stock returns. We then divide the sample into five subperiods pertinent to bank regulations and economic conditions. The results are reported in columns (2)–(7). Column (2) covers 1994 through 2003. The coefficient on *LLP* is negative but insignificant. Column (4) covers 2004 to 2006, during which Basel II was adopted. The coefficient on *LLP* is positive and statistically significant at the 5% level. Column (5) covers the subprime financial crisis from 2007 to 2009. *LLP* appears to have a significantly negative impact on future stock returns. Column (6) covers 2010–2015 (the post-crisis period), during which *LLP* remains significantly negatively associated with future stock returns. Column (7) is estimated based on the 2016–2017 period, when Basel III and the expected credit loss model were proposed. During this period, *LLP* is positively associated with future stock returns. Overall, the results reported in Panel A of Table 4 suggest that LLPs are negatively associated with future stock returns, on average. Consistent with our H2 and H3, this effect mainly occurs in the financial crisis period but is moderated during the initial stages of the Basel II and III periods.

Table 3
Mediation analysis. This table presents the regression results for the mediation analysis. Panel A reports the ordinary least squares regression estimates. The first model explains risk-adjusted return using *LLP* and other control variables, including *Lag(dNPL)*, *dNPL*, *NPL*, *NCO*, *TLTA*, *SIZE*, *CAPR1Q*, *EBP*, *MB* and *ARET*. The second model explains the mediation factor, turnover ratio (*TURN*), using the same control variables as model [1]. The third model includes *TURN* and all of the control variables in model [1]. Panel B reports the mediation analysis based on the natural indirect effect, which is the difference between the natural direct effect and the total effect. The *t*-statistics are reported in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Panel A: Ordinary least squares regression

	[1] ARET1	[2] TURN	[3] ARET1
LLP	−3.801***	36.688***	−3.579***
	[−18.55]	[17.35]	[−12.07]
Lag(dNPL)	−0.968***	2.486**	−0.953***
	[−5.54]	[3.71]	[−5.82]
dNPL	−0.762	−0.465	−0.765
	[−1.78]	[−1.14]	[−1.80]
NPL	−0.125	0.429	−0.123
	[−1.63]	[0.90]	[−1.63]
NCO	0.200	−4.011**	0.177
	[1.23]	[−4.48]	[1.05]
TLTA	−0.007	−0.143*	−0.008
	[−1.67]	[−2.71]	[−2.01]
SIZE	−0.000	0.208***	0.001
	[−0.72]	[55.29]	[0.86]
CAPR1Q	−0.001*	−0.010**	−0.001*
	[−2.22]	[−3.51]	[−2.45]
EBP	2.072***	−5.003*	2.036***
	[7.20]	[−2.30]	[7.36]
MB	−0.025***	−0.228***	−0.027***
	[−7.39]	[−20.68]	[−8.87]
ARET	−0.020	0.068	−0.019
	[−1.47]	[0.99]	[−1.45]
TURN			−0.006
			[−1.63]
Intercept	0.037*	−1.461***	0.027
	[2.14]	[−16.11]	[1.19]
Obs.	49,443	50,993	49,443
Adj. R^2	0.021	0.239	0.022

Panel B: Mediation analysis

	Estimate	t-value	95% Conf. Interval	
Natural Direct Effect	−3.444***	[−8.96]	−4.198	−2.691
Natural Indirect Effect	−0.217***	[−5.14]	−0.299	−0.134
Total Effect	−3.661***	[−9.58]	−4.410	−2.912

We also analyze the full sample in three broad subperiods in columns (2), (3) and (7). Column (3) covers the entire Basel II period from 2004 to 2015. *LLP* is significantly negatively associated with one-quarter-ahead returns during this period. The results for the Basel II period remain negative but are more significant than those for the Basel I period. This indicates that the market initially reacted to the regulation change from Basel I to Basel II as having a significant effect on the use of LLPs. Similarly, the relationship between *LLP* and one-quarter-ahead returns becomes positive during the initial stage of the Basel III period. This is consistent with our theory that during the Basel III period, when banks are required to meet new capital conservation buffers, their ability to manage earnings is constrained (Lim et al., 2021). The use of LLPs to signal positive private information (Wahlen, 1994) dominates earnings management incentives during the Basel III period. As a result, LLPs are positively associated with future stock returns.

Panel B of Table 4 presents the panel regression with year fixed effects. The result is largely consistent with the results in Panel A for the entire sample period and during 1994–2003 (i.e., the pre-Basel II period),

Table 4

Multivariate regression analysis. This table presents the results of the multivariate regression analysis. Panel A reports the ordinary least squares regression estimates. Panel B reports the panel regression with year fixed effects. Panel C reports the Fama–Macbeth regressions estimates. Standard errors are calculated with the Newey–West adjustment. Panel D reports the generalized method of moments regression estimates. Panel E reports the ordinary least squares regression estimates using an alternative risk-adjusted returns based on the Fama and French (2015) five factors. Standard errors are clustered by GICS industry in Panels A, B, D and E. The first model tests the entire sample from January 1994 to June 2017. The second model tests from 1994 to 2003, which is the pre-Basel II period. The third model tests 2004 to 2015, the entire Basel II period. We separate the Basel II period into three stages: the initial stage in model [4] (2004–2006), the financial crisis in model [5] (2007–2009) and the last stage in model [6] (2010–2015). The seventh model covers the initial stage of Basel III from January 2016 to June 2017. The *t*-statistics are reported in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Panel A: Ordinary least squares regression

	[1] All	[2] 1994–2003	[3] 2004–2015	[4] 2004–2006	[5] 2007–2009	[6] 2010–2015	[7] 2016–2017
LLP	−3.792***	−0.926	−3.979***	3.880**	−1.530**	−6.906***	2.586
	[−19.05]	[−1.51]	[−42.06]	[3.30]	[−3.43]	[−34.21]	[0.49]
Lag(dNPL)	−0.976***	0.446**	−1.698***	−1.355***	−1.666*	−1.243**	0.345
	[−5.59]	[3.03]	[−5.46]	[−5.75]	[−3.18]	[−5.29]	[1.59]
dNPL	−0.750	−0.256***	−0.939	−0.588***	−2.512**	−0.093	−0.444
	[−1.77]	[−11.64]	[−1.48]	[−5.96]	[−5.65]	[−0.14]	[−1.83]
NPL	−0.121	−0.309***	0.201**	−0.483	0.207*	0.102	0.264
	[−1.59]	[−49.06]	[3.10]	[−2.13]	[3.12]	[1.03]	[1.82]
NCO	0.223	0.377	−0.330	1.489	−1.870	0.060	7.472
	[1.32]	[1.49]	[−1.11]	[0.74]	[−1.51]	[0.09]	[0.69]
TLTA	−0.007	0.022*	−0.027*	0.017	−0.125***	0.012	−0.001
	[−1.74]	[2.22]	[−2.22]	[1.51]	[−6.02]	[1.31]	[−0.12]
SIZE	−0.000	0.002	−0.001	−0.004**	0.002	−0.001	−0.003
	[−1.00]	[1.33]	[−2.10]	[−3.73]	[0.69]	[−1.76]	[−2.02]
CAPR1Q	−0.001*	−0.002**	0.001	−0.001	0.005***	−0.000**	−0.003**
	[−2.23]	[−4.56]	[1.73]	[−0.93]	[8.36]	[−4.89]	[−5.30]
EBP	2.058***	1.770***	1.895**	1.851**	1.532**	1.759**	4.889*
	[7.20]	[8.31]	[3.79]	[2.89]	[4.26]	[3.35]	[2.42]
MB	−0.025***	−0.037***	−0.013***	0.002	−0.014	−0.038***	−0.056**
	[−7.40]	[−8.84]	[−4.75]	[1.28]	[−2.35]	[−14.58]	[−3.52]
ARET	−0.020	0.050**	−0.100***	−0.031*	−0.122***	−0.127***	−0.169***
	[−1.46]	[2.86]	[−13.26]	[−2.50]	[−9.46]	[−30.13]	[−12.10]
Intercept	0.037*	0.028	−0.002	0.004	−0.039	0.036*	0.149**
	[2.22]	[1.41]	[−0.14]	[0.15]	[−1.13]	[2.39]	[4.10]
Obs.	49,312	23,593	22,788	6511	6137	10,140	2932
Adj. R^2	0.021	0.025	0.038	0.015	0.045	0.041	0.053

Panel B: Panel regression with year fixed effects

	[1] All	[2] 1994–2003	[3] 2004–2015	[4] 2004–2006	[5] 2007–2009	[6] 2010–2015	[7] 2016–2017
LLP	−4.735***	−3.498***	−4.124***	2.115**	−2.132	−3.867***	−5.407
	[−30.10]	[−9.18]	[−76.29]	[3.32]	[−2.12]	[−6.22]	[−1.80]
Lag(dNPL)	−0.802***	0.408	−1.316**	−0.498**	−1.195*	−1.018**	2.149***
	[−5.83]	[1.80]	[−4.31]	[−3.65]	[−3.04]	[−4.07]	[21.04]
dNPL	−0.745	−0.378***	−0.807	−0.247**	−2.093**	0.065	−0.360**
	[−2.05]	[−18.22]	[−1.33]	[−3.56]	[−5.60]	[0.11]	[−4.43]
NPL	−0.228	−0.348	−0.066	−1.372***	−0.291	0.101	−1.432***
	[−1.80]	[−1.46]	[−0.32]	[−4.97]	[−1.38]	[0.55]	[−7.73]
NCO	−0.110	−0.239**	−0.393	1.154	−1.517	1.275**	−1.682
	[−0.42]	[−2.89]	[−0.94]	[0.65]	[−1.21]	[4.25]	[−0.25]
TLTA	0.008	0.051**	−0.035*	−0.081	−0.237	−0.098	0.360**
	[0.76]	[4.42]	[−2.53]	[−1.50]	[−2.13]	[−1.56]	[5.68]
SIZE	−0.046***	−0.081***	−0.054***	−0.155***	−0.136***	−0.072***	−0.169***
	[−36.37]	[−13.84]	[−7.66]	[−47.31]	[−6.14]	[−14.24]	[−31.00]

(*continued on next page*)

Table 4 (*continued*)

Panel B: Panel regression with year fixed effects

	[1] All	[2] 1994–2003	[3] 2004–2015	[4] 2004–2006	[5] 2007–2009	[6] 2010–2015	[7] 2016–2017
CAPR1Q	−0.000	−0.000	0.001***	0.000	0.010**	0.000	−0.006***
	[−0.55]	[−0.38]	[8.11]	[0.22]	[4.33]	[0.79]	[−17.67]
EBP	1.855***	0.559**	2.299***	2.673***	2.398***	1.185**	1.879
	[5.26]	[3.92]	[7.62]	[25.83]	[9.23]	[3.79]	[0.49]
MB	−0.024***	−0.040***	−0.003*	−0.033**	0.033	−0.077***	−0.221***
	[−6.62]	[−5.10]	[−2.64]	[−3.62]	[2.18]	[−7.59]	[−42.42]
ARET	−0.161***	−0.186***	−0.162***	−0.242***	−0.251***	−0.227***	−0.496***
	[−26.59]	[−40.26]	[−34.18]	[−33.96]	[−102.58]	[−31.54]	[−75.25]
YEAR FE	Yes	YES	YES	YES	YES	YES	YES
Intercept	0.463***	0.862***	0.659***	2.005***	1.565**	0.910***	2.369***
	[22.88]	[10.60]	[7.36]	[34.14]	[5.25]	[9.22]	[255.78]
Obs.	49,312	23,593	22,788	6511	6137	10,140	2932
Adj. R^2	0.133	0.221	0.067	0.142	0.076	0.113	0.342

Panel C: Fama−Macbeth regression

	[1] All	[2] 1994–2003	[3] 2004–2015	[4] 2004–2006	[5] 2007–2009	[6] 2010–2015	[7] 2016–2017
LLP	−2.861***	−2.456**	−4.017***	1.129	−6.083**	−5.557***	2.057
	[−3.65]	[−2.42]	[−3.46]	[0.51]	[−2.73]	[−4.08]	[0.69]
Lag(dNPL)	−0.475**	−0.184	−0.689***	−0.549	−1.343**	−0.432*	−0.643
	[−2.60]	[−0.56]	[−3.06]	[−1.17]	[−2.39]	[−1.76]	[−1.32]
dNPL	−0.302	−0.574	−0.302	0.257	−1.244	−0.110	1.052
	[−1.29]	[−1.60]	[−0.91]	[0.43]	[−1.43]	[−0.31]	[1.68]
NPL	−0.299***	−0.223**	−0.434***	−0.758***	−0.814**	−0.081	0.135
	[−3.53]	[−2.28]	[−3.19]	[−4.85]	[−2.64]	[−0.49]	[0.48]
NCO	−0.367	0.992	−1.502	−0.169	−3.313	−1.263	−0.359
	[−0.52]	[1.11]	[−1.49]	[−0.10]	[−1.25]	[−1.01]	[−0.10]
TLTA	−0.002	0.007	−0.006	0.047*	−0.101	0.016	−0.021
	[−0.16]	[0.64]	[−0.27]	[1.97]	[−1.57]	[1.22]	[−0.85]
SIZE	−0.001	−0.001	−0.001	−0.002	0.002	−0.002	−0.003
	[−0.49]	[−0.29]	[−0.25]	[−1.29]	[0.19]	[−0.71]	[−0.92]
CAPR1Q	−0.000	−0.001***	0.001	−0.000**	0.006**	−0.001*	−0.002**
	[−0.80]	[−3.87]	[0.98]	[−2.43]	[2.89]	[−2.07]	[−2.44]
EBP	1.509***	2.043***	1.075***	1.719***	0.063	1.259**	1.441
	[5.99]	[6.64]	[2.73]	[4.86]	[0.06]	[2.27]	[1.51]
MB	−0.018***	−0.017***	−0.021**	−0.004	0.001	−0.040**	−0.011*
	[−3.65]	[−4.52]	[−2.16]	[−1.28]	[0.07]	[−2.79]	[−2.28]
ARET	−0.096***	−0.099***	−0.091***	−0.067***	−0.085	−0.106***	−0.112*
	[−7.45]	[−5.40]	[−4.75]	[−3.21]	[−1.24]	[−6.89]	[−2.09]
Intercept	0.021	0.027	0.004	−0.029	−0.070	0.057	0.098***
	[0.74]	[0.73]	[0.08]	[−1.12]	[−0.39]	[1.54]	[3.53]
Obs.	50,109	23,874	23,208	6607	6244	10,357	3027

Panel D: Generalized method of moments regression

	[1] All	[2] 1994–2003	[3] 2004–2015	[4] 2004–2006	[5] 2007–2009	[6] 2010–2015	[7] 2016–2017
LLP	−3.430***	−0.005	−3.547***	5.236**	−0.697	−7.435***	7.306
	[−3.16]	[−0.00]	[−2.76]	[2.06]	[−0.36]	[−5.00]	[1.21]
Lag(dNPL)	−1.196***	1.036**	−1.711***	−1.416**	−1.763**	−1.197***	−1.343
	[−4.56]	[2.47]	[−5.22]	[−2.30]	[−2.40]	[−2.93]	[−1.52]
dNPL	−0.167	0.070	−0.301	−0.441	−1.563	0.665	0.947
	[−0.42]	[0.12]	[−0.62]	[−0.49]	[−1.39]	[1.19]	[0.63]
NPL	−0.356***	−1.014***	−0.064	−0.928**	−0.004	−0.239*	−0.211
	[−4.56]	[−5.36]	[−0.57]	[−2.26]	[−0.02]	[−1.88]	[−0.36]

Table 4 (*continued*)

Panel D: Generalized method of moments regression

	[1] All	[2] 1994–2003	[3] 2004–2015	[4] 2004–2006	[5] 2007–2009	[6] 2010–2015	[7] 2016–2017
NCO	−1.280	0.323	−1.441	1.296	−2.593	−2.497	8.762
	[−1.03]	[0.20]	[−0.98]	[0.48]	[−0.97]	[−1.42]	[1.55]
TLTA	−0.020*	−0.000	−0.008	0.024	−0.089**	0.033	−0.031
	[−1.77]	[−0.01]	[−0.52]	[1.39]	[−2.46]	[1.36]	[−0.62]
SIZE	−0.000	0.002	0.002	−0.006***	0.007	0.000	−0.007**
	[−0.17]	[0.90]	[1.21]	[−3.01]	[1.42]	[0.26]	[−2.03]
CAPR1Q	−0.000	−0.002***	0.002***	0.000	0.004***	0.001	−0.003*
	[−0.82]	[−4.38]	[4.03]	[0.02]	[3.09]	[1.64]	[−1.94]
EBP	1.413***	1.600***	0.985***	2.574***	1.116	0.923***	3.540
	[5.07]	[2.76]	[3.68]	[3.34]	[1.02]	[4.75]	[1.22]
MB	−0.024***	−0.035***	−0.017***	−0.004	−0.023	−0.032***	−0.041***
	[−7.46]	[−5.51]	[−4.36]	[−1.00]	[−1.51]	[−4.26]	[−4.44]
ARET	−0.005	0.062***	−0.068***	−0.003	−0.103***	−0.086***	−0.160***
	[−0.36]	[4.62]	[−3.65]	[−0.10]	[−3.79]	[−3.50]	[−5.27]
Intercept	0.041***	0.063**	−0.044**	0.014	−0.095	−0.009	0.199***
	[2.61]	[2.26]	[−2.04]	[0.63]	[−1.43]	[−0.30]	[3.68]
Obs.	16,812	6054	9448	2482	2541	4425	1310

(continued on next page)

Table 4 (continued)

Panel E: OLS regression on risk-adjusted return by Fama and French (2015)

	[1] All	[2] 1994–2003	[3] 2004–2015	[4] 2004–2006	[5] 2007–2009	[6] 2010–2015	[7] 2016–2017
LLP	−0.617***	−0.787**	−0.583	−0.053	0.131	−1.131**	−1.598
	[−8.29]	[−3.15]	[−1.28]	[−0.09]	[0.16]	[−4.18]	[−1.45]
Lag(dNPL)	−0.021	−0.018	−0.020	0.039	0.242	−0.053	−0.049
	[−0.26]	[−0.40]	[−0.19]	[0.19]	[1.52]	[−0.35]	[−0.57]
dNPL	−0.146*	−0.338***	−0.059	−0.116	−0.423	0.097	0.142
	[−2.18]	[−26.23]	[−0.52]	[−1.82]	[−1.28]	[0.33]	[2.15]
NPL	−0.071**	−0.111***	−0.058*	−0.066	−0.168	−0.016	0.020
	[−3.46]	[−6.64]	[−2.76]	[−0.91]	[−1.34]	[−0.65]	[0.83]
NCO	−0.046	0.007	−0.234	−1.142*	−0.242	−0.282	−1.284
	[−0.20]	[0.04]	[−0.27]	[−2.76]	[−0.11]	[−1.95]	[−1.21]
TLTA	−0.003	−0.009**	0.005	0.012**	−0.013	0.005	−0.004
	[−0.97]	[−3.47]	[0.52]	[3.62]	[−0.65]	[0.87]	[−0.82]
SIZE	0.001**	−0.000	0.002***	−0.001*	0.004**	0.003***	−0.005***
	[4.12]	[−0.04]	[5.54]	[−2.14]	[4.14]	[6.25]	[−9.74]
CAPR1Q	0.000	−0.000***	0.001**	0.000	0.003**	−0.000	−0.000
	[1.89]	[−6.16]	[3.21]	[0.89]	[3.22]	[−0.05]	[−0.01]
EBP	0.522**	0.353***	0.692**	0.586*	1.133***	0.161	0.437
	[3.70]	[6.38]	[2.94]	[2.23]	[7.55]	[0.70]	[1.06]
MB	−0.002***	−0.002	−0.001	−0.002*	0.001	−0.002	0.005
	[−5.73]	[−1.72]	[−1.54]	[−2.15]	[1.02]	[−0.87]	[1.34]
ARET	−0.011***	0.008	−0.030***	−0.005	−0.049***	−0.013*	0.013**
	[−4.74]	[2.01]	[−14.81]	[−0.49]	[−9.71]	[−2.81]	[5.64]
Intercept	−0.007***	0.012	−0.036**	−0.001	−0.076	−0.034*	0.052*
	[−7.17]	[1.66]	[−3.51]	[−0.09]	[−2.25]	[−2.75]	[3.06]
Obs.	48,622	23,185	22,532	6423	6061	10,048	2906
Adj. R^2	0.003	0.002	0.007	0.002	0.016	0.006	0.016

2004–2015 (i.e., the Basel II period) and 2007–2009 (i.e., the financial crisis period). Nevertheless, these results should be interpreted with caution because of the short event windows.

Panel C of Table 4 presents the Fama–Macbeth regression results. For the full sample, *LLP* is significantly negatively associated with future stock returns. The negative relationship remains during 1994–2003 (i.e., the pre-Basel II period), 2004–2015 (i.e., the Basel II period), 2007–2009 (i.e., the financial crisis period) and

Table 5
Time-series analysis.

Panel A

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
LLP	**−5.688**	**−6.614**	**−2.095**	−2.93	2.631	**−4.043**	**−3.708**	−1.091	−0.536	**4.374**	**4.655**	**4.419**
DLLP	**−3.385**	**−2.903**	**−5.631**	**−2.613**	−0.08	**−1.614**	−2.575	4.936	**−3.304**	1.208	−0.952	**1.747**
NDLLP	**−3.087**	**−2.401**	**3.347**	**−2.358**	**3.34**	**−7.273**	**−5.308**	**−9.658**	4.177	2.379	**7.044**	**4.444**

Panel B

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
LLP	**−5.582**	**−19.15**	**−4.902**	0.000	**−4.601**	**−4.581**	−2.949	−5.400	−4.063	**−10.522**	**6.964**	−1.35
DLLP	**−4.092**	−0.403	0.06	**2.853**	−0.941	−0.175	−1.136	0.787	−0.914	**−0.495**	1.856	−5.352
NDLLP	−3.951	**−14.187**	−2.266	**−5.978**	−2.672	−0.507	−2.004	0.483	**0.674**	**0.434**	−1.369	**7.521**

This table presents the ordinary least squares regression estimates of quarterly return predictions by year. The first regression model is $ARET_{i,t} = \alpha + \beta_1 LLP_{i,t-1} + Controls_{i,t-1} + \varepsilon$ where β_1 is reported in the first row.
The second regression model is
$ARET_{i,t} = \alpha + \beta_2 DLLP_{i,t-1} + Controls_{i,t-1} + \varepsilon$ where β_2 is reported in the second row.
The third regression model is
$ARET_{i,t} = \alpha + \beta_3 NDLLP_{i,t-1} + Controls_{i,t-1} + \varepsilon$ where β_3 is reported in the third row.
Controls includes *NPL*, change and the lagged changes in *NPL*, *NCO*, *TLTA*, *SIZE*, *CAPR1Q*, *EBP*, *MB* and *ARET*. Panel A reports the regression estimates of *LLP*, *DLLP* and *NDLLP* for each year from 1994 to 2005. Panel B reports the regression estimates of *LLP*, *DLLP* and *NDLLP* for each year from 2006 to 2017. Standard errors are clustered by GICS industry. Estimates that are significant at at least the 10% level are in bold.

2010–2015 (i.e., the post-crisis period). However, this negative relationship is less significant during the period when Basel III and the expected credit loss model were proposed. These results lend further support to our hypotheses.

Panel D of Table 4 presents the results using the generalized method of moments approach. The estimated coefficients are consistent with those in Panel A, with slightly lower *t*-statistics for the full sample and each subperiod. The statistically significant results reported in Panel A remain for the entire sample period and 1994–2003 (i.e., the pre-Basel II period), 2004–2015 (i.e., the Basel II period), 2010–2015 (i.e., the post-crisis period) and 2016–2017 (when Basel III and the expected credit loss model were proposed). These results further bolster our main findings.

Panel E of Table 4 presents the OLS regression results using an alternative risk-adjusted return based on Fama and French (2015), adjusting for market premium, size (*SMB*), growth (*HML*), profitability (*RMW*) and investment (*CMA*) factors. The estimated coefficients are consistent with those in Panel A, with slightly lower *t*-statistics for the full sample and each subperiod. The statistically significant results reported in Panel A remain largely unchanged for the entire sample period and during 1994–2003 (i.e., the pre-Basel II period), 2004–2015 (i.e., the Basel II period) and 2007–2009 (i.e., the financial crisis period).[4]

5.3. Year-by-year regression results

To further explore the return predictability of LLPs on a time-series basis, Table 5 presents the OLS regression estimates of quarterly return predictions by year. In most of the sample years (11 of 24 years), the coefficient on *LLP* is statistically negative. In particular, the coefficient is the most negative in the financial crisis period (2007: −19.150) versus the average coefficient of −3.801 during the full sample period. However, the coefficient on *LLP* turns positive for the initial years of Basel II (2004: 4.655) and Basel III (2016: 6.964).

[4] We perform subsample analysis rather than DiD for the following reasons: First, a major objective of our study is to test the time-series variation in the relationship between LLPs and future stock returns. This differentiates our study from those that look at the entire sample period. Second, because the time gap between events is short, there is overlap in the event windows. For example, the post-Basel II period is also the pre-crisis period. In the presence of such confounding effects, it is challenging to draw meaningful conclusions based on the DiD design.

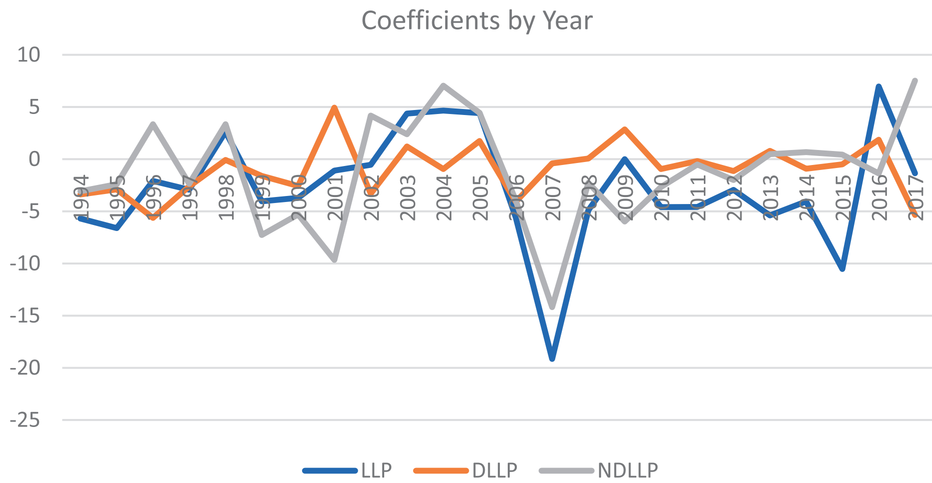

Fig. 1. OLS regression estimates of *LLP*, *DLLP* and *NDLLP* by year.

In addition, we decompose *LLP* into *DLLP* and *NDLLP*. Although both *DLLP* and *NDLLP* show patterns similar to that of *LLP*, the effect of *LLP* on future stock returns is mainly driven by *NDLLP*. For example, during the 2007–2009 financial crisis period, the coefficients on *DLLP* are −0.403, 0.06 and 2.853 in 2007, 2008 and 2009, respectively, whereas the coefficients on *NDLLP* are −14.187, −2.266 and −5.978 in 2007, 2008 and 2009 respectively. Moreover, the average coefficient on *DLLP* during the Basel II (III) period is 0.038 (−1.349), compared with 0.751 for *NDLLP* (−0.833). The coefficients by year are graphically represented in Fig. 1.

5.4. Hedge portfolio analysis

Table 6 reports the mean annual returns to various LLP quintile portfolios and their hedge returns. The results in column (1), based on the full sample, show that the higher the LLPs, the lower the future returns. The hedge portfolio strategy based on the level of *LLP* yields a positive annual return of 6.1% that is statistically significant at the 1% level. The results in column (3), based on the Basel II period, suggest that the higher the LLPs, the higher the future returns. Thus, taking long positions on stocks in the highest quintile and short positions on stocks in the lowest quintile generates a significantly positive annual return of 4.7%. In contrast, the results in column (4) are for the financial crisis period and show that the higher the LLPs, the lower the future returns. During this period, taking long positions on stocks in the lowest quintile and short positions on stocks in the highest quintile generates a significantly positive annual return of 34.4%, which is statistically and economically sizable. These results are also consistent with the regression results in Table 4.

5.5. Cross-sectional variation tests

In this subsection, we test whether the relationship between LLPs and future stock returns is conditional on banks' information environment. We measure information transparency using book-to-price (B/P) ratio, bank size and analyst coverage. The literature suggests that when a bank's B/P ratio is high, the bank is relatively undervalued, and therefore its managers have stronger incentives to use LLPs to signal private good news (Kanagaretnam et al., 2004). Bank size is measured by market capitalization, and analyst coverage is measured by the number of analysts following the bank. Both size and analyst coverage are positively related to banks' information environment.

Table 7 presents the subsample results based on B/P ratio. In Panel A, the coefficient estimate on *LLP* is −2.729 with a *t*-statistic of −5.20 for the entire sample period for the banks with a low B/P ratio. The next two rows consist of high B/P ratio banks, where the coefficient on *LLP* is −4.908 with a *t*-statistic of −32.64 for the entire sample period. The difference between the two subsamples is −2.179, with a *t*-statistic of −3.99. The difference in the coefficients on *LLP* between the banks with high versus low B/P ratios are positive and sig-

Table 6

Univariate portfolio analysis. This table reports the value-weighted returns of quarterly rebalanced quintile *LLP* portfolios; the return differentials between the top and bottom *LLP* quintiles are at the quarterly and annual levels. The first model tests the entire sample. The second model tests the 1994–2003 period. The third model tests the 2004–2006 Basel II period. The fourth model tests the 2007–August 2009 financial crisis period. The fifth model tests the September 2010–2015 period. The sixth model tests the 2016–2017 period, when Basel III was proposed. We do not have sufficient data to calculate the one year ahead return of the portfolio in this model. Standard errors are clustered by GICS industry. The *t*-statistics are reported in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	[1]	[2]	[3]	[4]	[5]	[6]
Low	−0.035	−0.021	−0.076	−0.091	−0.054	0.055
2	−0.045	−0.025	−0.063	−0.229	−0.067	0.064
3	−0.060	−0.036	−0.047	−0.272	−0.090	0.062
4	−0.070	−0.041	−0.050	−0.260	−0.091	0.054
High	−0.083	−0.050	−0.029	−0.306	−0.122	0.097
High-Low	−0.061***	−0.031	0.047**	−0.344***	−0.069	0.042
	[−2.72]	[−1.61]	[2.06]	[−3.02]	[−1.47]	[1.43]
ARET1Y	−0.022*	−0.005	0.025***	−0.193***	−0.008	
	[−1.95]	[−0.54]	[2.96]	[−4.69]	[−0.36]	

nificant during 1994–2003, which is the Basel I period. Panel B reports the results based on bank size. Similarly, for the small banks, the coefficient on *LLP* is −5.903, with a *t*-statistic of −7.41 for the entire sample period. However, for the large banks, the coefficient on *LLP* is −0.457, with a *t*-statistic of −2.27 for the entire sample. The difference between the two groups is 5.446, with a *t*-statistic of 6.63. The coefficients on *LLP* are economically and statistically more significant for smaller banks during the Basel I and Basel II periods. In Panel C, the differences between high and low analyst coverage are also positive, but they are only statistically significant during the Basel III period.

The results reported in Table 7 suggest that the baseline regression results are mainly driven by banks with a high level of information asymmetry, which have the strongest incentives to use LLPs to manage their earnings or regulatory capital.

5.6. Discretionary and nondiscretionary loan loss provisions

The literature uses signaling as a key explanation for market reactions to LLPs (Elliott et al., 1991; Wahlen, 1994; Beaver and Engel, 1996, Liu et al., 1997). Wahlen (1994) seeks to determine what investors learn from unexpected changes in nonperforming loans, LLPs and loan charge-offs. LLPs incorporate managerial expectations regarding loan losses and a discretionary element. Wahlen (1994) argues that unexpected changes in nonperforming loans and unexpected loan charge-offs are correlated with nondiscretionary unexpected future loan losses and unexpected loan losses in the current period, respectively, and that investors can estimate the discretionary component of unexpected LLPs. He demonstrates that unexpected changes in nonperforming loans and unexpected loan charge-offs are negatively related to stock returns and future cash flows. Wahlen (1994) finds that after conditioning for the unexpected increase in nonperforming loans and loan charge-offs, there is a positive relationship between unexpected loan losses and returns and between unexpected loan losses and future cash flows. He interprets this result as evidence that the stock market interprets higher discretionary LLPs from managers as a signal of private good news.

Following this stream of the literature, we decompose *LLP* into *DLLP* and *NDLLP*. Panel A of Table 8 presents the results based on *DLLP*. The coefficients on *DLLP* are largely insignificant, except those for the financial crisis period (2007–2009). Panel B presents the results based on *NDLLP*. Similar to the pattern of *LLP*, *NDLLP* is negatively associated with future returns, significant at the 1% level, especially during the financial crisis period. Comparing the significance levels of the relations of *DLLP* and *NDLLP* with future returns, we find that the relationship between *LLP* and future stock returns is primarily driven by the nondiscretionary component of *LLP*.

Table 7

Subsample analysis In the panels, the full sample is divided into two groups according to proxies for managers' incentives to signal and information asymmetry: low (<50 percentile) and high (>50 percentile). *B*/*P* ratio is the book-to-price ratio. We follow Ohlson's (1995) framework to compute the intrinsic value of a bank. If the *B*/*P* ratio is high, the bank is relatively undervalued, and its managers therefore have more incentive to use LLPs as a signal of performance. We use bank size and analyst coverage as proxies for information asymmetry in Panels B and C, respectively. The slope coefficients and *t*-statistics (in parentheses) are reported from the ordinary least squares estimations. Standard errors are clustered by GICS industry. The associated *t*-statistics are reported in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Panel A: B/P					Panel B: Size				Panel C: Analyst coverage			
	All	1994–2003	2004–2015	2016–2017	All	1994–2003	2004–2015	2016–2017	All	1994–2003	2004–2015	2016–2017
	low	low	low	low	small	small	small	small	low	low	low	low
LLP	−2.729***	−1.854**	−3.055**	−0.503	−5.903**	−3.091***	−5.588***	−0.221	−4.911***	−1.45	−5.026***	−11.9***
	[−5.20]	[−4.18]	[−3.45]	[−0.06]	[−7.41]	[−2.56]	[−10.46]	[−0.06]	[−4.31]	[−1.37]	[−5.33]	[−5.26]
	high	high	high	high	large	large	large	large	high	high	high	high
LLP	−4.908***	−0.629	−4.498***	3.409*	−0.457*	1.297**	−0.459**	6.091	−2.116**	0.023	−2.554***	8.675
	[−32.64]	[−1.21]	[−14.49]	[2.47]	[−2.27]	[2.09]	[−4.59]	[1.04]	[−2.14]	[0.04]	[−2.59]	[1.34]
	high-low				large-small				high-low			
LLP	−2.179***	1.225*	−1.443	3.912	5.446***	4.388***	5.129***	6.312	2.795*	1.473	2.472*	20.575***
	[−3.99]	[1.79]	[−1.54]	[0.46]	[6.63]	[3.23]	[9.44]	[0.91]	[1.85]	[1.22]	[1.81]	[3.00]

Table 8

Discretionary and nondiscretionary loan loss provision analysis. This table presents the ordinary least squares regression estimates of discretionary loan loss provision (DLLP) and nondiscretionary loan loss provision (NDLLP). Panel A reports the regression estimates of *DLLP*. Panel B reports the regressions estimates of *NDLLP*. The first model tests the entire sample. The second model tests the 1994–2003 period. The third model tests the 2004–2015 Basel II period. The fourth model tests the 2004–2006 pre-financial crisis period. The fifth model tests the 2007–2009 financial crisis period. The sixth model tests the 2010–2015 post-crisis period. The seventh model tests the 2016–2017 period during which Basel III was proposed. Standard errors are clustered by GICS industry. The *t*-statistics are reported in parentheses ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	Panel A: DLLP						
	[1] All	[2] 1994–2003	[3] 2004–2015	[4] 2004–2006	[5] 2007–2009	[6] 2010–2015	[7] 2016–2017
DLLP	−0.253	−0.894	0.038	−0.569	1.722***	−0.424	0.751
	[−0.32]	[−1.35]	[0.05]	[−0.43]	[15.25]	[−0.30]	[0.39]
Lag(dNPL)	−1.105***	0.424*	−1.810***	−1.234**	−1.706**	−1.344**	0.447***
	[−6.87]	[2.51]	[−5.45]	[−4.55]	[−3.33]	[−5.18]	[13.20]
dNPL	−0.834	−0.255***	−1.092	−0.274	−2.613**	−0.265	−0.435**
	[−1.78]	[−13.30]	[−1.56]	[−1.53]	[−4.34]	[−0.37]	[−4.95]
NPL	−0.160	−0.336***	0.210*	−0.362*	0.251*	0.102	0.381**
	[−1.68]	[−19.48]	[2.52]	[−2.49]	[2.39]	[0.75]	[5.09]
NCO	2.207**	0.458	2.757**	0.014	0.353	4.778***	6.242
	[4.17]	[1.83]	[3.65]	[0.01]	[0.18]	[6.98]	[0.86]
TLTA	−0.010**	0.022*	−0.032**	0.017*	−0.127***	0.004	0.001
	[−3.04]	[2.18]	[−2.86]	[2.18]	[−5.85]	[0.50]	[0.08]
SIZE	−0.001	0.002	−0.001*	−0.004**	0.002	−0.001	−0.003
	[−1.66]	[1.21]	[−2.35]	[−3.14]	[0.66]	[−1.14]	[−1.93]
CAPR1Q	−0.001*	−0.002***	0.001	−0.001	0.005***	−0.000**	−0.003***
	[−2.24]	[−4.70]	[1.82]	[−0.98]	[8.28]	[−5.65]	[−10.15]
EBP	2.010***	1.739***	1.906**	1.819*	1.597**	1.581*	4.970*
	[6.40]	[8.54]	[3.44]	[2.54]	[3.73]	[2.88]	[2.50]
MB	−0.025***	−0.037***	−0.012**	0.003	−0.015*	−0.036***	−0.057**
	[−7.36]	[−8.81]	[−4.15]	[1.26]	[−2.55]	[−15.08]	[−3.49]
ARET	−0.016	0.051**	−0.095***	−0.040*	−0.119***	−0.114***	−0.174***
	[−1.17]	[2.90]	[−10.72]	[−2.16]	[−8.32]	[−26.28]	[−10.96]
Intercept	0.041*	0.029	0.001	0.004	−0.035	0.035*	0.149**
	[2.54]	[1.43]	[0.11]	[0.13]	[−1.07]	[2.37]	[3.84]
Obs.	49,274	23,577	22,767	6507	6126	10,134	2931
adj. R^2	0.019	0.025	0.035	0.012	0.045	0.032	0.056

Panel B: NDLLP

	[1] All	[2] 1994–2003	[3] 2004–2015	[4] 2004–2006	[5] 2007–2009	[6] 2010–2015	[7] 2016–2017
NDLLP	−1.949*	−1.205**	−1.349	2.372*	−5.412**	−0.741	−0.833
	[−2.32]	[−3.98]	[−1.37]	[2.35]	[−4.01]	[−1.00]	[−0.69]
Lag(dNPL)	−1.033***	0.479**	−1.768***	−1.300**	−1.522**	−1.327**	0.479***
	[−6.33]	[3.26]	[−5.47]	[−4.38]	[−3.66]	[−5.24]	[8.65]
dNPL	−0.754	−0.253***	−1.010	−0.368	−2.292**	−0.223	−0.392**
	[−1.65]	[−10.13]	[−1.49]	[−2.01]	[−5.15]	[−0.31]	[−4.32]
NPL	−0.121*	−0.282***	0.218***	−0.429*	0.372*	0.108	0.379***
	[−2.59]	[−38.83]	[5.01]	[−2.62]	[2.87]	[1.08]	[6.93]
NCO	1.590**	0.333	2.144**	0.604	−2.439	4.601***	5.483
	[3.17]	[1.89]	[3.00]	[0.36]	[−2.00]	[12.55]	[0.70]
TLTA	−0.008	0.022*	−0.030*	0.016	−0.122***	0.005	0.002
	[−2.12]	[2.28]	[−2.60]	[1.79]	[−5.84]	[0.59]	[0.33]
SIZE	−0.000	0.002	−0.001	−0.004**	0.004	−0.001	−0.003
	[−1.15]	[1.31]	[−2.12]	[−3.24]	[1.04]	[−1.75]	[−2.07]
CAPR1Q	−0.001*	−0.002***	0.001	−0.001	0.005***	−0.000**	−0.003***
	[−2.16]	[−4.66]	[1.60]	[−1.03]	[9.53]	[−4.33]	[−11.03]
EBP	2.031***	1.785***	1.884**	1.810*	1.516**	1.532**	5.063*
	[6.73]	[8.77]	[3.61]	[2.62]	[3.87]	[3.45]	[2.64]

Table 8 (*continued*)

Panel B: NDLLP

	[1] All	[2] 1994–2003	[3] 2004–2015	[4] 2004–2006	[5] 2007–2009	[6] 2010–2015	[7] 2016–2017
MB	−0.025***	−0.037***	−0.012**	0.002	−0.018*	−0.036***	−0.057**
	[−7.20]	[−8.81]	[−4.00]	[1.29]	[−2.56]	[−10.99]	[−3.52]
ARET	−0.017	0.051**	−0.096***	−0.040	−0.122***	−0.114***	−0.174***
	[−1.25]	[2.91]	[−11.12]	[−2.04]	[−8.82]	[−35.41]	[−11.00]
Intercept	0.039*	0.028	0.000	0.005	−0.048	0.035	0.148**
	[2.36]	[1.38]	[0.01]	[0.17]	[−1.45]	[2.18]	[3.77]
Obs.	49,274	23,577	22,767	6507	6126	10,134	2931
adj. R^2	0.020	0.025	0.036	0.013	0.047	0.033	0.056

6. Conclusion

This study examines the effect of LLPs on future stock returns on a time-series basis. We find that on average, LLPs are negatively associated with future returns. After separating the full sample into five subperiods, our results show that the negative relationship between LLPs and future returns mainly occurs during the 2007–2009 financial crisis period. However, the relationship between LLPs and future returns is positive during the Basel II period. These results are primarily driven by the nondiscretionary component of LLPs and are more pronounced among banks with high information asymmetry.

These results have implications for various market participants, such as investors, regulators and standard-setters. First, as primary information users, investors should be aware of the information contained in LLPs, because it has valuation consequences. Second, regulators should enhance market participants' understanding of LLPs by improving the disclosure system pertinent to loan losses. Finally, standard-setters such as the FASB and IASB should develop a more credible loan loss provisioning model, aimed at providing more informative measures of expected loan losses.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Thinking of peace when rich: The effect of industry growth on corporate risk-taking

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ABSTRACT

We investigate the unique role and mechanisms of industry growth in firms' risk-taking policies. We find that industry growth is negatively associated with corporate risk-taking, consistent with the prospect theory that a high-growth industry gives firms a superior external environment, which may cause them to refrain from corporate risk-taking as in the saying "thinking of peace when rich." This correlation is stronger for product market leaders, industries encouraged by industry policies and industries that receive more government support. Firms reduce risk-taking through various corporate policies, including long-term, high-value investments, operational efficiency and cash holdings in response to high industry growth. Overall, our results are consistent with industry growth negatively affecting corporate risk-taking.

1. Introduction

The choice to take risks is one of the most important decisions involving corporate investment policies. Firms should engage in investment projects with positive expected net present value (NPV) to maximize corporate value and shareholder wealth (Fama and Miller, 1972). Risk-taking plays a significant role in improving corporate innovation enthusiasm and accelerating capital accumulation (Fiegenbaum and Thomas, 1988; John et al., 2008). Sustained economic growth depends on firms' willingness to take risks in pursuit of profitable investment opportunities (Hilary and Hui, 2009).

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Corporate risk-taking is affected by many factors. The first such factor is individual managerial characteristics such as gender (Faccio et al, 2016), religion (Jiang et al., 2015) and overconfidence (Adam et al., 2015), as well as CEOs' personal risk-taking preference (Cain and McKeon, 2016) and early-life exposure to fatal disasters (Bernile et al., 2017). The second is the influence of firm-level characteristics. Managers may choose to be risk-averse to pursue private interests, and appropriate compensation and turnover mechanisms may in turn strengthen managers' risk-taking (Coles et al., 2006; Chakraborty et al., 2007). Studies show that many other corporate governance factors—for example, corporate governance reform, large shareholder diversification, state and foreign owners, CEO ownership, ownership structure, creditor rights and board characteristics—are associated with corporate risk-taking (Acharya et al., 2011; Faccio et al, 2011; Kim and Lu, 2011; Wang, 2012; Boubakri et al., 2013; Dong et al., 2014; Koirala et al., 2020). Other corporate features such as the corporate life cycle, production networks, corporate social responsibility standing, employee stock options, knowledge management capabilities, debt enforcement and disclosures are also relevant (Favara et al., 2017; Habib and Hasan, 2017; Badia et al., 2020; Billings et al., 2020; Dunbar et al., 2020; Gofman et al., 2020; Hock-Doepgen et al., 2021). Finally, the macro-level institutional environment, which includes such aspects as economic policy uncertainty, investor protection, managerial taxes, the Sarbanes–Oxley Act, corruption, cultural tradition and labor protection, also influences risk-taking policies (John et al., 2008; Bargeron et al., 2010; Li et al., 2013; Chen et al., 2015; Armstrong et al., 2019; Jiang and Chen, 2021; Zhang et al., 2021). Studies provide extensive evidence of the factors of corporate risk-taking; however, corporate risk-taking policies also reflect the characteristics of industry growth and the market competition environment. Industry structure, production factor endowments, relative prices and related industrial policies exert considerable influence on corporate profit opportunities as well as corporate survival and, thus, influence corporate behavior and decision-making, including risk-taking policies. Firms' competitive investment and competitive behavior comprise one of the hot spots in the field of industrial organization theory and empirical research. Therefore, the analysis of corporate risk-taking policies should also focus on industry-level forces.

In this study, we investigate the role of industry growth in corporate risk-taking in emerging markets. The relationship between industry growth and corporate risk-taking may appear different in emerging markets than in developed markets. High industry growth rates mean improved development prospects, increased profitability, rapid growth of product demand and abundant resources and opportunities, which give firms the impression that supply is less than demand. Prospect theory and behavioral theory allow for objective, in-depth analysis of decision-makers' risk preferences from the new perspective of high-growth profitability, sufficient resources and cash flow. Under prospect theory and behavioral theory, corporate risk-taking is the result of firms' comparison of expectations or targets (Fiegenbaum and Thomas, 1988; Fiegenbaum et al., 1996). For returns below expectations, individuals are risk-seeking, whereas for returns above expectations, individuals are risk-averse. A high-growth industry gives firms a superior external environment in terms of demand, opportunities and profitability. In such an environment, it is easy for firms to live up to their expectations, which may cause them to refrain from corporate risk-taking, as expressed in the saying "Poverty leads to change, wealth to stability." The emerging market in China exhibits rapid growth with unprecedented market demand; thus, Chinese companies in fast-growing industries can earn high profits through short-term investment, especially when government industrial policies make it easy for them to obtain financial support in the form of subsidies and loans (Xu, 2011). Such companies' resources are rich and plentiful. As a result, firms in high-growth industries may lose the impetus to take risks and instead rely on the benefits of high growth rates. We use scenarios unique to China to discover the new mechanisms by which industry growth influences corporate risk-taking in emerging markets.

To test our predictions, we use a firm-level panel dataset consisting of 26,338 firm-year observations from publicly traded Chinese firms from 1999 to 2016. Following previous studies, we measure industry growth as the industry average sales growth rate (Lancaster, 1984; Fisman and Love, 2003; Hoitash et al., 2016). To proxy for corporate risk-taking, we use the variation in firm-level earnings over total assets (John et al., 2008). We run firm-level regressions of industry growth in a year and compare the variation in firm-level earnings over total assets for the subsequent 5 years. Consistent with prospect theory and behavioral theory in emerging markets analysis, a high industry growth rate restrains corporate risk-taking. Cross-sectional analysis provides consistent evidence that the effect is more pronounced for product market leaders, as they have more market share and thus higher persistent profitability. The effect is also more pronounced for industries promoted by industry policies and industries that receive more government support, as firms in these industries have access to more resources and support. The "thinking of peace when rich" phenomenon is strengthened for these firms.

To understand by what means firms reduce their risk-taking in response to high industry growth rates, we examine their long-term investments, existing operations and financial choices. We find that high industry growth rates significantly reduce long-term capital expenditure and R&D investment, reduce liquid asset turnover, lengthen the operating cycle and cause firms to hold more cash. We verify that our results are robust to using alternative windows to measure risk-taking and industry growth, for example, the variation in firm-level earnings over total assets for the subsequent 3 years. We also create a ranked measure of industrial sales growth that is independent of total assets to provide further evidence that our identification is not influenced by firms' asset size in the industry. Additionally, we find that our results remain the same after we remove outliers for asset structure. We conduct a series of endogenous tests and find that our results are robust to these designs.

Our study contributes to multiple streams of literature. First, we investigate cross-sectional variation in corporate risk-taking behavior by applying concepts from the industrial perspective to emerging markets. Against a unique background comprising both China's rapid economic development and institutional policy support, we provide direct evidence of the effect of an industry-level characteristic, that is, industry growth, on emerging markets. Second, we contribute to the finance and accounting literature on the consequences of industry growth. This literature documents the effects of industry growth on investment decisions (Maksimovic and Phillips, 2008), strategy content (McDougall et al., 1994) and corporate performance (Hoitash et al., 2016), among other elements. We contribute by examining the effect of industry growth on corporate risk-taking. Finally, we contribute to the literature on prospect theory and behavioral theory (Fiegenbaum and Thomas, 1988; Fiegenbaum et al., 1996) by demonstrating that it is not only firms' high returns but the superior external environment that leads them to maintain the status quo and to be risk-averse.

The remainder of this paper proceeds as follows. Section 2 discusses our hypotheses; Section 3 describes the sample, data and research design; and the empirical analysis and main results are reported in Section 4. Section 5 presents cross-sectional heterogeneity analysis, Section 6 presents channel mechanism analysis, Section 7 reports the robustness tests and Section 8 provides concluding remarks.

2. Hypothesis development

A firm's risk-taking behavior reflects its managers' choices of investment projects with uncertain expected income and cash flow. Although taking excessive risks can lead to bankruptcy, few firms can succeed without taking risks (Nakano and Nguyen, 2012). Classical economic theory posits that entrepreneurs are innovators and explorers who are brave enough to take risks in pursuit of excess profits, to eschew old production modes and to seek new opportunities. This behavior is indeed the driving force of sustained economic growth (Drucker, 1986). Thus, the outstanding characteristic of successful entrepreneurs is that they dare to take risks and innovate, and the essence of entrepreneurship is the pursuit of profits through taking risks. Firms that engage in high risk-taking rarely pass up high-risk, high-return investment opportunities. Such opportunities are often accompanied by high capital expenditure (Cain and McKeon, 2016), high innovation initiative and more R&D investment (Ljungqvist et al., 2017).

The industry environment accounts for much of the variation in corporate survival and investment policies (Ghemawat, 1984). "Industry" generally refers to the kind of economic activity classified by the production of similar products, similar processes or similar types of services. An industry typically has many similar products or similar business conducts as its constituent elements. According to industry life cycle theory, an industry has an obvious life cycle and typically experiences initial high-speed growth, followed by stable development and, eventually, gradual decline. The high-speed growth stage is marked by rising product sales and expanding sales groups. At this stage, there is more demand than supply, the product price is high and the net profit per unit product is at its highest, creating an ideal setting for firms to increase their market share (Szymanski et al., 1993; Anderson et al., 1994; Blundell et al., 1999; Aghion et al., 2005). The structure–conduct–performance paradigm posits that industry structure determines the competitive landscape within an industry, which in turn affects a firm's behavior and strategic choices and, ultimately, determines firm performance. In periods of relatively high growth or low growth, the internal structure of the industry, factor endowment, relative prices and differences between the divisions of labor in the industrial chain determine firms' profit opportunities and threats to their survival. Industry growth, firm number, scale and market forces within an industry interact with each other, leading to changes in industry structure and companies' strategic choices and performances. Corporate risk-taking is an important investment decision-making orientation that is obviously affected by industry growth.

Prospect theory and behavioral theory extend the decision-making behaviors of individuals to those of firms. Corporate risk-taking policies are the result of firms' comparison of various expectations or targets. A firm is more prone to risk-avoidance in times of profit, and it is more prone to risk-seeking in times of loss. In individual behavior, a target is the difference in value between the individual's assessment of normal competencies and the ideal performance as the individual perceives it (Kahneman and Tversky, 1979; Baum et al., 2005). When a given industry is high-growth, the market is promising, and it is relatively easy to make money and gain benefits (Keats and Hitt, 1988). Well-developed markets can provide managers with more opportunities and resources to support sustainable development. In such an environment, managers achieve their anticipated goals and are easily satisfied. They become content with what they have and no longer have the motivation to undertake risky investments to generate value in the future; thus, they lose their impetus toward ventures and innovation, as being rich provides safety and stability.

China's economic reform and opening up to foreign investment has placed its economy and society in a stage of rapid growth. Compared with the planned economy era, market demand has expanded unprecedentedly. In this environment, firms in high-growth industries can earn high profits through short-term investment. Accordingly, the motivation to create value through high-risk innovation and other value-based, long-term investments has weakened. Furthermore, since China's economic reform and opening up, the East Asian model of government-led market development has received great attention and recognition in China. It has become an important macro control tool in developing countries to guide industrial development through industrial policies, realize rapid economic growth by taking advantage of being late-comers to the market (Rodrik, 2009). Studies also show that firms in high-growth industries shaped by industrial policy support can obtain central transfer payments more easily, which stimulates local economic vitality and development (Stiglitz, 2017). Firms in industries supported by industrial policies may also become the "favorites" of local governments, which provide firms with financial support such as subsidies and loans; thus, these firms are especially rich in resources. Firms in high-speed growth industries are more likely to avoid risks and enjoy industrial dividends.

Based on these prospect theory and behavioral theory analyses, especially in the context of emerging markets, we propose the following hypothesis:

H1. Industry growth is negatively associated with corporate risk-taking.

3. Sample, data and variable measurement

3.1. Sample selection

Our sample consists of 26,338 firm-year observations spanning the 1999–2016 period. We begin our sample in 1999 because we derive data from cash flow statements, which became mandatory in China starting in 1998. We exclude firms in the financial and comprehensive trade industries due to inherent differences in the regulatory and institutional structures of these firms. We also exclude industries with fewer than 10 firms because of the calculation bias that may be introduced by examining industry conditions in a small number of listed firms. We exclude observations with missing data. The data come from the Wind and China Stock Market & Accounting Research databases. To minimize the effect of outliers, we winsorize all continuous variables at the top and bottom 1% of each variable's distribution.

3.2. Variable measurement

3.2.1. Industry growth

Following the literature (Lancaster, 1984; Fisman and Love, 2003; Hoitash et al., 2016), we use sales growth rate as a proxy for demand and opportunity. We measure industry growth (*Ind-Growth*) using industrial sales growth, calculated as the industry average sales growth rate.

3.2.2. Corporate risk-taking

As riskier corporate operations have more volatile returns on capital, following the literature (John et al., 2008; Faccio et al., 2011; Boubakri et al., 2013), we construct the following two firm-level measures. (1) We measure corporate risk-taking (*RISK1*) using the standard deviation of the firm's earnings before interest, taxes, depreciation, and amortization divided by assets (*ROA*) in the subsequent 5 years. For each firm with available earnings and total assets for at least 5 years over the 1999–2020 period, we first subtract the firm's annual *ROA* from the average value of the industry to which the firm belongs to eliminate the influence of industry factors. Then we calculate the standard deviation of the industry-adjusted *ROA* of the firm for the corresponding year. (2) We measure corporate risk-taking (*RISK2*) using the difference between the maximum and the minimum *ROA* in the subsequent 5 years. As with *RISK1*, we subtract the firm's annual ROA from the average value of the industry to which the firm belongs. Then we calculate the difference between the maximum and the minimum of the industry-adjusted *ROA* of the firm for the corresponding year. The end time of our sample is 2016; however, the calculation of corporate risk-taking spans 1999–2020, as the volatility of firm's earnings is calculated over a 5-year observation period.

3.2.3. Control variable

Following the literature (John et al., 2008; Faccio et al., 2011; Li et al., 2013), we include an extensive array of firm-level controls identified as affecting corporate risk-taking. We include return on assets (*ROA*), total assets (*TA*), years since the firm was first listed (*AGE*) and leverage (*LEV*) to capture profitability, life cycle and capital structure, respectively. We include the shareholding ratio of the largest shareholder (*Shrcr1*) and whether it is a state-owned enterprise (*State*) to capture the ownership structure. To control the effect of firm-level growth opportunities, we include sales growth (*Sales-Growth*).

4. Research design

To test the correlation between industry growth and corporate risk-taking (H1), we use an ordinary least squares (OLS) regression, based on John et al. (2008), that adjusts standard errors for firm-level clustering and controls for year fixed effects (γ_t) as follows:.

$$RISK_{it} = \beta_0 + \beta_1 Ind - Growth_{it} + \beta_2 ROA_{it} + \beta_3 TA_{it} + \beta_4 LEV_{it} + \beta_5 Shrcr1_{it} + \beta_6 State_{it} + \beta_7 Sales - Growth_{it} + \beta_8 AGE_{it} + \gamma_t + \varepsilon_{it} \quad (1)$$

The dependent variable (*RISK*) is one of our two proxies for corporate risk-taking, *RISK1* and *RISK2*. Our variable of interest (*Ind-Growth*) is the industry average sales growth rate, measured following Lancaster (1984). The subscripts i and t denote firm and time, respectively. To test our first hypothesis, we examine β_1, the coefficient on *Ind-Growth*. As *RISK* is measured as the corporate volatile returns in the subsequent 5 years, it represents the effect of current industry growth on corporate risk-taking in the future. A negative coefficient on *Ind-Growth* suggests that high industry growth rates lead firms to lose impetus toward ventures and innovation, consistent with emerging markets analysis as well as prospect theory and behavioral theory, as expressed in the phrase "thinking of peace when rich.".

A potential concern with our empirical data is that we do not include non-listed firms in our sample. We address this concern in four ways. First, we use the industry average sales growth rate, aiming to remove the influence of the individual factors of a single firm while extracting the common growth opportunities of the industry. In contrast to the measurement of industry concentration, the measurement of industry growth does not involve the internal industrial structure. We also exclude industries with fewer than 10 listed firms to avoid extreme individual factors. Second, listed firms are representative of firms in the industry; as such, they face the same overall industry growth as non-listed firms. Compared with growth differences between industries, growth differences between listed firms and non-listed firms within an industry are relatively small. Third, studies usually measure industry growth using listed firms' data (Hoitash et al., 2016; Baginski et al., 2018), and we follow the literature in creating our sample and variables. Finally, the use of non-listed firms also has limitations. For example, most of their financial data has not been audited by a third party; thus, their reliability and completeness are doubtful. Moreover, China's industrial database, which provides information on non-listed firms, only provides information through 2013, which is not suitable for our empirical design.

5. Empirical analyses and main results

5.1. Descriptive statistics

Table 1, Panel A reports descriptive statistics at the firm level. The mean of *Ind-Growth* (0.469) is equal to that of corporate sales growth (*Sales-Growth*), while the standard deviation of *Ind-Growth* (0.554) is smaller than that of *Sales-Growth* (1.474). These results are consistent with the product markets' reality during our sample period. The mean values of our *RISK* variables are 10.860 for *RISK1* and 4.445 for *RISK2*, which resemble the results of other corporate risk-taking studies that use Chinese data. On average, the sample firms are 24.7% state-owned, and the shareholding ratio of the largest shareholder is 0.368. On average, the sample firms are profitable, have a mean *ROA* value of 0.056 and have experienced 46.8% of leverage in recent years.

Table 1, Panel B is a correlation matrix showing the univariate correlations between our dependent variables, control variables, moderators and variables of interest. The Spearman correlation coefficients are above the diagonal, and the Pearson correlation coefficients are below the diagonal. We find that our two risk measures are highly positively correlated, suggesting that both measures capture the same underlying construct. Most of the pair-wise correlations are significant in the expected direction at the 1% level. More importantly, we find that *Ind-Growth* is negatively related to both *RISK1* and *RISK2*, providing univariate evidence of a negative relation between industry growth and corporate risk-taking.

5.2. Test of H1 on industry growth and corporate risk-taking

Table 2 reports the regression results of the test of H1. *Ind-Growth* is negatively associated with both measures of risk. The effect is also economically meaningful. In economic terms, moving from the 25th to the 75th percentile of *Ind-Growth* is associated with a 3.09% relative decrease in *RISK1* and a 3.04% relative decrease in *RISK2*. Consistent with H1, this result suggests that emerging markets analysis, as well as prospect theory and behavioral theory, support the relation between industry growth and corporate risk-taking, that is, firms are more likely to achieve satisfaction in a growing industry environment in emerging markets and avoid long-term risks and thus lose impetus toward innovation and risk-taking.

6. Cross-sectional heterogeneity analysis

6.1. Cross-sectional results on product market power

Firms with different resources vary in their attitudes toward risk in a superior industry environment. In our first cross-sectional test, we examine whether product market leaders react more negatively in a growing industry to further prove our basic results. Product market leaders possess a higher market share and display higher persistent profitability; thus, they are major beneficiaries of a rapidly developing market, as they acquire a majority of the demand, opportunities and resources. A well-developed industry gives them more support and satisfaction. Therefore, product market leaders are more likely to avoid risks and to prefer to remain stable in a growing market. The negative association between industry growth and corporate risk-taking is therefore more pronounced for product market leaders.

To explore cross-section variation in the baseline relation conditional on product market power, we modify Equation (1) to include price–cost margin (*PCM*) and the interaction between *PCM* and *Ind-Growth*.

Table 1
Descriptive statistics and correlations.

Panel A: Descriptive Statistics

Variable	*N*	*Mean*	*Std. Dev.*	*25%*	*Median*	*75%*
Ind-Growth	26,338	0.469	0.554	0.198	0.328	0.501
RISK1	26,338	10.860	10.610	4.277	7.172	13.020
RISK2	26,338	4.445	4.368	1.746	2.919	5.322
PCM	26,338	0.200	0.400	0.000	0.000	0.000
IP	26,338	0.335	0.472	0.000	0.000	1.000
Top-subsidy	25,297	0.250	0.433	0.000	0.000	1.000
ROA	26,338	0.056	0.076	0.028	0.053	0.088
TA	26,338	21.740	1.277	20.850	21.580	22.420
LEV	26,338	0.468	0.227	0.298	0.464	0.623
Shrcr1	26,338	0.368	0.157	0.244	0.347	0.483
State	26,338	0.247	0.431	0.000	0.000	0.000
Sales-Growth	26,338	0.469	1.474	–0.047	0.128	0.422
AGE	26,338	13.530	5.559	9.000	13.000	17.000

Panel B: Correlations

	Ind-Growth	*RISK1*	*RISK2*	*PCM*	*IP*	*Top-subsidy*	*ROA*	*TA*	*LEV*	*Shrcr1*	*State*	*Sales-Growth*	*AGE*
Ind-Growth	1.000	–0.060	–0.058	0.076	–0.063	0.142	–0.023	0.098	0.036	–0.057	–0.109	0.295	0.166
RISK1	–0.045	1.000	0.995	–0.010	0.080	–0.087	–0.107	–0.278	0.004	–0.133	–0.002	–0.039	–0.032
RISK2	–0.043	0.993	1.000	–0.008	0.078	–0.085	–0.106	–0.278	0.002	–0.133	–0.004	–0.038	–0.032
PCM	0.125	–0.048	–0.047	1.000	–0.071	0.000	0.489	0.025	–0.318	0.078	–0.032	0.058	–0.077
IP	0.033	0.061	0.059	–0.070	1.000	–0.286	–0.004	–0.193	0.155	0.028	0.324	–0.021	–0.301
Top-subsidy	–0.064	–0.054	–0.053	0.000	–0.286	1.000	–0.017	0.244	0.009	0.021	–0.158	0.016	0.193
ROA	–0.023	–0.219	–0.218	0.423	–0.022	–0.004	1.000	0.092	–0.268	0.103	–0.024	0.008	–0.088
TA	0.109	–0.266	–0.266	0.027	–0.191	0.261	0.105	1.000	0.323	0.196	–0.003	0.001	0.201
LEV	0.116	0.184	0.181	–0.313	0.160	0.002	–0.295	0.264	1.000	0.024	0.096	0.018	0.140
Shrcr1	0.002	–0.151	–0.154	0.083	0.029	0.024	0.104	0.234	0.005	1.000	0.203	–0.030	–0.206
State	–0.065	–0.031	–0.034	–0.032	0.324	–0.159	–0.022	–0.008	0.084	0.207	1.000	–0.036	–0.259
Sales-Growth	0.376	0.021	0.023	0.075	0.012	–0.024	0.016	–0.003	0.073	0.003	–0.025	1.000	0.045
AGE	0.175	0.014	0.015	–0.074	–0.297	0.192	–0.053	0.174	0.136	–0.201	–0.246	0.088	1.000

Notes: This table reports descriptive statistics and correlations. The sample comprises 26,338 firm-years spanning the 1999–2016 period. Firms in the financial and comprehensive trade industries are excluded; industries in which firm numbers are less than 10 are also excluded. Panel A presents summary statistics for the variables used in the empirical analyses. Panel B presents correlations for our dependent variables, all of the control variables, moderators and variables of interest. Spearman correlation coefficients are above the diagonal, while Pearson correlation coefficients are below the diagonal. Coefficients that are significant at $p < 0.05$ are in bold. All of the variables are defined in Appendix A.

Table 2
OLS regression of corporate risk-taking on industry growth.

Variable	(1) *RISK = RISK1*	(2) *RISK = RISK2*
Ind-Growth	–1.107***	–0.446***
	(–5.74)	(–5.50)
ROA	–0.156***	–0.064***
	(–8.44)	(–8.28)
Sales-Growth	0.160**	0.070**
	(2.46)	(2.57)
AGE	–0.024	–0.011
	(–0.89)	(–1.01)
LEV	11.734***	4.790***
	(11.34)	(11.08)
Shrcr1	–0.037***	–0.016***
	(–4.69)	(–4.88)
State	–1.373***	–0.593***
	(–4.29)	(–4.53)
TA	–2.591***	–1.063***
	(–18.27)	(–17.77)
Intercept	64.419***	26.535***
	(23.76)	(23.21)
S.E. clustering by firm	YES	YES
Year fixed effects	YES	YES
Observations	26,338	26,338
Adjusted R^2	0.179	0.179

Notes: This table reports the results from estimating the following multivariate regression that examines the relation between industry growth and corporate risk-taking:
$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 ROA_{it} + \beta_3 TA_{it} + \beta_4 LEV_{it} + \beta_5 Shrcr1_{it} + \beta_6 State_{it} + \beta_7 Sales\text{-}Growth_{it} + \beta_8 AGE_{it} + \gamma_t + \varepsilon_{it}$.
The dependent variable, *RISK1*, is defined as the standard deviation of the firm's EBITDA/Assets (*ROA*) in the subsequent 5 years, and *RISK2* is defined as the difference between the maximum and the minimum of *ROA* in the subsequent 5 years. The key independent variable, *Ind-Growth*, is calculated as the industry average sales growth rate. The other variables are defined in Appendix A. t-statistics (in parentheses) are reported below the coefficient estimates and are based on robust standard errors clustered by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

$$RISK_{it} = \beta_0 + \beta_1 Ind - Growth_{it} + \beta_2 PCM_{it} + \beta_3 PCM_{it} \times Ind - Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \beta_9 Sales - Growth_{it} + \beta_{10} AGE_{it} + \gamma_t + \varepsilon_{it} \quad (2)$$

Economic theory argues that in purely competitive markets, product price is equal to marginal cost. The excess price–cost margin of a firm reflects the firm's product market power and diminished threats from its competitors (Lerner 1934; Gaspar and Massa 2006). Therefore, we measure *PCM* as the ratio of a firm's sales, less the cost of goods sold, to sales, following Peress (2010). We partition our sample into quintiles, defining the top quintile as 1, indicating greater market power, and the rest as 0, indicating the weaker competition of a particular firm. The coefficient (β_3) on the interaction between *PCM* and *Ind-Growth* indicates whether the negative association between industry growth and corporate risk-taking is stronger for product market leaders. We expect β_3 to be negative.

Columns (1) and (2) in Table 3 report the regression results, showing that the coefficient (β_3) on the interaction between *PCM* and *Ind-Growth* is negative, indicating that the negative association between industry growth and corporate risk-taking is stronger for product market leaders.

6.2. Cross-sectional results on industrial policy

Industrial policy is an important tool to guide industrial development and realize rapid economic growth in China's emerging market (Rodrik, 2009). Firms in the industries supported by industrial policy more easily obtain central transfer payments, as well as local financial support such as subsidies and loans (Stiglitz,

Table 3
Cross-sectional tests: Under prospect theory and behavioral theory in the context of emerging markets.

Variable	Product market power		Industry Policies		Government Subsidy	
	(1) RISK = RISK1	(2) RISK = RISK2	(3) RISK = RISK1	(4) RISK = RISK2	(5) RISK = RISK1	(6) RISK = RISK2
Ind-Growth	–1.108***	–0.450***	–0.790***	–0.312***	–1.053***	–0.424***
	(–4.77)	(–4.60)	(–3.35)	(–3.17)	(–8.56)	(–8.37)
PCM	3.907***	1.595***				
	(12.31)	(12.30)				
*Ind-Growth*PCM*	–1.087***	–0.433***				
	(–4.09)	(–3.94)				
IP			0.045	0.015		
			(0.11)	(0.08)		
*Ind-Growth*IP*			–0.609**	–0.256**		
			(–2.23)	(–2.22)		
Top-subsidy					0.658**	0.264**
					(2.28)	(2.23)
*Ind-Growth*Top-subsidy*					–1.670***	–0.648***
					(–2.83)	(–2.67)
ROA	–0.218***	–0.090***	–0.156***	–0.064***	–0.144***	–0.059***
	(–11.82)	(–11.56)	(–8.44)	(–8.28)	(–16.44)	(–16.38)
Sales-Growth	0.138**	0.061**	0.160**	0.070**	0.166***	0.073***
	(2.13)	(2.25)	(2.46)	(2.57)	(3.75)	(3.98)
AGE	0.025	0.008	–0.025	–0.012	–0.025*	–0.012**
	(1.04)	(0.85)	(–0.92)	(–1.04)	(–1.88)	(–2.14)
LEV	12.749***	5.209***	11.717***	4.783***	11.858***	4.836***
	(12.08)	(11.82)	(11.30)	(11.04)	(37.88)	(37.55)
Shrcr1	–0.041***	–0.018***	–0.038***	–0.016***	–0.038***	–0.016***
	(–5.24)	(–5.43)	(–4.72)	(–4.92)	(–9.07)	(–9.45)
State	–1.732***	–0.736***	–1.378***	–0.595***	–1.288***	–0.559***
	(–5.95)	(–6.18)	(–4.31)	(–4.55)	(–7.40)	(–7.80)
TA	–2.522***	–1.036***	–2.596***	–1.065***	–2.611***	–1.072***
	(–18.25)	(–17.74)	(–18.25)	(–17.74)	(–46.33)	(–46.22)
Intercept	63.924***	26.333***	64.583***	26.608***	68.226***	28.076***
	(23.74)	(23.20)	(23.47)	(22.91)	(57.09)	(57.10)
S.E. clustering by firm	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Observations	26,338	26,338	26,338	26,338	25,297	25,297
Adjusted R^2	0.189	0.189	0.179	0.179	0.178	0.178

Notes: This table reports results from estimating the following multivariate regressions that examine the cross-sectional results on product market power, industrial policy and government support, by interacting the corresponding indicators with industry growth:

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 PCM_{it} + \beta_3 PCM_{it}{*}Ind\text{-}Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \beta_9 Sales\text{-}Growth_{it} + \beta_{10} AGE_{it} + \gamma_t + \varepsilon_{it}$.

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 IP_{it} + \beta_3 IP_{it}{*}Ind\text{-}Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \beta_9 Sales\text{-}Growth_{it} + \beta_{10} AGE_{it} + \gamma_t + \varepsilon_{it}$.

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 Top\text{-}subsidy_{it} + \beta_3 Top\text{-}subsidy_{it}{*}Ind\text{-}Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it}$ + - $_{it} \sum \beta_5 YA_{it} \sum \beta_6 MEX_{it} \sum \beta_7 T\vartheta\sigma\gamma\sigma\varsigma_{it} \sum \beta_8 T\upsilon\alpha\upsilon\varepsilon_{it} \sum \beta_9 T\alpha\mu\varepsilon\tau\varpi H\sigma o\psi\upsilon\theta_{it} \sum \beta_{10} AHE_{it} \sum \gamma_t \sum \varepsilon_{it}$.

The first two columns report the cross-sectional results on product market power; the variable *PCM* is defined as 1 if the firm's price–cost margins are in the top quintile of the sample, and 0 otherwise. The middle two columns report the cross-sectional results on industrial policy; the variable *IP* is defined as 1 if the industry is supported by industry policies in the Five-Year Plan documents, and 0 otherwise. The first two columns report the cross-sectional results on government support; the variable *Top-subsidy* is defined as 1 if the industry average government subsidies are in the top quintile of the sample, and 0 otherwise. The dependent variable, *RISK1*, is defined as the standard deviation of the firm's EBITDA/Assets (*ROA*) in the subsequent 5 years, and *RISK2* is defined as the difference between the maximum and the minimum of *ROA* in the subsequent 5 years. The key independent variable, *Ind-Growth*, is calculated as the industry average sales growth rate. The other variables are defined in Appendix A. t-statistics (in parentheses) are reported below the coefficient estimates and are based on robust standard errors clustered by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

2017). In our second cross-sectional test, we further examine whether firms supported by industrial policy react more negatively in a growing industry to further support our basic results. We hypothesize that firms supported by industrial policy react more negatively than other firms in a growing industry because these firms are especially rich in resources and are thus more likely to avoid risks and enjoy the industrial dividends.

To explore cross-section variation in the baseline relation conditional on industrial policy, we modify Equation (1) to include *IP* and the interaction between *IP* and *Ind-Growth*.

$$RISK_{it} = \beta_0 + \beta_1 Ind-Growth_{it} + \beta_2 IP_{it} + \beta_3 IP_{it} \times Ind-Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \beta_9 Sales-Growth_{it} + \beta_{10} AGE_{it} + \gamma_t + \varepsilon_{it} \quad (3)$$

Following Chen and Yao (2018), we measure *IP* by screening industrial policies in Five-Year Plan documents; industries associated with words such as "encourage" and "support" in the policies are supported industries. *IP* is assigned a value of 1 for firms in supported industries, and 0 otherwise. We interact *IP* with *Ind-Growth* in our specification to test this hypothesis.

Our results are also reported in Table 3. In Columns (3) and (4), the coefficients on *Ind-Growth*IP* are negative and significant at the 5% level. These results are consistent with supported industry firms' perceiving their superior environment and holding a more negative attitude toward taking risks than other firms.

6.3. Cross-sectional result on government support

We further examine the strength of industrial policy support, which is usually reflected by government support such as government subsidies and long-term loans (Wang et al., 2017). In our third cross-sectional test, we examine whether industries that receive more government subsidies are more likely to restrain corporate risk-taking in a growing industry. We expect government-supported industries to be richer in resources and that firms in these industries have an easier experience and thereby lose enthusiasm for taking risks.

To explore cross-section variation in the baseline relation conditional on government support, we modify Equation (1) to include government support (*Top-subsidy*) and the interaction between *Top-subsidy* and *Ind-Growth*.

$$RISK_{it} = \beta_0 + \beta_1 Ind-Growth_{it} + \beta_2 IP_{it} + \beta_3 IP_{it} \times Ind-Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \beta_9 Sales-Growth_{it} + \beta_{10} AGE_{it} + \gamma_t + \varepsilon_{it} \quad (4)$$

We measure government support based on government subsidies, following Wang et al. (2017). Average government subsidies received by firms in an industry are calculated to reflect industry-level government support. Similar to our calculation of *PCM*, we partition our sample into quintiles. *Top-subsidy* is defined as 1 for firms in the top quintile, indicating industries with more government support, and the rest are defined as 0, indicating industries with less government support. The coefficient (β_3) on the interaction between *Top-subsidy* and *Ind-Growth* indicates whether the negative association between industry growth and corporate risk-taking is stronger for firms that receive more governmental support. We expect β3 to be negative.

Columns (5) and (6) in Table 3 report the regression results: the coefficients (β_3) on the interaction between *Top-subsidy* and *Ind-Growth* are negative and significant at the 1% level, indicating that the negative association between industry growth and corporate risk-taking is stronger for firms supported by government. All of the above cross-sectional results confirm that a high-growth industry gives firms a superior external environment and cause them to refrain from risk-taking.

7. Channel mechanisms

7.1. Effect of industry growth on investment choices

By what means do firms reduce risk in response to high industry growth? Given their reduction in risk-taking (measured over the 5-year period from t to $t+4$), firms choose to change the risks they take in their investment projects; for example, they may change their R&D spending and capital expenditures. To test whether industry growth discourages risk-taking by causing firms to reduce their R&D spending and capital expenditures, we follow previous research (e.g., Ljungqvist et al., 2017) by estimating the following regression model:

$$R\&D_{it} = \beta_0 + \beta_1 Ind - Growth_{it} + \beta_2 ROA_{it} + \beta_3 AGE_{it} + \beta_4 LEV_{it} + \beta_5 TA_{it} + \beta_6 CFO_{it} + \beta_7 Tangible_{it} + \beta_8 Liq_{it} + \beta_9 RE_{it} + \gamma_t + \varepsilon_{it} \quad (5)$$

$$Capex_{it} = \beta_0 + \beta_1 Ind - Growth_{it} + \beta_2 ROA_{it} + \beta_3 AGE_{it} + \beta_4 LEV_{it} + \beta_5 TA_{it} + \beta_6 Smooth_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \gamma_t + \varepsilon_{it} \quad (6)$$

where R&D contains the two measures *R&D1* and *R&D2*; *R&D1* is the number of patents for firm *I* and year *t*, and *R&D2* is the R&D spending for firm *i* in year *t*. As there is a significant amount of missing data on R&D spending before 2007, we begin our sample in 2007 to estimate *R&D2*. *Capex* is a measure of capital expenditures captured by the ratio of the purchase of property, plant and equipment in the cash flow statement to total assets. In the regression of *R&D*, we include a wide array of firm-level controls previously identified as influencing *R&D*: return on assets (*ROA*); years since the firm was first listed (*AGE*); leverage (*LEV*); total assets (*TA*); operating cash flow (*CFO*); property, plant and equipment (*Tangible*); current assets (*Liq*); and retained earnings (*RE*). In the regression of *Capex*, we include a wide array of firm-level controls previously identified as influencing capital expenditures: return on assets (*ROA*), years since the firm was first listed (*AGE*), leverage (*LEV*), total assets (*TA*), earnings smoothed (*Smooth*), shareholding ratio of the largest shareholder (*Shrcr1*) and whether the firm is a state-owned enterprise (*State*). We also control for year fixed effects. Standard errors are clustered by firm.

Table 4 shows that firms adjust both their R&D spending and capital expenditures in response to high industry growth; for example, firms may abandon risky R&D projects (such as inventing new products). In a year exhibiting growth in industry demand, we observe that firms reduce their numbers of patents; R&D spending; and the ratio of the purchase of property, plant and equipment to total assets by an average of 0.609, 0.686 and 0.017, respectively.

7.2. Effect of industry growth on operational choices and financial policies

Another way in which firms reduce corporate risk-taking is by changing operational choices, such as reasonably reducing operational efficiency. For example, a firm may change its operating cycle and liquid asset turnover, the procedure by which cash is transformed into goods in progress, finished goods, accounts receivable and, ultimately, back into cash. Shortening the operating cycle and increasing liquid asset turnover means making efforts to increase operational efficiency. As a high-growth industry gives firms a superior external environment and increases their satisfaction and achievements, firms thereby lose their impetus toward improving operational efficiency. Firms can also reduce corporate risk-taking by changing their financial policies. As we show above, high industry growth discourages firms from plunging into R&D spending and capital expenditures, potentially rendering corporate cash holdings unnecessarily redundant. To test whether industry growth discourages risk-taking by causing firms to reduce liquid asset turnover, to lengthen their operating cycle or to hold more cash than necessary, we follow previous research (e.g., Ljungqvist et al., 2017; Bernile et al., 2017) by estimating the following regression models:

$$Operating - cycle_{it} = \beta_0 + \beta_1 Ind - Growth_{it} + \beta_2 ROA_{it} + \beta_3 Sales - Growth_{it} + \beta_4 AGE_{it} + \beta_5 LEV_{it} + \beta_6 TA_{it} + \beta_7 Indepen_{it} + \beta_8 Bsize_{it} + \beta_9 DUAL_{it} + \beta_{10} Shrcr1_{it} + \beta_{11} State_{it} + \gamma_t + \varepsilon_{it} \quad (7)$$

$$Liq - turnover_{it} = \beta_0 + \beta_1 Ind - Growth_{it} + \beta_2 ROA_{it} + \beta_3 Sales - Growth_{it} + \beta_4 AGE_{it} + \beta_5 LEV_{it} + \beta_6 TA_{it} + \beta_7 Indepen_{it} + \beta_8 Bsize_{it} + \beta_9 DUAL_{it} + \beta_{10} Shrcr1_{it} + \beta_{11} State_{it} + \gamma_t + \varepsilon_{it} \quad (8)$$

Table 4
OLS regression of investment choice on industry growth.

Variable	(1) R&D1	(2) R&D2	(3) Capex
Ind-Growth	–0.609***	–0.686***	–0.017***
	(–17.05)	(–4.00)	(–16.86)
ROA	0.001	0.011	0.001***
	(0.28)	(0.63)	(13.57)
AGE	–0.018***	–0.060***	–0.002***
	(–3.65)	(–2.65)	(–10.65)
LEV	–0.321**	–2.316***	–0.017***
	(–2.40)	(–3.36)	(–5.81)
TA	–0.139**	0.907***	0.004***
	(–2.06)	(3.10)	(6.19)
CFO	–0.065***	–0.343***	
	(–5.36)	(–4.61)	
Tangible	–0.234	–4.364***	
	(–1.39)	(–5.96)	
Liq	0.601***	0.233	
	(10.58)	(0.91)	
RE	0.065**	–0.414***	
	(2.42)	(–2.76)	
Smooth			–0.001***
			(–3.27)
Shrcr1			–0.001
			(–0.91)
State			–0.002
			(–1.11)
Intercept	–8.556***		0.017
	(–15.10)		(1.48)
S.E. clustering by firm	YES	YES	YES
Year fixed effects	YES	YES	YES
Observations	17,836	13,936	26,239
Adjusted R^2	0.313	0.042	0.110

Notes: This table reports results from estimating the following multivariate regressions that examine the effect of industry growth on investment choices:

$R\&D_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 ROA_{it} + \beta_3 AGE_{it} + \beta_4 LEV_{it} + \beta_5 TA_{it} + \beta_6 CFO_{it} + \beta_7 Tangible_{it} + \beta_8 Liq_{it} + \beta_9 RE_{it} + \gamma_t + \varepsilon_{it}$.

$Capex_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 ROA_{it} + \beta_3 AGE_{it} + \beta_4 LEV_{it} + \beta_5 TA_{it} + \beta_6 Smooth_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \gamma_t + \varepsilon_{it}$.

The first two columns report the effect of industry growth on R&D. The dependent variable, *R&D1* (*R&D2*), is defined as the natural logarithm of total number of patents applied by firm (R&D spending) in a given year. The last column reports the effect of industry growth on capital expenditures. The dependent variable, *Capex*, is defined as the ratio of purchase of property, plant and equipment in the cash flow statement to total assets. The key independent variable, *Ind-Growth*, is calculated as the industry average sales growth rate. Other variables are as defined in Appendix A. t-statistics (in parentheses) are reported below the coefficient estimates and are based on robust standard errors clustered by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

$$Cash_{it} = \beta_0 + \beta_1 Ind - Growth_{it} + \beta_2 ROA_{it} + \beta_3 AGE_{it} + \beta_4 LEV_{it} + \beta_5 TA_{it} + \beta_6 CFO_{it} + \beta_7 Capex_{it} + \beta_8 WC_{it} + \gamma_t + \varepsilon_{it} \quad (9)$$

where *Operating-cycle* is days sales of inventory plus days sales outstanding and less days payable outstanding. *Liq-turnover* is liquid asset turnover, and *Cash* is net cash and cash equivalents. In the regression of *Operating-cycle* and *Liq-turnover*, we include a wide array of firm-level controls previously identified as influencing the operating cycle and asset turnover (Ljungqvist et al., 2017). Specifically, we include the following factors of corporate financial conditions: *ROA*, *Sales-Growth*, *AGE*, *LEV* and *TA*, as well as the following factors of corporate governance: proportion of independent directors on the board (*Indepen*), board size (*Bsize*), CEO duality (*DUAL*), the shareholding ratio of the largest shareholder (*Shrcr1*) and whether the firm

Table 5
OLS regression of operating choice and financial policies on industry growth.

Variable	(1) Operating-cycle	(2) Liq-turnover	(3) Cash
Ind-Growth	419.243***	–0.505***	0.009***
	(22.82)	(–23.93)	(2.67)
ROA	–3.157***	0.015***	0.002***
	(–4.60)	(5.53)	(8.81)
Sales-Growth	30.085***	–0.070***	
	(6.19)	(–8.05)	
AGE	0.855	0.025***	–0.003***
	(0.88)	(6.25)	(–6.73)
LEV	0.410	0.711***	–0.213***
	(0.02)	(6.65)	(–21.51)
Shrcr1	0.173	0.005***	
	(0.51)	(4.00)	
State	–39.554***	0.179***	
	(–3.57)	(2.72)	
TA	–1.188	0.094***	–0.019***
	(–0.26)	(4.91)	(–9.83)
Indepen	–97.823	–0.277	
	(–1.19)	(–0.94)	
Bsize	–9.437***	0.021*	
	(–3.09)	(1.90)	
DUAL	–24.017**	0.131***	
	(–2.42)	(3.79)	
CFO			0.009***
			(8.21)
Capex			–0.313***
			(–14.42)
WC			0.001***
			(7.78)
Intercept	217.594**	–1.743***	0.528***
	(2.25)	(–4.65)	(16.23)
S.E. clustering by firm	YES	YES	YES
Year fixed effects	YES	YES	YES
Observations	22,732	23,148	20,153
Adjusted R^2	0.356	0.141	0.260

Notes: This table reports results from estimating the following multivariate regressions that examine the effect of industry growth on operating choice and financial policies:

$Operating\text{-}cycle_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 ROA_{it} + \beta_3 Sales\text{-}Growth_{it} + \beta_4 AGE_{it} + \beta_5 LEV_{it} + \beta_6 TA_{it} + \beta_7 Indepen_{it} + \beta_8 Bsize_{it} + \beta_9 DUAL_{it} + \beta_{10} Shrcr1_{it} + \beta_{11} State_{it} + \gamma_t + \varepsilon_{it}$.

$Liq\text{-}turnover_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 ROA_{it} + \beta_3 Sales\text{-}Growth_{it} + \beta_4 AGE_{it} + \beta_5 LEV_{it} + \beta_6 TA_{it} + \beta_7 Indepen_{it} + \beta_8 Bsize_{it} + \beta_9 DUAL_{it} + \beta_{10} Shrcr1_{it} + \beta_{11} State_{it} + \gamma_t + \varepsilon_{it}$.

$Cash_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 ROA_{it} + \beta_3 AGE_{it} + \beta_4 LEV_{it} + \beta_5 TA_{it} + \beta_6 CFO_{it} + \beta_7 Capex_{it} + \beta_8 WC_{it} + \gamma_t + \varepsilon_{it}$.

The first column reports the effect of industry growth on operating cycle. The dependent variable, *Operating-cycle*, is defined as days sales of inventory plus days sales outstanding and less days payable outstanding. The second column reports the effect of industry growth on liquid asset turnover. The dependent variable, *Liq-turnover*, is defined as the ratio of sales to total current assets. The last column reports the effect of industry growth on cash holding. The dependent variable, *Cash*, is defined as the ratio of net cash and cash equivalents to total assets. The key independent variable, *Ind-Growth*, is calculated as the industry average sales growth rate. Other variables are as defined in Appendix A. t-statistics (in parentheses) are reported below the coefficient estimates and are based on robust standard errors clustered by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

is a state-owned enterprise (*State*). We also control for year fixed effects. Standard errors are clustered by firm. In the regression of *Cash*, we include a wide array of firm-level controls previously identified as influencing net cash (Bernile et al., 2017): *ROA*, *AGE*, *LEV*, *TA*, *CFO*, *Capex* and working capital (*WC*).

Table 5 presents the results, which suggest that firms reduce their liquid asset turnover, lengthen their operating cycles and increase their cash holdings in a growing market. Therefore, firms reduce their risk-taking in

Table 6
Robustness: Another measure of industry growth.

Variable	(1) RISK = RISK1	(2) RISK = RISK2
Ind-Growth2	–1.088***	–0.438***
	(–5.74)	(–5.50)
ROA	–0.156***	–0.064***
	(–8.44)	(–8.28)
Sales-Growth	0.141**	0.063**
	(2.21)	(2.34)
AGE	–0.024	–0.011
	(–0.89)	(–1.01)
LEV	11.734***	4.790***
	(11.34)	(11.08)
Shrcr1	–0.037***	–0.016***
	(–4.69)	(–4.88)
State	–1.373***	–0.593***
	(–4.29)	(–4.53)
TA	–2.591***	–1.063***
	(–18.27)	(–17.77)
Intercept	64.424***	26.537***
	(23.76)	(23.21)
S.E. clustering by firm	YES	YES
Year fixed effects	YES	YES
Observations	26,338	26,338
Adjusted R^2	0.179	0.179

Notes: This table reports results of the robustness tests using another measure of industry growth obtained by estimating the following multivariate regression:
$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth2_{it} + \beta_2 ROA_{it} + \beta_3 TA_{it} + \beta_4 LEV_{it} + \beta_5 Shrcr1_{it} + \beta_6 State_{it} + \beta_7 Sales\text{-}Growth_{it} + \beta_8 AGE_{it} + \gamma_t + \varepsilon_{it}$.
The dependent variable, *RISK1*, is defined as the standard deviation of the firm's EBITDA/Assets (*ROA*) in the subsequent 5 years, and *RISK2* is defined as the difference between the maximum and the minimum of *ROA* in the subsequent 5 years. The key independent variable, *Ind-Growth2*, is calculated as the industry average sales growth rate excluding the sales growth of the firm itself. Other variables are as defined in Appendix A. t-statistics (in parentheses) are reported below the coefficient estimates and are based on robust standard errors clustered by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

response to high industry growth not only by means of long-term investment choices but also by short-term operational choices and financial policies.

8. Robustness tests

8.1. Alternative measure of industry growth and corporate risk-taking

We examine the robustness of our baseline results by using another measure of industry growth. We calculate a new average industrial sales growth rate (*Ind-Growth2*), excluding the sales growth of the firm itself. Tables 6 and 7 show the results, which are similar to our baseline model and cross-sectional results. In another robustness check of our main results, we recalculate corporate risk-taking, using the variation in firm-level earnings over total assets for the subsequent 3 years, and generate *RISK3* and *RISK4*. Thus, the new sample contains 33,018 firm-year observations spanning the 1999–2018 period. Tables 8 and 9 report the results, which are also similar to our prior results.

8.2. Remove outliers for the asset structure

Firms may not make a profit solely in the industry to which they belong. In particular, when a corporate asset structure deviates from the industry average, it is likely that the firm is engaged in other industries and its revenues are not derived entirely from its primary industry. To empirically explore this issue, we recalculate

Table 7
Robustness: Cross-sectional results on another measure of industry growth.

Variable	Product market power		Industry Policies		Government Subsidy	
	(1) RISK = RISK1	(2) RISK = RISK2	(3) RISK = RISK1	(4) RISK = RISK2	(5) RISK = RISK1	(6) RISK = RISK2
Ind-Growth2	–1.088***	–0.442***	–0.778***	–0.307***	–1.034***	–0.417***
	(–4.76)	(–4.59)	(–3.34)	(–3.16)	(–5.35)	(–5.13)
PCM	3.870***	1.580***				
	(12.23)	(12.22)				
*Ind-Growth2*PCM*	–1.044***	–0.415***				
	(–3.94)	(–3.79)				
IP			0.041	0.013		
			(0.10)	(0.08)		
*Ind-Growth2*IP*			–0.598**	–0.253**		
			(–2.19)	(–2.18)		
Top-subsidy					0.631	0.250
					(1.62)	(1.56)
*Ind-Growth2*Top-subsidy*					–1.604**	–0.613*
					(–2.06)	(–1.92)
ROA	–0.218***	–0.089***	–0.156***	–0.064***	–0.144***	–0.059***
	(–11.80)	(–11.54)	(–8.44)	(–8.28)	(–7.54)	(–7.37)
Sales-Growth	0.110*	0.050*	0.142**	0.063**	0.144**	0.064**
	(1.74)	(1.88)	(2.23)	(2.36)	(2.19)	(2.33)
AGE	–0.008	–0.005	–0.025	–0.012	–0.025	–0.012
	(–0.30)	(–0.43)	(–0.92)	(–1.04)	(–0.93)	(–1.05)
LEV	13.131***	5.362***	11.717***	4.783***	11.856***	4.835***
	(12.38)	(12.11)	(11.30)	(11.04)	(11.36)	(11.09)
Shrcr1	–0.039***	–0.017***	–0.038***	–0.016***	–0.038***	–0.016***
	(–4.98)	(–5.17)	(–4.72)	(–4.92)	(–4.76)	(–4.93)
State	–1.342***	–0.581***	–1.377***	–0.595***	–1.289***	–0.559***
	(–4.27)	(–4.52)	(–4.31)	(–4.55)	(–3.96)	(–4.22)
TA	–2.618***	–1.074***	–2.596***	–1.065***	–2.611***	–1.071***
	(–18.48)	(–17.97)	(–18.25)	(–17.74)	(–18.20)	(–17.69)
Intercept	63.957***	26.350***	64.586***	26.609***	68.219***	28.072***
	(23.75)	(23.20)	(23.48)	(22.92)	(23.66)	(23.14)
S.E. clustering by firm	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Observations	26,338	26,338	26,338	26,338	25,297	25,297
Adjusted R^2	0.191	0.191	0.179	0.179	0.178	0.178

Notes: This table reports the cross-sectional results of the robustness tests using another measure of industry growth obtained by estimating the following multivariate regressions:

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth2_{it} + \beta_2 PCM_{it} + \beta_3 PCM_{it}*Ind\text{-}Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \beta_9 Sales\text{-}Growth_{it} + \beta_{10} AGE_{it} + \gamma_t + \varepsilon_{it}$.

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth2_{it} + \beta_2 IP_{it} + \beta_3 IP_{it}*Ind\text{-}Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \beta_9 Sales\text{-}Growth_{it} + \beta_{10} AGE_{it} + \gamma_t + \varepsilon_{it}$.

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth2_{it} + \beta_2 Top\text{-}subsidy_{it} + \beta_3 Top\text{-}subsidy_{it}*Ind\text{-}Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8\text{-} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \beta_9 Sales\text{-}Growth_{it} + \beta_{10} AGE_{it} + \gamma_t + \varepsilon_{it}$.

The first two columns report the cross-sectional results on product market power; the variable *PCM* is defined as 1 if the firm's price–cost margins are in the top quintile of the sample, and 0 otherwise. The middle two columns report the cross-sectional results on industrial policy; the variable *IP* is defined as 1 if the industry is supported by industry policies in the Five-Year Plan documents, and 0 otherwise. The last two columns report the cross-sectional results on government support; the variable *Top-subsidy* is defined as 1 if the industry average government subsidies are in the top quintile of the sample, and 0 otherwise. The dependent variable, *RISK1*, is defined as the standard deviation of the firm's EBITDA/Assets (*ROA*) in the subsequent 5 years, and *RISK2* is defined as the difference between the maximum and the minimum of *ROA* in the subsequent 5 years. The key independent variable, *Ind-Growth2*, is calculated as the industry average sales growth rate excluding the sales growth of the firm itself. Other variables are as defined in Appendix A. t-statistics (in parentheses) are reported below the coefficient estimates and are based on robust standard errors clustered by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Table 8
Robustness: Another measure of corporate risk-taking.

Variable	(1) RISK = RISK3	(2) RISK = RISK4
Ind-Growth	–0.710***	–0.372***
	(–5.09)	(–5.05)
ROA	–0.200***	–0.106***
	(–13.69)	(–13.51)
Sales-Growth	0.146***	0.079***
	(2.83)	(2.90)
AGE	0.013	0.007
	(0.88)	(0.86)
LEV	8.213***	4.320***
	(10.86)	(10.71)
Shrcr1	–0.032***	–0.017***
	(–6.28)	(–6.41)
State	–1.212***	–0.653***
	(–6.10)	(–6.22)
TA	–1.632***	–0.863***
	(–16.42)	(–16.23)
Intercept	42.915***	22.744***
	(22.49)	(22.32)
S.E. clustering by firm	YES	YES
Year fixed effects	YES	YES
Observations	33,018	33,018
Adjusted R^2	0.169	0.168

Notes: This table reports results of the robustness tests using another measure of corporate risk-taking obtained by estimating the following multivariate regression:
$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 ROA_{it} + \beta_3 TA_{it} + \beta_4 LEV_{it} + \beta_5 Shrcr1_{it} + \beta_6 State_{it} + \beta_7 Sales\text{-}Growth_{it} + \beta_8 AGE_{it} + \gamma_t + \varepsilon_{it}$.
The dependent variable, *RISK3*, is defined as the standard deviation of the firm's EBITDA/Assets (*ROA*) in the subsequent 3 years, and *RISK4* is defined as the difference between the maximum and the minimum of *ROA* in the subsequent 3 years. The key independent variable, *Ind-Growth*, is calculated as the industry average sales growth rate. Other variables are as defined in Appendix A. t-statistics (in parentheses) are reported below the coefficient estimates and are based on robust standard errors clustered by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

industry growth (*Ind-Growth-T*) and reexamine the relation between industry growth and corporate risk-taking by excluding firms with the top and bottom 5% of the distribution of the proportion of tangible assets in the industry.

Tables 10 and 11 report the results obtained after we remove outliers for the proportion of tangible assets. As shown in Table 10, even after excluding outliers for asset structure, we again find that the coefficients on *Ind-Growth-T* are negative and statistically significant. As shown in Table 11, the correlation between industry growth and corporate risk-taking is still stronger for product market leaders, industries promoted by industry policies and industries that receive more government support, consistent with our predictions. These findings support our prior results and mitigate concerns about our measurements of industry growth.

8.3. Industry growth versus corporate size

A potential concern with our identification of the effects of industry growth stems from the fact that the calculations of industry growth is influenced by firms' asset size in the industry, although we have explicitly included controls for total assets (*TA*) in our baseline model. To address this concern, we create a ranked measure of sales growth that only captures variations in sales growth that are independent of *TA*. In this methodology, firms with a relatively high sales growth rate but low assets are ranked the same as firms with a relatively high sales growth rate and high assets. To accomplish this, we rank firms into deciles of *TA*. Then, within each *TA* decile (*R_TA*), we rank the sales growth into deciles. *R-Growth* is the ranked value of *Sales-Growth* within its given *TA* decile. Therefore, *R-Growth* ranges from 1 to 10. We re-estimate the baseline model

Table 9
Robustness: Cross-sectional results on another measure of corporate risk-taking.

Variable	Product market power		Industry Policies		Government Subsidy	
	(1) RISK = RISK3	(2) RISK = RISK4	(3) RISK = RISK3	(4) RISK = RISK4	(5) RISK = RISK3	(6) RISK = RISK4
Ind-Growth	–0.724***	–0.381***	–0.461***	–0.240***	–0.629***	–0.330***
	(–4.46)	(–4.44)	(–2.70)	(–2.65)	(–6.75)	(–6.64)
PCM	3.468***	1.817***				
	(15.72)	(15.50)				
*Ind-Growth*PCM*	–1.080***	–0.563***				
	(–5.79)	(–5.70)				
IP			–0.451	–0.239		
			(–1.64)	(–1.63)		
*Ind-Growth*IP*			–0.460**	–0.245**		
			(–2.31)	(–2.32)		
Top-subsidy					0.538**	0.287**
					(2.38)	(2.39)
*Ind-Growth*Top-subsidy*					–1.258***	–0.651***
					(–2.72)	(–2.64)
ROA	–0.254***	–0.135***	–0.200***	–0.106***	–0.190***	–0.101***
	(–16.78)	(–16.47)	(–13.68)	(–13.51)	(–30.93)	(–30.78)
Sales-Growth	0.125**	0.068**	0.145***	0.078***	0.145***	0.078***
	(2.45)	(2.52)	(2.82)	(2.89)	(4.41)	(4.46)
AGE	0.028*	0.015*	0.008	0.004	–0.017*	–0.009*
	(1.90)	(1.87)	(0.55)	(0.53)	(–1.80)	(–1.81)
LEV	9.452***	4.968***	8.282***	4.356***	8.652***	4.555***
	(12.32)	(12.15)	(10.91)	(10.75)	(37.68)	(37.25)
Shrcr1	–0.033***	–0.018***	–0.032***	–0.017***	–0.031***	–0.017***
	(–6.66)	(–6.79)	(–6.33)	(–6.46)	(–10.31)	(–10.48)
State	–1.094***	–0.590***	–1.154***	–0.622***	–0.724***	–0.397***
	(–5.67)	(–5.78)	(–5.78)	(–5.90)	(–5.43)	(–5.59)
TA	–1.660***	–0.878***	–1.653***	–0.875***	–1.728***	–0.915***
	(–16.83)	(–16.64)	(–16.47)	(–16.28)	(–43.36)	(–43.11)
Intercept	41.988***	22.252***	43.397***	22.999***	45.606***	24.181***
	(22.22)	(22.04)	(22.39)	(22.22)	(54.02)	(53.78)
S.E. clustering by firm	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Observations	33,018	33,018	33,018	33,018	31,963	31,963
Adjusted R^2	0.180	0.178	0.170	0.168	0.169	0.168

Notes: This table reports the cross-sectional results of the robustness tests using another measure of corporate risk-taking obtained by estimating the following multivariate regressions:

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 PCM_{it} + \beta_3 PCM_{it}{*}Ind\text{-}Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \beta_9 Sales\text{-}Growth_{it} + \beta_{10} AGE_{it} + \gamma_t + \varepsilon_{it}$.

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 IP_{it} + \beta_3 IP_{it}{*}Ind\text{-}Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \beta_9 Sales\text{-}Growth_{it} + \beta_{10} AGE_{it} + \gamma_t + \varepsilon_{it}$.

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 Top\text{-}subsidy_{it} + \beta_3 Top\text{-}subsidy_{it}{*}Ind\text{-}Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \text{-}_{it} \sum \beta_5 YA_{it} \sum \beta_6 MEX_{it} \sum \beta_7 T\vartheta\sigma\gamma\sigma\varsigma_{it} \sum \beta_8 T\upsilon\alpha\upsilon\varepsilon_{it} \sum \beta_9 T\alpha\mu\varepsilon\tau\varpi H\sigma o\psi\upsilon\theta_{it} \sum \beta_{10} AHE_{it} \sum \gamma_t \sum \varepsilon_{it}$.

The first two columns report the cross-sectional results on product market power; the variable *PCM* is defined as 1 if the firm's price–cost margins are in the top quintile of the sample, and 0 otherwise. The middle two columns report the cross-sectional results on industrial policy, and the variable *IP* is defined as 1 if the industry is supported by industry policies in the Five-Year Plan documents, and 0 otherwise. The last two columns report the cross-sectional results on government support, and the variable *Top-subsidy* is defined as 1 if the industry average government subsidies are in the top quintile of the sample, and 0 otherwise. The dependent variable, *RISK3*, is defined as the standard deviation of the firm's EBITDA/Assets (*ROA*) in the subsequent 3 years, and *RISK4* is defined as the difference between the maximum and the minimum of *ROA* in the subsequent 3 years. The key independent variable, *Ind-Growth*, is calculated as the industry average sales growth rate. Other variables are as defined in Appendix A. t-statistics (in parentheses) are reported below the coefficient estimates and are based on robust standard errors clustered by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Table 10
Robustness: Outliers removed for the proportion of tangible assets.

Variable	(1) RISK = RISK1	(2) RISK = RISK2
Ind-Growth-T	–0.909***	–0.362***
	(–4.58)	(–4.35)
ROA	–0.183***	–0.076***
	(–9.04)	(–9.01)
Sales-Growth	0.110	0.048
	(1.55)	(1.62)
AGE	–0.024	–0.012
	(–0.91)	(–1.06)
LEV	10.222***	4.154***
	(10.55)	(10.35)
Shrcr1	–0.034***	–0.015***
	(–4.17)	(–4.44)
State	–1.377***	–0.591***
	(–4.11)	(–4.31)
TA	–2.339***	–0.957***
	(–17.64)	(–17.33)
Intercept	59.562***	24.494***
	(23.33)	(22.99)
S.E. clustering by firm	YES	YES
Year fixed effects	YES	YES
Observations	23,270	23,270
Adjusted R^2	0.163	0.163

Notes: This table reports results of the robustness tests excluding outliers for asset structure from estimating the following multivariate regression:
$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth\text{-}T_{it} + \beta_2 ROA_{it} + \beta_3 TA_{it} + \beta_4 LEV_{it} + \beta_5 Shrcr1_{it} + \beta_6 State_{it} + \beta_7 Sales\text{-}Growth_{it} + \beta_8 AGE_{it} + \gamma_t + \varepsilon_{it}$.
The dependent variable, *RISK1*, is defined as the standard deviation of the firm's EBITDA/Assets (*ROA*) in the subsequent 5 years, and *RISK2* is defined as the difference between the maximum and the minimum of *ROA* in the subsequent 5 years. The key independent variable, *Ind-Growth-T*, is calculated as the industry average sales growth rate using the new excluded sample. Other variables are as defined in Appendix A. t-statistics (in parentheses) are reported below the coefficient estimates and are based on robust standard errors clustered by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

using the industrial average ranked version of sales growth (*Ind-R-Growth*). Columns (1) and (2) in Table 12 present the evidence of the new data. We continue to find negative and significant coefficients on *Ind-R-Growth*, consistent with industry growth being negatively related to corporate risk-taking, after we control for asset size.

8.4. Endogeneity concerns

In this section, we discuss the results of a series of tests that aim to address potential endogeneity concerns of our baseline evidence and main inferences. First, as individual managerial characteristics and the macro-level environment are important driving forces of corporate risk-taking decisions, we re-estimate Equations (1) to (4), including these factors. We include CEO age (*CEO-age*), gender (*CEO-gender*) and financial background (*CEO-finance*) to control for individual managerial characteristics, and we also include GDP (*GDP*), GDP per capita (*GDP-per*) and the proportion of corporate income tax in the government's fiscal revenue in the province where the firm is located (*Pro-tax*) to control for macro-level and regional factors. Columns (3) and (4) in Table 12 report the results, which are consistent with our predictions and show the coefficient of *Ind-Growth* to be larger than in our basic model. Second, to control for potential unobservable omitted variables related to firm fixed characteristics, we re-estimate Equations (1) to (4) with the firm fixed effects. The results are presented in Columns (5) and (6) in Table 12. In this set of tests, our results remain unchanged. Third, we address the concern that unobservable factors such as the macroeconomic cycle may jointly affect industry growth and corporate risk policies. On the one hand, the macroeconomic cycle is closely related to industry

Table 11
Robustness: Cross-sectional results on removing outliers for the proportion of tangible assets.

Variable	Product market power		Industry Policies		Government Subsidy	
	(1) RISK = RISK1	(2) RISK = RISK2	(3) RISK = RISK1	(4) RISK = RISK2	(5) RISK = RISK1	(6) RISK = RISK2
Ind-Growth-T	–0.890***	–0.358***	–0.611**	–0.235**	–0.828***	–0.328***
	(–3.77)	(–3.61)	(–2.45)	(–2.25)	(–4.09)	(–3.86)
PCM	3.888***	1.596***				
	(11.90)	(11.97)				
*Ind-Growth-T*PCM*	–1.118***	–0.449***				
	(–4.12)	(–4.02)				
IP			0.016	0.002		
			(0.04)	(0.01)		
*Ind-Growth-T*IP*			–0.659**	–0.278**		
			(–2.25)	(–2.25)		
Top-subsidy					0.782**	0.308*
					(2.01)	(1.94)
*Ind-Growth-T*Top-subsidy*					–1.802**	–0.677**
					(–2.28)	(–2.09)
ROA	–0.249***	–0.103***	–0.183***	–0.076***	–0.170***	–0.071***
	(–12.06)	(–11.98)	(–9.03)	(–9.00)	(–8.13)	(–8.10)
Sales-Growth	0.089	0.039	0.110	0.048	0.107	0.047
	(1.27)	(1.34)	(1.56)	(1.63)	(1.48)	(1.53)
AGE	–0.009	–0.005	–0.024	–0.012	–0.026	–0.012
	(–0.33)	(–0.48)	(–0.91)	(–1.06)	(–0.97)	(–1.12)
LEV	11.655***	4.744***	10.213***	4.151***	10.404***	4.227***
	(11.74)	(11.54)	(10.52)	(10.32)	(10.60)	(10.39)
Shrcr1	–0.036***	–0.016***	–0.034***	–0.015***	–0.034***	–0.015***
	(–4.50)	(–4.78)	(–4.20)	(–4.47)	(–4.20)	(–4.45)
State	–1.350***	–0.580***	–1.385***	–0.594***	–1.299***	–0.558***
	(–4.11)	(–4.32)	(–4.13)	(–4.34)	(–3.82)	(–4.03)
TA	–2.358***	–0.965***	–2.345***	–0.959***	–2.370***	–0.971***
	(–17.86)	(–17.55)	(–17.65)	(–17.34)	(–17.45)	(–17.13)
Intercept	58.954***	24.248***	59.782***	24.591***	63.051***	25.921***
	(23.30)	(22.97)	(23.14)	(22.81)	(22.88)	(22.57)
S.E. clustering by firm	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Observations	23,270	23,270	23,270	23,270	22,359	22,359
Adjusted R^2	0.176	0.176	0.163	0.164	0.162	0.162

Notes: This table reports the cross-sectional results of the robustness tests excluding outliers for asset structure from estimating the following multivariate regressions:

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth\text{-}T_{it} + \beta_2 PCM_{it} + \beta_3 PCM_{it}{*}Ind\text{-}Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \beta_9 Sales\text{-}Growth_{it} + \beta_{10} AGE_{it} + \gamma_t + \varepsilon_{it}$.

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth\text{-}T_{it} + \beta_2 IP_{it} + \beta_3 IP_{it}{*}Ind\text{-}Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \beta_9 Sales\text{-}Growth_{it} + \beta_{10} AGE_{it} + \gamma_t + \varepsilon_{it}$.

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth\text{-}T_{it} + \beta_2 Top\text{-}subsidy_{it} + \beta_3 Top\text{-}subsidy_{it}{*}Ind\text{-}Growth_{it} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8\text{-} + \beta_4 ROA_{it} + \beta_5 TA_{it} + \beta_6 LEV_{it} + \beta_7 Shrcr1_{it} + \beta_8 State_{it} + \beta_9 Sales\text{-}Growth_{it} + \beta_{10} AGE_{it} + \gamma_t + \varepsilon_{it}$.

The first two columns report the cross-sectional results on product market power; the variable *PCM* is defined as 1 if the firm's price–cost margins are in the top quintile of the sample, and 0 otherwise. The middle two columns report the cross-sectional results on industrial policy; the variable *IP* is defined as 1 if the industry is supported by industry policies in the Five-Year Plan documents, and 0 otherwise. The last two columns report the cross-sectional results on government support; the variable *Top-subsidy* is defined as 1 if the industry average government subsidies are in the top quintile of the sample, and 0 otherwise. The dependent variable, *RISK1*, is defined as the standard deviation of the firm's EBITDA/Assets (*ROA*) in the subsequent 5 years, and *RISK2* is defined as the difference between the maximum and the minimum of *ROA* in the subsequent 5 years. The key independent variable, *Ind-Growth-T*, is calculated as the industry average sales growth rate using the new excluded sample. The other variables are defined in Appendix A. t-statistics (in parentheses) are reported below the coefficient estimates and are based on robust standard errors clustered by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Table 12
Robustness and Endogeneity.

Variable	(1) *RISK = RISK1*	(2) *RISK = RISK2*	(3) *RISK = RISK1*	(4) *RISK = RISK2*	(5) *RISK = RISK1*	(6) *RISK = RISK2*	(7) *RISK = RISK1*	(8) *RISK = RISK2*
Ind-Growth			–1.269***	–0.512***	–1.506***	–0.612***		
			(–6.47)	(–6.19)	(–9.03)	(–8.94)		
Ind-R-Growth	–0.466***	–0.186**						
	(–2.65)	(–2.56)						
Ind-Growth-lag1							–1.449***	–0.580***
							(–6.32)	(–6.03)
ROA	–0.154***	–0.064***	–0.156***	–0.064***	–0.131***	–0.053***	–0.154***	–0.063***
	(–8.34)	(–8.18)	(–8.16)	(–7.96)	(–16.83)	(–16.61)	(–7.82)	(–7.70)
Sales-Growth	0.008	0.009	0.162**	0.070**	–0.069*	–0.027*	0.193***	0.084***
	(0.12)	(0.33)	(2.42)	(2.51)	(–1.84)	(–1.78)	(2.80)	(2.90)
AGE	–0.038	–0.017	–0.020	–0.009	0.128***	0.047***	–0.023	–0.011
	(–1.42)	(–1.53)	(–0.73)	(–0.84)	(4.96)	(4.43)	(–0.81)	(–0.95)
LEV	11.617***	4.743***	11.541***	4.699***	10.893***	4.326***	11.883***	4.832***
	(11.23)	(10.97)	(11.23)	(11.04)	(27.95)	(27.03)	(11.08)	(10.81)
Shrcr1	–0.038***	–0.016***	–0.038***	–0.016***	–0.119***	–0.050***	–0.037***	–0.016***
	(–4.69)	(–4.88)	(–4.71)	(–4.91)	(–18.01)	(–18.31)	(–4.45)	(–4.66)
State	–1.311***	–0.569***	–1.258***	–0.543***	–0.252	–0.135**	–1.468***	–0.632***
	(–4.08)	(–4.33)	(–3.89)	(–4.12)	(–1.51)	(–1.97)	(–4.28)	(–4.53)
TA	–2.608***	–1.070***	–2.559***	–1.048***	–1.450***	–0.566***	–2.659***	–1.090***
	(–18.01)	(–17.51)	(–18.19)	(–17.80)	(–14.81)	(–14.08)	(–18.47)	(–18.04)
Pro-tax			12.395***	4.944***				
			(2.75)	(2.65)				
GDP			–0.414*	–0.182*				
			(–1.82)	(–1.95)				
GDP-per			0.031	0.028				
			(0.06)	(0.14)				
CEO-gender			0.000	–0.006				
			(0.00)	(–0.03)				
CEO-age			–1.663**	–0.696**				
			(–2.16)	(–2.19)				
CEO-finance			0.368	0.162				
			(1.22)	(1.30)				
Intercept	67.040***	27.583***	71.747***	29.555***	42.711***	17.096***	69.476***	28.585***
	(23.72)	(23.30)	(13.19)	(13.09)	(21.90)	(21.35)	(23.69)	(23.25)
S.E. clustering by firm	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Firm fixed effects	NO	NO	NO	NO	YES	YES	NO	NO

Kleibergen–Paap rk LM statistic							226.448	226.448
Observations	26,338	26,338	25,650	25,650	26,338	26,338	23,348	23,348
Adjusted R^2	0.177	0.177	0.179	0.178	0.011	0.008	0.184	0.183

Notes: This table reports results of the robustness tests and endogenous tests estimating the following multivariate regressions:

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}R\text{-}Growth_{it} + \beta_2 ROA_{it} + \beta_3 TA_{it} + \beta_4 LEV_{it} + \beta_5 Shrcr1_{it} + \beta_6 State_{it} + \beta_7 Sales\text{-}Growth_{it} + \beta_8 AGE_{it} + \gamma_t + \varepsilon_{it}$.

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 ROA_{it} + \beta_3 TA_{it} + \beta_4 LEV_{it} + \beta_5 Shrcr1_{it} + \beta_6 State_{it} + \beta_7 Sales\text{-}Growth_{it} + \beta_8 AGE_{it} + \beta_9 Pro\_tax_{it} + \beta_{10} GDP_{it} + \beta_{11} GDP\_per_{it} + \beta_{12} CEO\_gender_{it} + \beta_{13} CEO\_age_{it} + \beta_{14} CEO\_finance_{it} + \gamma_t + \varepsilon_{it}$.

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth_{it} + \beta_2 ROA_{it} + \beta_3 TA_{it} + \beta_4 LEV_{it} + \beta_5 Shrcr1_{it} + \beta_6 State_{it} + \beta_7 Sales\text{-}Growth_{it} + \beta_8 AGE_{it} + \gamma_t + \delta_i + \varepsilon_{it}$.

$RISK_{it} = \beta_0 + \beta_1 Ind\text{-}Growth\text{-}lag1_{it} + \beta_2 ROA_{it} + \beta_3 TA_{it} + \beta_4 LEV_{it} + \beta_5 Shrcr1_{it} + \beta_6 State_{it} + \beta_7 Sales\text{-}Growth_{it} + \beta_8 AGE_{it} + \gamma_t + \varepsilon_{it}$.

The first two columns report the robustness tests using another measure of industry growth that rules out the effect of asset size. The key independent variable, *Ind-R-Growth*, is defined as the industry average ranked version of sales growth. The second and third two columns report the endogenous tests that control managerial individual characteristics, macro-level and regional factors or firm fixed effects. The key independent variable, *Ind-Growth*, is calculated as the industry average sales growth rate. The fourth two columns report the endogenous tests of the instrumental variable model. The exogenous instrumental variable, *Ind-Growth-lag1*, is defined as the one-period lagged industrial sales growth. The dependent variable, *RISK1*, is defined as the standard deviation of the firm's EBITDA/Assets (*ROA*) in the subsequent 5 years, and *RISK2* is defined as the difference between the maximum and the minimum of *ROA* in the subsequent 5 years. The key independent variable, *Ind-Growth-T*, is calculated as the industry average sales growth rate using the new excluded sample. The other variables are defined in Appendix A. t-statistics (in parentheses) are reported below the coefficient estimates and are based on robust standard errors clustered by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Table 13
Endogeneity: First-order difference model.

Variable	(1) *RISK = Dif-RISK1*	(2) *RISK = Dif-RISK2*
Dif-Ind-Growth	–0.307***	–0.109**
	(–2.65)	(–2.46)
Dif-ROA	–0.068***	–0.026***
	(–6.33)	(–6.29)
Dif-Sales-Growth	0.005	0.003
	(0.19)	(0.29)
Dif-LEV	2.936***	1.008***
	(4.26)	(3.76)
Dif-Shrcr1	–0.047***	–0.018***
	(–5.33)	(–5.07)
Dif-TA	–0.028	0.038
	(–0.13)	(0.44)
Intercept	1.055***	0.405***
	(5.37)	(5.28)
S.E. clustering by firm	YES	YES
Year fixed effects	YES	YES
Observations	23,348	23,348
Adjusted R^2	0.033	0.031

Notes: This table reports endogenous tests of the first-order difference model estimated using the following multivariate regression: $Dif\text{-}RISK_{it} = \beta_0 + \beta_1 Dif\text{-}Ind\text{-}R\text{-}Growth_{it} + \beta_2 Dif\text{-}ROA_{it} + \beta_3 Dif\text{-}TA_{it} + \beta_4 Dif\text{-}LEV_{it} + \beta_5 Dif\text{-}Shrcr1_{it} + \beta_6 Dif\text{-}Sales\text{-}Growth_{it} + \gamma_t + \varepsilon_{it}$. The dependent variable, *RISK1*, is defined as the standard deviation of the firm's EBITDA/Assets (*ROA*) in the subsequent 5 years, and *RISK2* is defined as the difference between the maximum and the minimum of *ROA* in the subsequent 5 years. The key independent variable, *Ind-Growth*, is calculated as the industry average sales growth rate. The other variables are defined in Appendix A. t-statistics (in parentheses) are reported below the coefficient estimates and are based on robust standard errors clustered by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

growth and recession. On the other hand, the literature shows that the macroeconomic environment is an important factor affecting corporate risk policies (Mclean and Zhao, 2014). To alleviate the possible interference of other omitted variables besides control variables and fixed effect models, we further adopt the instrumental variable model. Columns (7) and (8) in Table 12 present the evidence. Following Yang et al. (2016), we use *Ind-Growth-lag1* as the exogenous instrumental variable. The F value of the Kleibergen–Paap rk LM statistic is 226.448, indicating that weak instrumental variables do not present a significant problem. The results support our initial conclusions. Fourth, as industry growth and corporate policies may exhibit time inertia, to alleviate the possible autocorrelation problem of time series, we further use the first-order difference model to re-examine the basic model and report the results in Table 13. The findings are consistent with our predictions.

9. Conclusions

We ask whether and how industry growth affects corporate risk-taking. From the perspective of prospect theory and behavioral theory, corporate risk-taking is the result of a comparison of expectations or targets. A high-growth industry gives firms a superior external environment, which may cause them to refrain from corporate risk-taking, as in the saying "thinking of peace when rich." Especially for China, an emerging market, market demand has recently expanded unprecedentedly, meaning that firms in high-growth industries can earn high profits through short-term investment, especially firms in high-growth industries shaped by industrial policy support who are easily able to obtain financial support such as subsidies and loans and whose resources are rich and plentiful.

Using firm-level panel data consisting of 26,338 firm-year observations of publicly traded Chinese firms, we discover that industry growth is negatively associated with corporate risk-taking in emerging markets, consistent with prospect theory and behavioral theory in emerging markets analysis. Furthermore, the correlation is stronger for product market leaders, firms in industries promoted by industry policies and firms in industries that receive more government support. We examine by what means firms reduce their risk-taking in response to high industry growth and find that they do so by reducing their operational efficiency and long-term valuable investment, as well as by adopting conservative financial policies. High industry growth rates lengthen the operating cycle, reduce liquid asset turnover, reduce long-term capital expenditure and R&D investment and increase corporate cash holding.

Studies primarily focus on individual-level, firm-level and macro-level factors of risk-taking in developed markets. This study contributes to the research by presenting evidence that industry growth is an important factor influencing corporate risk-taking and creates new features in emerging markets. Our results also have implications for the growing literature on the consequences of industry growth. Furthermore, we provide additional insight into prospect theory and behavioral theory by demonstrating that it is not only firms' own high returns but also the superior external environment that leads firms to be risk-averse, especially in emerging markets. As this study considers Chinese data, these results are of great significance to the economy of developing countries. We can make reasonable inferences that firms are more dependent on external industrial demand than internal strength when it comes to their development and growth. For such companies, relying on external environment rather than inner ability to survive still prevails.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Administrative division adjustments and stock price comovement: Evidence from the city–county mergers in China

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ABSTRACT

Under the background of Chinese market segmentation, whether government-led administrative division adjustments can promote regional economic integration is a practical issue. Taking interregional firms' stock price comovement as a micro measurement of regional integration, this paper investigates the regional integration effect of administrative division adjustments, i.e., city–county mergers. We find that stock price comovement between county-level and municipal district-level firms in the merged counties and municipal districts significantly improve after city–county mergers, particularly in regions with a higher degree of market segmentation and lower degree of marketization. We further find that the increase in stock price comovement caused by city–county mergers emerges from the increase in comovement of real activities between firms in the merged counties and municipal districts. Taken together, our results suggest that government-led administrative division adjustments effectively promote regional integration.

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1. Introduction

Administrative divisions are an important means of building state power and administrative management. With progress in productivity and economic development, administrative divisions gradually change from being dominated by political factors to being influenced by economic factors. Administrative divisions affect the spatial flows of economic elements and allocation of resources, which in turn profoundly impact the regional economy. The recent administrative division adjustments in China are mainly based on economic development. However, no consensus exists on whether administrative division adjustments achieve the original goal of promoting regional economic development (Fan et al., 2012; Wang and Xie, 2012; Shao et al., 2018). Theoretically, administrative division adjustments can successfully affect regional economic development when they effectively promote regional market integration, expand the market scale, and realize economic agglomeration (Fan et al., 2012; Tang and Wang, 2015).

Since its reform and opening up in 1978, China's regional markets have been segmented. The main institutional causes for this segmentation are based on the administrative decentralization and local protectionism resulting from the GDP-centric mechanism for evaluating local officials (Lin and Liu, 2004; Zhou, 2004). This regional market segmentation hinders the spatial flows of economic elements and rational resource allocation and is not conducive to long-term economic development (Liu, 2005). To improve resource allocation efficiency and fully explore China's potential for economic growth, efforts must be made to alleviate regional market segmentation and promote regional integration. Therefore, this paper investigates whether administrative division adjustments lead to regional integration.

Recently, prefecture-level Chinese cities are conducting frequent administrative division adjustments. As a representative policy on administrative division adjustments, city–county mergers (CCMs) are a powerful tool used by the central government to promote urbanization by breaking the administrative barriers between counties and municipal districts in cities. However, it is an empirical question whether the use of CCMs as a government-led policy for urban spatial expansion can comply with market laws and achieve economic integration between the merged counties and municipal districts, instead of expanding urbanization ineffectively. Scholars rarely investigate the regional integration effect of CCM policies because of the abstract nature of the related concepts. Through their administrative interventions, local governments mainly protect the production and operation of local firms because they are important market players; that is, firms are the micro-foundation of regional market segmentation (Yin and Cai, 2001). Therefore, the achievement of regional integration will inevitably take the inter-regional firms' co-movement as a microscopic performance. From a micro perspective, this paper uses comovement between county-level and municipal district-level firms in the merged counties and municipal districts to examine the effect of administrative division adjustments on regional integration.

Specifically, this paper uses a sample of A-share listed firms registered in county administrative regions in China to examine the impact of CCMs on stock price comovement between firms in the merged counties and municipal districts. After CCMs, we find that stock price comovement increases significantly between firms in the merged counties and municipal districts. This result is especially pronounced in regions with a higher degree of market segmentation and a lower degree of marketization. In addition, corporate earnings comovement increases significantly after CCMs, which demonstrates the increase in stock price comovement resulting from the increase in the comovement of real activities between firms in the merged counties and municipal districts. These results show that administrative division adjustments promote the comovement of interregional firms and demonstrate the regional integration effect of administrative division adjustments.

This study makes two contributions to the literature. First, our results supplement studies on the policy effect of administrative division adjustments, which are mostly performed at the macro level, that is, they examine the effects of administrative division adjustments, including county reform as directly administrated by provincial governments (Cai et al., 2011; Zheng et al., 2011; Chen and Lu, 2014; Liu and Wang, 2018), the county-to-city upgrading policy (Fan et al., 2012; Tang, 2019a) and CCMs (Wang and Xie, 2012; Tang and Wang, 2015; Lu et al., 2017; Shao et al., 2018; Zhang et al., 2018a; Ji and Zou, 2019; Tang, 2019b), from the perspective of local fiscal revenues, population and urbanization processes and regional economic growth. Considering the literature on the policy effects of CCMs, scholars mostly use economic integration between counties and municipal districts as an important mechanism for analyzing the economic consequences of

CCMs (Wang and Xie, 2012; Tang and Wang, 2015; Shao et al., 2018; Tang, 2019b), but few studies can verify this mechanism because of measurement issues. This paper uses the comovement of firms in counties and municipal districts as micro reflection to illustrate their economic integration and examine the regional integration effect of CCMs to obtain evidence for the micro-level mechanism in the literature focused on macro-level policy effects. Our findings suggest that the government-led urban spatial expansion policy can effectively comply with market laws and achieve regional economic integration rather than cause a disorderly expansion of the city's scale. Therefore, the combination of "effective market" and "active government" is significant for emerging economies, such as China.

Second, this study enriches the literature on the determinants of stock price comovement, which can generally be divided into two aspects: fundamental-induced and trading-induced comovement (Barberis et al., 2005). Accordingly, scholars examine geographical stock price comovement (Pirinsky and Wang, 2006; Li et al., 2009), market stock price comovement (Morck et al., 2000; Boyer et al., 2006; Chan and Hameed, 2006), stock price comovement caused by investor characteristics (Boyer et al., 2006; Kumar and Lee, 2006; Anton and Polk, 2014; Kumar et al., 2016; Huang et al., 2019; Zhaunerchyk et al., 2020; Hu et al., 2021), analyst-induced stock price comovement (Muslu et al., 2014; Hameed et al., 2015), industry stock price comovement (Kallberg and Pasquariello, 2008) and technology stock price comovement (Fung, 2003; Bekkerman et al., 2021). Among these studies, our paper is closely related to geographical stock price comovement. While earlier studies examine stock price comovement between firms located in the same geographic area or administrative division, this paper examines stock price comovement between firms located in different administrative divisions. Although studies of geographical stock price comovement mainly use regional market segmentation as their research setting (Li et al., 2009), they seldom consider the role of the government. In the emerging economies represented by China, however, the impact of government behavior on the micro market cannot be ignored (Chen et al., 2017). In the context of Chinese regional market segmentation, this paper dynamically examines the changes in stock price comovement between county-level firms and municipal district-level firms before and after CCMs. In this way, this paper incorporates the government's role into an analytical framework for geographical stock price comovement. In addition, we find that the impact of administrative division adjustments on stock price comovement emerges from improvements in comovement of corporate real activities, which also supplements empirical evidence for fundamental-induced stock price comovement.

2. Literature, institutions and theory

2.1. Literature review

This paper is related to two lines of research: the policy effect of administrative division adjustments and the determinants of stock price comovement.

Considering the policy effect of administrative division adjustments, scholars investigate the effects of policies such as the reform of counties directly administrated by provinces, the county-to-city upgrading policy and CCMs. According to differences in research objectives, we can roughly divide the literature into three categories.

The first category concerns the impact of administrative division adjustments on local fiscal revenues. Specifically, studies show that the reform of counties administrated directly by provinces raises the county-level government's infrastructure expenditures, reduces people's livelihood expenditures (Chen and Lu, 2014) and reduces the local fiscal revenues of county-level and municipal-level governments (Cai et al., 2011; Liu and Wang, 2018). Considering the impact of the county-to-city upgrading policy on local fiscal revenues, studies show that the number of public officials in the newly established city government increases after implementing the policies, which exacerbates the government's financial burden and has a crowding-out effect on its productive fiscal expenditures (Fan et al., 2012). Considering the impact of CCMs, Ji and Zou (2019) suggest that they weaken the fiscal incentives of the merged county-level government, which results in declining tax revenues for prefecture-level cities. Considering expenditures, Zhang et al. (2018a) claim that CCMs lead to reductions in competitive incentives for the merged county-level governments, which in turn lead to reductions in productive expenditures and growth in livelihood expenditures.

The second category concerns the impact of administrative division adjustments on rural/urban populations and the urbanization process. One perspective is that administrative division adjustments accelerate the migration and agglomeration of the population to cities, thereby promoting a population urbanization process (Tang and Wang, 2015). Another perspective is that despite the reduction in the rural-registered population, the actual share of employment among the rural population does not decrease. Therefore, the urbanization brought by administrative division adjustments is nominal (Lu et al., 2017). A third perspective is that the impact of administrative division adjustments on the urbanization process cannot be determined in general, which reflects not only on the urban scale but also the urban development quality (Cai et al., 2011). In summary, whether administrative division adjustments can effectively promote urbanization has yet to be shown.

The third category concerns the impact of administrative division adjustments on regional economic growth. Some studies find that administrative division adjustments have a positive effect on the regional economy (Zheng et al., 2011; Wang and Xie, 2012; Tang, 2019a, 2019b), while others have different conclusions of their economic effect. For example, Fan et al. (2012) suggest that the small and medium-sized cities formed by the county-to-city upgrading policy are not conducive for regional market integration and economic agglomeration; therefore, the policy has no positive effect on regional economic growth. Shao et al. (2018) point out that the stimulus effect of CCMs on regional economies is driven by the expansion of economic elements and lacks long-term sustainability. Overall, the literature does not reach a consensus on the impact of administrative division adjustments on regional economies, especially CCMs, which are the focus of this paper. Although conclusions vary among studies, the achievement of regional integration is generally regarded as an important mechanism for administrative division adjustments to promote regional economic growth (Fan et al., 2012; Tang and Wang, 2015; Shao et al., 2018; Tang, 2019b). Therefore, it is of great significance of investigation of the regional integration effect of administrative division adjustments.

In addition to the macro-level literature mentioned above, a small number of studies focus on the impact of administrative division adjustments on micro firms, including corporate tax burdens (Wang and Fang, 2015; Fan and Zhao, 2020; Li and Jia, 2020), corporate financing constraints (Lu and Chen, 2017) and corporate performance (Liu et al., 2014; Tang and Wang, 2015). Generally, micro-level studies concentrate on the impact of administrative division adjustments on the behavior or performance of individual firms, whereas our paper investigates the effect of administrative division adjustments on interregional firms' comovement from the perspective of regional integration. The extension of perspectives from individual firms to the comovement of interregional firms enriches the cognitive dimension of the impact of administrative division adjustments on micro firms.

Considering determinants of stock price comovement, we can roughly divide the literature into two categories: that is, fundamental-induced and trading-induced comovement (Barberis et al., 2005). On this basis, scholars explore various kinds of stock price comovement and their determinants. In terms of geographical comovement, scholars find significant stock price comovement among firms in the same region, which is attributed to the similar trading behavior of regional investors' rather than the relationship between firms' fundamentals (Pirinsky and Wang, 2006; Li et al., 2009). In terms of market comovement, scholars point out that incomplete institutions in emerging economies inhibit the reflection of firm-specific information in stock prices, which leads to stock price comovement among listed firms within the same market (Morck et al., 2000; Chan and Hameed, 2006).

Scholars also investigate the impact of investors' characteristics on stock price comovement. For example, Kumar and Lee (2006) find that retail investors' noise trading causes high stock price comovement among stocks with high retail concentrations. Boyer et al. (2006) observe comovement in the stocks from different markets held by common international investors. Anton and Polk (2014) suggest that nonfundamental factors between stocks with common mutual fund owners induce stock price comovement. Kumar et al. (2016) find that the correlated trading of gambling-motivated investors leads to comovement in stocks with lottery characteristics. Other scholars indicate that when faced with a shock that distracts investors, their limited attention makes them focus on market information rather than firm-specific information, which increases comovement between individual stocks and the market (Huang et al., 2019; Zhaunerchyk et al., 2020). However, there are also studies finding the opposite conclusion (Hu et al., 2021).

Some scholars study the impact of analysts on stock price comovement. Hameed et al. (2015) points out a positive association between the number of analysts following stocks and stock price comovement. Muslu et al. (2014) observes stock price comovement among firms followed by common analysts, which occurs because analysts excavate characteristic information from the stock portfolios they follow. Finally, scholars also examine stock price comovement in the same industry (Kallberg and Pasquariello, 2008) and stock price comovement induced by technology (Fung, 2003; Bekkerman et al., 2021). Among these stock price comovement studies, the most closely related to this paper are those exploring geographical stock price comovement, such as stock price comovement among firms in the same geographic area or administrative division. However, we explore stock price comovement among firms located in different administrative divisions and focus on the impact of government-led administrative division adjustments on interregional stock price comovement. Therefore, we include the government's role in the analytic framework for stock price comovement.

2.2. Institutional background and theoretical analysis

Long-term regional market segmentation is a consequence of technical and institutional factors following China's reform and opening up in 1978. The technical factors mainly refer to the transportation costs caused by the natural geographic environment, while the institutional factors are reflected in local protectionism, which is mainly induced by administrative decentralization and the GDP-centric evaluation mechanism for local officials. Specifically, since China's reform and opening up, administrative decentralization has given local governments a certain amount of administrative and economic powers to mobilize their development of the local economy. Hence, administrative decentralization is an important factor in the rapid development of China's economy (Yin and Cai, 2001). However, the decentralization of administrative powers endows local governments with the power to distribute resources within their own regions (Lin and Liu, 2004). Therefore, local governments have an incentive to protect local firms by using their administrative powers to expand the tax base and increase local fiscal revenue. Moreover, since the early 1980s, the promotion criteria for officials has changed from a purely political indicator to having a basis in economic performance, especially using local GDP as the basis for official evaluation and assessment (Zhou, 2004). In their efforts to increase local GDP, local officials use administrative interventions to make excessive investments and repeated constructions, which leads to the convergence of industries and hinders cooperation among different regions (Yin and Cai, 2001; Zhou, 2004).[1] Therefore, regional market segmentation hinders the spatial flows and rational allocation of resources across regions (Yin and Cai, 2001) and slows the speed of technological innovations, thereby restraining long-term regional economic development (Lin and Liu, 2004; Liu, 2005; Lu and Chen, 2009).

In China's current five levels of administrative divisions (central government–province–prefecture-level city–county–township), regional market segmentation not only exists among provinces but also within prefecture-level cities. Counties and municipal districts experience market segmentation problems because of the different interests of the county and city governments. As urbanized economic zones directly under the authority of the prefecture-level city government, municipal districts are the management focus of city governments (Shao et al., 2018). In addition, under the "city governing counties" system, the phenomenon of "city suppressing counties, city scraping counties and city restraining counties" is widespread, which makes it difficult for municipal districts and counties to coordinate with each other in the construction of infrastructure and industrial interactions. In contrast, counties are provincial administrative units stipulated by the Constitution of the People's Republic of China, with relatively independent fiscal and administrative powers. County-level governments have an incentive to protect their local markets to expand their local fiscal revenues

[1] The government's local protection behaviors include but are not limited to the following: adopting administrative control measures to restrict the entry of foreign products and raw materials into the local market (Lin and Liu, 2004), using administrative power to interfere with local consumers' purchases to create monopoly profits for local firms, intervening in the financial system to create low-cost financing opportunities for local firms, intervening in the judicial system to help local firms obtain low-cost land resources (Lin and Liu, 2004) and even condoning the production and sale of fake products by local firms (Yin and Cai, 2001). In addition to the product market, the local government also causes segmentation of the capital and labor markets by restricting the cross-regional operation and investment of firms in addition to the cross-regional flow of labor (Yin and Cai, 2001).

and promote the county's economic development[2] (Wang and Xie, 2012; Shao et al., 2018). Therefore, administrative barriers directly lead to market segmentation between counties and municipal districts.

As a government-led administrative division adjustment, CCM refers to dismantling county-level administrative systems by transferring the merged county into municipal district of prefecture-level cities or municipalities. Theoretically, CCMs break the administrative barriers between the merged counties and municipal districts to promote regional integration. This paper takes stock price comovement between county-level and municipal district-level firms as a micro reflection of integration between counties and municipal districts and explores the regional integration effect of administrative division adjustments by analyzing the impact of CCMs on stock price comovement. Specifically, CCMs may improve stock price comovement between firms in the merged counties and municipal districts through two mechanisms.

First, CCMs promote convergence of the external environment experienced by firms in the merged counties and municipal districts. Before a CCM, a county is an independent administrative unit; therefore, county-level governments have incentives to implement local protection to expand local fiscal revenues and stimulate the local economy, thereby gaining an advantage in the competition between local governments. However, when county-level administrative divisions are merged into municipal districts, the competition between local governments in the merged county-level government reduces significantly (Zhang et al., 2018a), which weakens the incentive to intervene in local economies. In addition, after a CCM, most of the fiscal and administrative power of the merged county-level government is simultaneously transferred to the city-level government (Tang and Wang, 2015; Tang, 2019b). Therefore, the incentive and ability of the merged county-level government to implement administrative interventions in the external environment of county-level firms are both weakened. The city government is now responsible for the overall planning of its external environment; therefore, the external environment experienced by firms in the merged counties and municipal districts will converge after CCMs. The external environment (e.g., the financial environment, fiscal and taxation policies, and infrastructure construction) has an important influence on local firms' survival and development. Hence, its effects are reflected in stock prices (Claessens and Laeven, 2003; Li et al., 2014; Wang and Tan, 2016; Zhang et al., 2018b; Smajlbegovic, 2018). We argue that the convergence of external environments after CCMs enhances stock price comovement between firms in the merged counties and municipal districts.

Second, CCMs facilitate cooperation and learning between firms in the merged counties and municipal districts. Before a CCM, the county-level government may adopt administrative means to restrict goods and services from foreign firms in the local market, which hinders interactions between firms in counties and municipal districts. After a CCM, the disappearance of administrative barriers weakens the county government's incentive and ability to intervene in the local economy. The city government is then responsible for the overall planning of resource allocations and industrial layouts in the entire municipal area, including the former counties, which strengthens interactions between firms in the merged counties and municipal districts (Wang and Xie, 2012; Tang and Wang, 2015). After CCMs, municipal districts extend their urban roads, buses, subways, and other kinds of transportation infrastructure into the merged counties (Tang and Wang, 2015; Tang, 2019b), which enhances the traffic connections between the merged counties and municipal districts. This intensification of traffic connections promotes the spatial flow of economic elements between the merged counties and municipal districts. Therefore, the supply chain cooperation of firms between the merged counties and municipal districts after CCMs is intensified. Considering the high level of stock price comovement between firms with supply chain relationships due to the interconnections between their production and operations (Cohen and Frazzini, 2008; Menzly and Ozbas, 2010), we argue that stock price comovement between firms in the merged counties and municipal districts increases because of the strength of the firms' supply chain operations. Moreover, the elimination of administrative barriers and increases in spatial

[2] In 2001, a China Central Television news program reported that a certain county government had established a "commodity rectification office," whose job was to ensure the sales of local products to guarantee local fiscal revenues. This office established targets for each township to sell local wine and cement, with rewards and punishment based on the completion of sales. In addition, the county government stipulated that foreign cement was not allowed in the local market, which meant that residents could not buy more cost-effective cement from other regions. Considering the protection of local wine, the county government adopted a "wine wages" approach by withholding 60–70 yuan of "wine wages" from the local teachers' wages, which accounted for about 10 percent of the local teachers' monthly wages at that time.

connections also promote communication and learning between firms in the merged counties and municipal districts (Tang and Wang, 2015). These connections further lead to convergences or alliances between the interregional firms in terms of their real activities, including production, operation, investment, and financing (Kogut and Chang, 1996; Chaudhuri et al., 1997; Geng et al., 2021). This convergence or alliance of firms' real activities also increases stock price comovement (Cao et al., 2016). Therefore, the improvement in cooperation and learning between firms in the merged counties and municipal districts after CCMs increases their stock price comovement.

Based on these analyses, we develop the following hypothesis:

Hypothesis: Stock price comovement between firms in the merged counties and municipal districts improves significantly after CCMs.

Considering institutional inertia and the intensity of relationships between county and municipal governments, the practical results of CCMs may be heterogeneous, which would make our hypothesis untenable. For example, counties and municipal districts may only merge spatially after CCMs instead of being integrated substantially; therefore, county governments may still retain a considerable degree of independence. That is to say, the characteristics of the original city–county institutions continue within the new municipal districts in the city. This creates the phenomenon of "different treatments in the same city" and "one city, two administrative bodies" (Shao et al., 2018, page 107).[3] This circumstance may weaken the effect of CCMs on stock price comovement.

3. Research design

3.1. Data and methodology

This paper uses data on A-share listed firms in China from 1998 to 2018 as the initial sample. CCMs are an important policy in the shift from quality expansion to scale expansion in China's urban development strategy after 2000. The effect of CCMs during this stage has higher research value; therefore, we follow the literature in focusing on CCMs after 2000 (Tang and Wang, 2015; Shao et al., 2018). In addition, observations from 1998 to 1999 are included in the sample as the benchmark. We manually collect information on CCMs, and the financial information on firms is from the China Stock Market and Accounting Research database. We use the following process to refine the sample. (1) We exclude firms whose registered addresses are in municipal districts; therefore, only firms whose registered addresses are in counties, namely county-level firms, are retained in the sample. (2) If a city experiences a CCM with no listed firms registered in the municipal area before the CCM, we exclude observations from these cities. We also exclude (3) observations from counties directly administrated by provinces, (4) firms from the financial industry, (5) firms with negative net assets, special treatment, or particular transfer, and (6) observations with incomplete data. We obtain 173,013 firm-week observations from 338 county-level firms. The standard errors are clustered by firm given the multiple yearly observations available for each firm (Petersen, 2009).

3.2. Model specification and variable definition

We follow the literature (e.g., Barberis et al., 2005; Pirinsky and Wang, 2006) in testing our hypothesis by estimating the following staggered difference-in-difference (DID) model:

$$Ret_{i,w} = \alpha_0 + \alpha_1 Ret_{s,w} + \alpha_2 CCM + \alpha_3 CCM * Ret_{s,w} + \Sigma Controls + \Sigma Firm + \Sigma Week + \varepsilon_{i,w} \quad (1)$$

[3] While Jiangning County transformed spatially from a county into a municipal district during a CCM with Nanjing City, the original city–county management system still dominates under the city–district system. Similarly, after the administration of Wujin City (a county-level city) was transferred to the Wujin District of Changzhou City, the Wujin District still retains most of the administrative authority, and its urban planning and industrial layout continue to follow the original administrative strategies and do not match the planned layout for Changzhou City.

Table 1
Definition of variables.

Variables	Definition
$Ret_{i,w}$	The rate of return of the county-level firm *i* in week *w*.
$Ret_{s,w}$	The market value-weighted average rate of return for all listed municipal district-level firms in the city where the county-level firm *i* belongs in week *w*.
CCM	A dummy variable that measures CCM implementation. Specifically, if in year *y*, a CCM is implemented in the county where county-level firm *i* is located, *CCM* equals 1 for observations in the year of *y* and later years, and 0 otherwise. For the county where CCMs are never implemented during the sample period, *CCM* always equals 0.
$Ret_{ind,w}$	The market value-weighted average rate of return of the industry to which the county-level firm *i* belongs in week *w*.
$Ret_{i,w-1}$	Short-term reversal. The rate of return of the county-level firm *i* in week *w*-1.
$Ret_{i,w-12,\ w-2}$	Medium-term continuation. The average rate of return of the county-level firm *i* from week *w*-12 to week *w*-2.
Size	Firm size, equal to the natural logarithm of total assets.
Lev	Firm leverage, equal to the total liabilities divided by total assets.
BM	Book-to-market ratio, equal to the net assets divided by the total market value.

In Model (1), $Ret_{i,w}$ is the rate of stock returns for county-level firm *i* in week *w*, and $Ret_{s,w}$ is the market value-weighted average return for all listed municipal district-level firms in the city where the county-level firm *i* belongs in week *w*. The coefficient α_1 measures the correlation of the stock returns between county-level firm *i* and municipal district-level firms, reflecting the degree of stock price comovement between firms in counties and municipal districts in the absence of a CCM. *CCM* is the main independent variable, which measures the CCM implementation. Specifically, if in year *y*, a CCM is implemented in the county where county-level firm *i* is located, *CCM* equals 1 for observations in year *y* and later years, and 0 otherwise. For a county where a CCM is never implemented during the sample period, *CCM* always equals 0. Following the literature (Barberis et al., 2005; Pirinsky and Wang, 2006, Bekkerman et al., 2021), control variables include the average stock return of the industry in week *w* ($Ret_{ind,w}$), short-term reversal ($Ret_{i,w-1}$) and medium-term continuation ($Ret_{i,w-12w-2}$), firm size (*Size*), firm leverage (*Lev*) and book-to-market ratio (*BM*). For the convenience of understanding of coefficients, we standardize all stock return variables[4] (Bekkerman et al., 2021). In addition, we control for firm (*Firm*) and week (*Week*) fixed effects in Model (1). Table 1 shows the detailed definitions for these variables. According to our hypothesis, we expect the coefficient α_3 of the interaction item between *CCM* and $Ret_{s,w}$ to be significantly positive, that is, after CCMs, the stock price comovement between firms in the merged counties and municipal districts should increase.

4. Main results

4.1. Summary statistics

Table 2 presents the summary statistics for the main variables. All continuous variables are winsorized at the top and bottom 1% to mitigate the influence of outliers. The mean of the standardized weekly rate of return is 0 and the standard deviation is close to 1, indicating that the relevant variables for the standardized weekly rate of return conform to a normal distribution.[5] The mean (median) of *CCM* is 0.185 (0.000), indicating that about 18.5% of the observations show experiences of CCMs. The distribution of the other variables is similar to those in prior Chinese studies.

4.2. Regression results

Table 3 reports the regression results for the impact of CCMs on stock price comovement between firms in the merged counties and municipal districts. Column 1 shows the regression results without including fixed effects, whereas Column 2 shows the regression results with the firm and week fixed effects included. The results show that the coefficients of the interaction term between *CCM* and $Ret_{s,w}$ are both positive and sta-

[4] We also use the raw return data to perform regressions. Our results do not change materially.

Table 2
Summary statistics.

Variables	Mean	Std.	25%	Median	75%
$Ret_{i,w}$	0.000	0.997	–0.594	–0.106	0.474
$Ret_{i,w}(Raw)$	0.003	0.066	–0.032	0.001	0.035
$Ret_{s,w}$	0.000	0.997	–0.560	–0.060	0.487
$Ret_{s,w}(Raw)$	0.004	0.051	–0.022	0.004	0.030
CCM	0.185	0.388	0.000	0.000	0.000
$Ret_{ind,w}$	0.000	0.997	–0.582	–0.041	0.530
$Ret_{ind,w}(Raw)$	0.004	0.042	–0.018	0.005	0.027
$Ret_{i,w\text{-}1}$	0.000	0.997	–0.593	–0.105	0.473
$Ret_{i,w\text{-}1}(Raw)$	0.003	0.066	–0.031	0.001	0.035
$Ret_{i,w\text{-}12,\ w\text{-}2}$	0.000	0.997	–0.573	–0.119	0.480
$Ret_{i,w\text{-}12,w\text{-}2}(Raw)$	0.003	0.019	–0.008	0.000	0.012
Size	21.45	0.988	20.755	21.43	22.06
Lev	0.399	0.197	0.247	0.393	0.544
BM	0.722	0.531	0.335	0.568	0.953

Table 3
Impact of CCMs on stock price comovement.

Dependent variable: $Ret_{i,w}$	(1)	(2)
$\boldsymbol{CCM*Ret_{s,w}}$	**0.076*** **	**0.078*** **
	(10.91)	**(5.09)**
$Ret_{s,w}$	0.012***	0.012***
	(4.89)	(3.19)
CCM	0.007	–0.008
	(1.09)	(–0.76)
$Ret_{ind,w}$	0.142***	0.142***
	(59.84)	(17.82)
$Ret_{i,w\text{-}1}$	–0.050***	–0.052***
	(–20.85)	(–15.47)
$Ret_{i,w\text{-}12,\ w\text{-}2}$	–0.001	–0.001
	(–0.35)	(–0.49)
Size	–0.013***	–0.064***
	(-5.19)	(–10.32)
Lev	0.037***	0.191***
	(2.98)	(8.98)
BM	0.011**	0.087***
	(2.42)	(12.29)
Constant	0.256***	1.132***
	(4.84)	(5.54)
Firm FE	No	Yes
Week FE	No	Yes
N	173,013	173,013
Adj-R^2	0.024	0.025

Note: The *t*-statistics shown in brackets are adjusted for clustering by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

tistically significant at the 1% level (0.076, *t*-stat = 10.91 in Column 1; 0.078, *t*-stat = 5.09 in Column 2), which indicates that the stock price comovement between firms in the merged counties and municipal districts improves significantly after the implementation of CCMs, consistent with our hypothesis. We take the results in Column 2 as an example. Before CCMs, when the average weekly return of municipal district-level firms changes by one standard deviation, the weekly return of county-level firms changes by 0.012 standard deviations. After CCMs, once the average weekly return of municipal district-level firms changes by one standard deviation, the weekly return of county-level firms changes by 0.09 (0.078 + 0.012) standard deviations, indicating that after CCMs, stock price comovement between firms in the merged counties and municipal districts increases by about 6.5 times. Therefore, the impact of CCMs on stock price comovement is both economically and statistically significant. The behavior of the control variables is consistent with the literature. For example, the weekly return of individual stocks is higher when the industry average return and *BM* ratio are higher and when the asset size of the firm is smaller. In addition, the higher the lagging weekly return, the lower the current weekly return, which is consistent with the short-term reversal effect.

4.3. Robustness tests

4.3.1. Validity of the parallel trend assumption

We validate the parallel trend assumption to justify the DID identification strategy, where we expect no significant changes in stock price comovement between firms in counties and municipal districts in the absence of a CCM shock. Specifically, we construct the dummy variables CCM^{-5}, $CCM^{-4\text{-}3}$, $CCM^{-2\text{-}1}$, CCM^{0}, CCM^{+1+2}, CCM^{+3+4} and CCM^{+5}, denoting the fifth year before CCM implementation, the fourth and third years before CCM implementation, the second and first years before CCM implementation, the current year of the CCM implementation, the first and second years after CCM implementation, the third and fourth years after CCM implementation and the fifth year after CCM implementation, respectively. Furthermore, we substitute *CCM* with CCM^{-5}-CCM^{+5} in Model (1) and construct interaction items between $Ret_{s,w}$ and each of these dummy variables. We use observations of the sixth year before CCM implementation as the benchmark and re-estimate Model (1). Table 4 shows the regression results. We find insignificant coefficients for the interaction items between $Ret_{s,w}$ and dummy variables, which denote the years before CCM implementation, indicating no meaningful stock price comovement before CCM implementation.

Table 4
Test of validity of the parallel trend assumption.

Dependent variable: $Ret_{i,w}$	Coefficient	*t*-statistics
$CCM^{-5}*Ret_{s,w}$	**0.062**	**(1.28)**
$CCM^{-4\text{-}3}*Ret_{s,w}$	**0.023**	**(0.56)**
$CCM^{-2\text{-}1}*Ret_{s,w}$	**0.070**	**(1.49)**
$CCM^{0}*Ret_{s,w}$	**0.065***	**(1.73)**
$CCM^{+1+2}*Ret_{s,w}$	**0.073****	**(2.04)**
$CCM^{+3+4}*Ret_{s,w}$	**0.064****	**(2.41)**
$CCM^{+5}*Ret_{s,w}$	**0.087****	**(2.27)**
CCM^{-5}	0.075*	(1.95)
$CCM^{-4\text{-}3}$	0.015	(0.35)
$CCM^{-2\text{-}1}$	–0.033	(–0.97)
CCM^{0}	–0.013	(–0.28)
CCM^{+1+2}	–0.032	(–0.92)
CCM^{+3+4}	–0.027	(–0.59)
CCM^{+5}	0.009	(0.22)
$Ret_{s,w}$	0.008*	(1.92)
$Ret_{ind,w}$	0.143***	(15.42)
$Ret_{i,w\text{-}1}$	–0.054***	(–13.66)
$Ret_{i,w\text{-}12,w\text{-}2}$	–0.001	(–0.50)
Size	–0.067***	(–7.86)
Lev	0.194***	(6.29)
BM	0.081***	(9.23)
Constant	1.251***	(6.15)
Firm FE	Yes	
Week FE	Yes	
N	120,784	
Adj-R^2	0.027	

Note: The *t*-statistics shown in brackets are adjusted for clustering by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

Table 5
Propensity score matching.

Dependent variable: $Ret_{i,w}$	(1)	(2)
	Method 1	Method 2
$CCM*Ret_{s,w}$	**0.070****	**0.058*****
	(2.59)	**(3.72)**
CCM	–0.012	0.003
	(–0.72)	(0.25)
$Ret_{s,w}$	–0.006	0.016**
	(–0.54)	(2.03)
$Ret_{ind,w}$	0.136***	0.159***
	(9.74)	(12.19)
$Ret_{i,w-1}$	–0.060***	–0.059***
	(–7.55)	(–11.44)
$Ret_{i,w-12,w-2}$	–0.002	0.004
	(–0.31)	(1.29)
Size	–0.072***	–0.076***
	(–9.37)	(–8.91)
Lev	0.313***	0.229***
	(9.43)	(8.00)
BM	0.121***	0.104***
	(5.66)	(8.64)
Constant	0.920***	1.468***
	(4.95)	(4.72)
Firm FE	Yes	Yes
Week FE	Yes	Yes
N	31,639	76,552
Adj-R^2	0.051	0.042

Note: The *t*-statistics shown in brackets are adjusted for clustering by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

4.3.2. *Propensity score matching*

Various factors affect the implementation of CCMs, such as regional economic development, corporate characteristics, and geographical locations. These factors may also affect stock price comovement between firms in the merged counties and municipal districts, which challenges the causality between CCMs and stock price comovement. We use two propensity score matching methods to alleviate this endogenous problem. Method 1 takes firms that have experienced CCMs as the treatment firms, with municipal-level firms in the same city included in the treatment group, while county-level firms in counties that have not experienced CCMs are considered as the control group. Furthermore, we estimate a logit regression using information from one year before the CMM implementation to model the probability of being affected by a CMM. We include all independent variables in Model (1) in our logit model. Next, we calculate the propensity score for each firm using the predicted probabilities obtained from the logit model, and match each treatment firm to the control firm using the nearest-neighborhood technique to identify the control firms whose characteristics are similar to those of treatment firms. Method 2 is basically similar to Method 1, except for the selection rule for the control group. Specifically, we take firms in different cities as the treatment firms, but they are located in counties that have not experienced CCMs and are adjacent to the municipal districts used for the control firms in Method 2[6]. We re-estimate Model (1) using the two matched groups of samples and show the results in Table 5. We find positive and significant coefficients of the interactive items between *CCM* and $Ret_{s,w}$ in the two matched groups of samples (0.070, *t*-stat = 2.59 in Column 1; 0.058, *t*-stat = 3.72 in Column 2), indicating that our findings do not appear to be driven by the endogeneity of the CMM implementation.

[6] We also try to combine the two methods. We set as the control firms the firms in the same city as the treatment firms but located in counties that have not experienced a CCM and are adjacent to municipal districts. However, fewer firms meet these selection criteria.

Table 6
Alternative measurement of stock price comovement.

Dependent variable: *SYN_city*	Coefficient	*t*-statistics
CCM	**0.162****	**(2.17)**
Size	0.240***	(6.72)
Lev	–0.709***	(–4.86)
BM	–0.044	(–0.50)
Constant	–5.274***	(–7.50)
Firm FE	Yes	
Year FE	Yes	
N	3,796	
Adj-R^2	0.232	

Note: The *t*-statistics shown in brackets are adjusted for clustering by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

4.3.3. Alternative measurement of stock price comovement

The stock price comovement which we focus on in this paper is essentially the linkage between the stock return of firms in counties and municipal districts, and the stock price synchronicity is also used to capture the linkage between the individual stock return and the market return. Therefore, referring to the measurement of stock price synchronicity (Gul et al., 2010, Li et al., 2011), we run an annual regression on Model (2) to obtain R^2. The definition of variables in Model (2) is the same as for Model (1). We use Model (3) to obtain the stock price comovement index *SYN_city*. Finally, we substitute the dependent variable in Model (1) with *SYN_city* and estimate Model (4).

$$Ret_{i,w} = \varphi_0 + \varphi_1 Ret_{s,w} + \varphi_2 Ret_{ind,w} + \varepsilon_{i,w} \tag{2}$$

$$SYN\_city_{i,y} = Ln\left(\frac{R^2_{i,y}}{1 - R^2_{i,y}}\right) \tag{3}$$

$$SYN\_city_{i,y} = \beta_0 + \beta_1 CCM + \Sigma Controls + \Sigma Firm + \Sigma Year + \varepsilon_{i,y} \tag{4}$$

In Model (4), the dependent variable is the stock price comovement index *SYN_city*, the independent variable is *CCM* and the control variables include *Size*, *Lev*, and *BM*. In addition, we control for firm and year fixed effects in Model (4). Table 6 shows the regression results. The coefficient of *CCM* is still positive and statistically significant at the 5% level, suggesting the robustness of our findings under the alternative measurement of stock price comovement between firms in counties and municipal districts.

4.3.4. Other robustness tests

We perform two additional tests to ascertain the robustness of our findings. First, we use the standardized monthly rate of return (Ret_m) as an alternative measurement for stock return variables and re-estimate Model (1). Column 1 of Table 7 reports the regression results. We find a significant and positive coefficient of the interactive item between *CCM* and $Ret_{s,m}$, indicating that our findings still hold. Second, we use the market-adjusted weekly rate of return and the firm size-adjusted weekly rate of return as alternative measurements for stock return variables, respectively. Columns 2 and 3 of Table 7 report the results from re-estimating Model (1). The coefficients of the interaction term between *CCM* and $Ret_{s,w}$ are both positive and statistically significant at the 1% level in Columns 2 and 3, indicating that our findings are robust when we use alternative measurements for stock return variables.

5. Further analysis

5.1. Impact of the degree of regional market segmentation

The main test verifies the positive effect of CCMs on stock price comovement between firms in the merged counties and municipal districts. However, this effect may be heterogeneous with the degree of market segmen-

Table 7
Other robustness tests.

Dependent variable	(1) Monthly return	(2) Market-adjusted weekly return	(3) Firm size-adjusted weekly return
CCM*Ret$_{s,w/m}$	**0.070*** **	**0.078*** **	**0.102*** **
	(2.99)	**(5.12)**	**(3.74)**
Ret$_{s,w/m}$	0.020***	0.012***	0.012***
	(3.11)	(3.18)	(3.20)
CCM	–0.021	–0.008	–0.007
	(–1.07)	(–0.75)	(–0.60)
Ret$_{ind,w/m}$	0.146***	0.143***	0.146***
	(14.39)	(17.86)	(18.82)
R$_{i,w-1/m-1}$	–0.050***	–0.047***	–0.049***
	(–7.75)	(–12.82)	(–14.80)
R$_{i,w-12,w-2/m-12,m-2}$	–0.028***	–0.025***	–0.023***
	(–5.45)	(–8.44)	(–7.89)
Size	–0.132***	–0.068***	–0.082***
	(-9.37)	(–10.31)	(–12.90)
Lev	0.320***	0.202***	0.206***
	(6.50)	(8.97)	(8.79)
BM	0.259***	0.092***	0.104***
	(8.80)	(12.15)	(13.75)
Constant	2.426***	1.202***	1.470***
	(7.74)	(5.76)	(7.38)
Firm FE	Yes	Yes	Yes
Week/Month FE	Yes	Yes	Yes
N	42,787	173,013	173,013
Adj-R^2	0.029	0.025	0.027

Note: The *t*-statistics shown in brackets are adjusted for clustering by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

tation in different regions. The impact of the degree of regional market segmentation may be reflected in the following two aspects. On the one hand, given the same degree of market integration between merged counties and municipal districts after CCMs in different regions, greater segmentation before CCMs indicates a larger range of improvement in market segmentation; therefore, the increase in stock price comovement becomes more pronounced. On the other hand, due to institutional inertia and differences in intensity between municipal and county governments, county governments may have a higher tendency to control and protect their local economy in regions with more (vs. less) severe market segmentation. Thus, county governments may show strong resistance to CCMs. In this case, to promote the smooth conduct of CCMs, municipal governments should concede some administrative authority to the newly established districts (i.e., the merged counties). As a result, although the merged counties are spatially integrated with municipal districts, the original administrative barriers are not eliminated entirely. Therefore, the markets in the merged counties and municipal districts are still relatively independent, which indicates the weak effect of CCMs on improving stock price comovement between firms.

To test this conjecture, we try to test for the moderating effect of the degree of market segmentation on our main results. However, most scholars use the relative price method to measure the degree of interprovincial market segmentation. The data required to apply the relative price method within prefecture-level cities to measure the degree of market segmentation between counties and municipal districts are not yet available. The higher the degree of market segmentation between a province and other provinces, the stronger the provincial governments' intervention and protection of their markets. This strong government intervention may not only be reflected at the provincial government level but also at all government levels within the province. In provinces with a higher (vs. lower) degree of market segmentation, therefore, the degree of market segmentation within its prefecture-level cities is also likely to be higher. Hence, the degree of market segmentation between counties and municipal districts in the provincial-level cities is correspondingly higher. We use the degree of market segmentation at the provincial level as a proxy for the degree of market segmentation within prefecture-level cities. Specifically, according to the relative price method, we calculate the segmentation index of each province's commodity market, capital market and labor market (Zhao, 2009). We divide the average value of these three market segmentation indexes for each province into 30 groups from low to high for each year (denoted as *Segment*). Next, we construct the three-term interaction of *Segment*, *CCM* and $Ret_{s,w}$ and add it to Model (1) for re-estimation. Column 1 of Table 8 shows the regression results. We find that the coefficient of the three-term interaction of *Segment*, *CCM* and $Ret_{s,w}$ is significantly positive, indicating that the higher the degree of market segmentation, the more pronounced the effect of CCMs on stock price comovement between firms in the merged counties and municipal districts, which further supports our main findings.

Table 8
Impact of market segmentation and regional marketization.

Dependent variable: $Ret_{i,w}$	(1)	(2)
Segment*CCM*Ret$_{s,w}$	**0.002****	
	(2.30)	
*Segment*Ret$_{s,w}$*	–0.000	
	(–0.09)	
*Segment*CCM*	–0.000	
	(–0.43)	
Market*CCM*Ret$_{s,w}$		**0.002***
		(1.71)
*Market*Ret$_{s,w}$*		0.000
		(0.00)
*Market*CCM*		–0.001
		(–1.54)
*CCM*Ret$_{s,w}$*	0.043*	0.046*
	(1.73)	(1.87)
Segment	0.000	
	(0.68)	
Market		0.000
		(0.68)
$Ret_{s,w}$	0.014**	0.012*
	(2.09)	(1.73)
CCM	–0.020	0.010
	(–1.12)	(0.70)
Ret_{ind}	0.141***	0.142***
	(16.74)	(17.85)
$Ret_{i,w-1}$	–0.055***	–0.052***
	(–14.67)	(–15.48)
$Ret_{i,w-12,w-2}$	–0.004	–0.001
	(–1.52)	(–0.49)
Size	–0.073***	–0.065**
	(–9.46)	(–10.29)
Lev	0.206***	0.192***
	(7.71)	(9.03)
BM	0.082***	0.087***
	(10.48)	(12.23)
Constant	1.342***	1.132***
	(7.36)	(5.55)
Firm FE	Yes	Yes
Week FE	Yes	Yes
N	173,013	173,013
Adj-R^2	0.025	0.025

Note: The *t*-statistics shown in brackets are adjusted for clustering by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

5.2. Impact of the degree of regional marketization

Next, we consider the moderating effect of the degree of regional marketization on stock price comovement during CCMs. The degree of regional marketization reflects the degree of regional government intervention in the market and shows the depth and breadth of regional marketization reforms (Fan et al., 2003). Similar to the logic of the influence of regional market segmentation, the impact of regional marketization may also be reflected in positive or negative aspects. To evaluate the moderating effect of the degree of regional marketization, we use Fan and Wang's marketization index as a proxy for regional marketization (Fan et al., 2003). Similar to the market segmentation index, Fan and Wang's marketization index also uses provincial-level data. Given that the degree of marketization at the provincial level is determined by the degree of marketization of its subordinate administrative regions, we attempt to use the provincial-level marketization index to measure the degree of marketization in counties within the province. Specifically, we divide each province's marketization index into 30 groups from high to low for each year (denoted as *Market*). Next, we construct the three-term interaction of *Market*, *CCM* and $Ret_{s,w}$ and add it to Model (1) for re-estimation. Column 2 of Table 8 reports the regression results. The coefficient of the three-term interaction of *Market*, *CCM and* $Ret_{s,w}$ is significantly positive, which indicates that the lower the degree of regional marketization, the more pronounced the effect of CCMs on stock price comovement between firms in the merged counties and municipal districts. Collectively, the results in Table 8 suggest that CCMs facilitate stock price comovement between firms in the merged counties and municipal districts by breaking administrative barriers and mitigating regional market segmentation. These results simultaneously strengthen the validity of using stock price comovement as a micro measurement of regional integration.

5.3. Impact of CCMs on the comovement of corporate earnings

Extensive studies show evidence of "local bias" in stock investments (e.g., Coval and Moskowitz, 1999; Ivković and Weisbenner, 2005). Therefore, an alternative explanation for our main findings is that the increase in stock price comovement between firms in the merged counties and municipal districts is induced by stock investors' changes rather than the comovement of corporate real activities. Specifically, CCMs enable the spatial flow of firms' information between the merged counties and municipal districts. Consequently, stock investors in municipal districts become more familiar with county-level firms in merged counties, while stock investors in merged counties become more familiar with municipal district-level firms. In terms of investors' familiarity, county-level firms in merged counties become "local firms" for stock investors in municipal districts, while municipal district-level firms become "local firms" for stock investors in merged counties. Therefore, the tendency of stock investors in merged counties to hold "local bias" about municipal district-level firms, as well as the tendency of stock investors in municipal districts to have "local bias" about county-level firms in the merged counties, may increase after CCMs. This increasing overlap of investors between firms in the merged counties and municipal districts after CCMs could increase stock price comovement. To verify that our findings are not totally driven by this alternative explanation, we further test the effect of CCMs on the comovement of corporate earnings between firms in merged counties and municipal districts by estimating Model (5):

$$ROA_{i,y} = \beta_0 + \beta_1 ROA_{s,y} + \beta_2 CCM + \beta_3 CCM * ROA_{s,y} + \Sigma Controls + \Sigma Firm + \Sigma Year + \varepsilon_{i,y} \quad (5)$$

In Model (5), $ROA_{i,y}$ is the return on total assets of county-level firm i in year y. $ROA_{s,y}$ is the average return on total assets of all listed municipal district-level firms of the city where the county-level firm i belongs in year y. The coefficient β_1 measures the correlation of the return on total assets between county-level firm i and municipal district-level firms, reflecting the degree of corporate earnings comovement between firms in counties and municipal districts. The definition of the main independent variable *CCM* is consistent with Model (1). The control variables include $ROA_{ind,y}$, *Size*, *Lev* and *BM*. In addition, the firm and year fixed effects are controlled in Model (5). We expect the coefficient β_3 of the interaction item between *CCM and* $ROA_{s,y}$ to be positive. Table 9 reports the regression results. We find a significantly positive coefficient of the interaction term between *CCM and* $ROA_{s,y}$, which shows that the corporate earnings comovement

Table 9
Impact of CCMs on corporate earnings comovement.

Dependent variable: $ROA_{i,y}$	Coefficient	t-statistics
CCM*ROA $_{s,y}$	**0.221****	**(2.33)**
CCM	–0.016*	(–1.87)
$ROA_{s,y}$	–0.037	(–1.29)
$ROA_{ind,y}$	0.116***	(2.99)
Size	–0.010**	(–2.36)
Lev	–0.038***	(–2.61)
BM	–0.012	(–1.53)
Constant	0.277***	(3.16)
Firm FE	Yes	
Year FE	Yes	
N	3,796	
Adj-R^2	0.056	

Note: The *t*-statistics shown in brackets are adjusted for clustering by firm. ***, ** and * denote significance at the 1%, 5% and 10% levels (two-tailed), respectively.

between firms in the merged counties and municipal districts increase after CCMs. The promotion of the corporate earnings comovement shows that the observed increase in stock price comovement results from the strengthened relationship between corporate real activities after CCMs.

6. Conclusion

Regional market segmentation hinders the spatial flow of economic elements and rational allocation of resources, slows technological innovations and blocks long-term economic development. Therefore, how to mitigate regional market segmentation and establish an integrated national market is a prominent issue in many developing countries. From a micro perspective, this paper explores the regional integration effect of CCMs, which are a type of administrative division adjustment. We find that stock price comovement between firms in the merged counties and municipal districts significantly increases after CCMs. This effect is pronounced in regions with a high degree of market segmentation and a low degree of marketization. We further find substantial growth in earnings comovement between firms in the merged counties and municipal districts, indicating that the increase in stock price comovement emerges from increases in real activity comovement. Collectively, our results suggest that government-led administrative division adjustments can effectively promote regional integration.

Our conclusions may have some implications. First, our results reveal the importance of improving the government's governance system to better exert its role at all levels of government. Historical experience shows that the administrative decentralization system between the central and local governments infuses local developers with enthusiasm, which promotes economic growth. However, this system leads to a market segmentation problem, which hinders long-term economic development. Nevertheless, government-led administrative division adjustments effectively alleviate market segmentation and promote regional integration. Therefore, the governance system crucially influences the allocation of resources and market development. Second, both a solid institutional foundation and a good market environment are required to drive regional integration and establish a unified national market. Administrative division adjustments provide an institutional foundation to realize regional integration. With the support of this institutional foundation, the government should also actively guide the market environment and create a favorable platform for industrial cooperation and development to maximize the effectiveness of the institution and further boost market integration.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Political governance in China's state-owned enterprises

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ABSTRACT

State-owned enterprises (SOEs) are both the economic and political bases of the Chinese Communist Party (the Party) and the Chinese state. The overarching principle of SOE reform is to firmly implement the Party's leadership and the modern enterprise system. This principle creates a political governance system in China's SOEs—a Party-dominated governance system characterized by Party leadership, state ownership, Party cadre management, Party participation in corporate decision-making, and intra-Party supervision. This survey explains the logic of political governance in China's SOEs, presents the evolution and current practices of each element of the system, and discusses findings from both academic research and the field.

1. Introduction

China runs the world's largest state asset system. State-owned enterprises (SOEs hereafter) are both the economic and political bases of the Communist Party of China (CPC or the Party hereafter) and the Chinese state. Since the 1980s, SOEs in China have undergone a variety of reforms to which their performance has responded both positively and negatively. During this period, a "twin governance structure" has emerged (Wang, 2014). This structure involves the coexistence of corporate and political governance in SOEs' control and operation (Wang, 2014). According to Shleifer and Vishny (1997), corporate governance involves the ways in which corporations' financial suppliers assure themselves of receiving a return on their investment, aiming to resolve the agency problems that arise from the separation of ownership and control.

In China, corporate governance is characterized by the "modern enterprise system" and derives rules from China's Company Law. Corporate governance is a factor in all corporations, and it focuses on the interactions between shareholders, directors, supervisors, and managers. The objective of corporate governance is to max-

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imize shareholder wealth. The objective function of SOEs, however, is to maximize social welfare. Political governance addresses the special objectives of state-owned firms. It is embedded into the governance structure of SOEs and is a CPC-dominated system characterized by Party leadership, through which economic, social, and political objectives are set and the means of obtaining these objectives and the associated monitoring mechanisms are determined. Although China's SOEs are organized in corporate form with all or most of the attributes of corporate governance, they are controlled mainly by the CPC through political governance.

The vast majority of the literature related to the governance structure of China's SOEs focuses on corporate governance, leaving political governance largely underexplored (for reviews of corporate governance in Chinese firms, see Wong, 2014; Jiang and Kim, 2015; Jiang and Kim, 2020; and Lu and Zhu, 2020).[1] In this study, we examine SOEs' political governance by discussing and analyzing China's institutions, the literature, real-world observations, and interviews.

SOEs' political governance is realized through four "pillars". The first pillar and the foundation of political governance is state ownership. The state, under the CPC's leadership, gains control of SOEs through legal ownership. The CPC and the state set strategies for the overall framework of the state-owned economy, and SOEs serve special political and social goals of both the Party and the Chinese state as part of that framework.

The second pillar is the Party's cadre management system, under which SOE executives are recruited, evaluated, promoted, trained, and supervised by the CPC's Organizational Department (OD hereafter, i.e., the Party's human resources department) and its branches. SOE managers are bound by two sets of rules, namely the political rules set by the CPC's Constitution and the commercial rules set by China's Company Law and corporate charters. The cadre management system helps align the objective functions of cadres with the Party's objectives.

The third pillar is the Party's participation in corporate decision-making through the "ex-ante procedure" and "two-way entry and cross-appointment" mechanism. To ensure the political legitimacy of important and material decisions, each SOE's Local Party Committee (LPC hereafter) is mandated to discuss and has veto power over major corporate decisions before the proposed decisions are discussed by the board of directors; this is known as the ex-ante procedure. Under the two-way entry and cross-appointment mechanism, Party committee members also serve as directors or supervisors and participate in corporate decision-making. The Party's participation in corporate decision-making serves as the process control of political governance.

The last pillar is intra-Party supervision, the monitoring mechanism of political governance. The CPC has installed Discipline Inspection Committees (DICs hereafter) within the state sector to enforce the Party's rules and discipline Party members who breach those rules.

In this survey, we first review the evolution of China's SOE reforms during the past 40 years and the role of the Party during this period. From a theoretical perspective, the evolution of China's SOE reforms and the formation of political governance in SOEs both conform with the stakeholder theory. The stakeholder theory of the firm addresses multiple objectives and therefore has difficulty in maintaining consistent, purposeful managerial decisions and accountability (Jensen, 2001). Political governance in China's SOEs is in place to counter this difficulty. The ultimate shareholders of SOEs are the people. The ultimate goal of SOEs is to maximize benefits to the citizenry, i.e., social welfare. Under the stakeholder theory, SOEs' political, social, and economic goals point to a single, ultimate goal, namely social welfare. The Party represents the fundamental interests of the greatest possible majority of the Chinese people.[2] The Party's political governance reconciles the economic and noneconomic goals of SOEs to maximize social welfare. When economic goals are more significant, SOE reforms address economic efficiency. Similarly, when noneconomic goals are more significant, the reforms address political and social responsibilities. The Party, as a social welfare coordinator, is expected to remain neutral and integral (Yao and Xi, 2018). The goal of political governance is to ensure that the Party and the state remain in control and that SOEs' social welfare functions are properly executed.

[1] Note that the reviews by Wong (2014), Jiang and Kim (2015), Jiang and Kim (2020), and Lu and Zhu (2020) discuss state ownership and political connections; however, the discussions are from the corporate governance perspective.

[2] The first paragraph of the Constitution of the Communist Party of China (National Congress of CPC, 2002/2007/2012/2017) states, "The Party represents the fundamental interests of the greatest possible majority of the Chinese people." This notion is part of the important thought of "Three Represents" (San Ge Dai Biao) and guides the governance of both the state and enterprise (SOEs) sectors.

This survey then presents the overall structure of SOE political governance, followed by detailed discussions of each pillar of the structure, with a focus on the most recent developments. Political governance is embedded in the governance systems of China's SOEs, which are based on the Party's rules. Party rules and company laws ran in parallel until 2015, when the CCCPC and the State Council issued "Guiding Opinions on Deepening the SOE Reform," requiring SOEs to amend their corporate charters to incorporate requirements for Party-building work. This institutionalized the role of the Party in corporate SOEs. The final part of this survey introduces both the status and the effect of incorporating Party-building work into corporate charters.

Although political and corporate governance coexist in China's SOEs, political governance has the dominant role. Nevertheless, while there is ample research on corporate governance in the literature, political governance remains largely unexplored. In China, political control over SOEs comes from three main sources: the Party, the government, and the state shareholder (Chang and Wong, 2004). While the roles of the government and state shareholder have gained much attention, the role of the Party remains to be investigated (Ma et al., 2013). In this survey, we propose a framework for the CPC-dominated political governance structure and examine how it would work. From a practical perspective, the role of political governance is rather opaque, especially for foreign investors (ACGA, 2018). This survey aims to illustrate the role of political governance in SOEs, helping investors, especially foreign investors, to understand the Party's role in China's SOEs.

As much of the Party's role has yet to be discovered, this study is intended to examine certain findings on political governance, identify problems, and inspire future studies. The main intent of SOE reform is to firmly establish both Party leadership and the modern enterprise system. This intent comes from China's socialist market economy practice and conforms with the stakeholder theory of the firm. SOEs worldwide are subject to two inherent problems: excessive government interference and insufficient oversight of managers (OECD, 2015). Recent SOE governance practice has tended to impose oversight of managers. Meanwhile, Party leadership, and thus government interference, has been strengthened. We expect the evidence summarized and the problems discussed in this study to inspire more research on the political governance system of China's SOEs.

The rest of this paper is organized as follows. First, the evolution of the role of the Party in SOE reforms is reviewed, followed by a discussion of the theoretical underpinnings of political governance in Chinese SOEs. After a brief introduction to the system, each pillar of political governance is discussed separately. The recent move of incorporating Party-building work into corporate charters is addressed as well. Last, conclusions are drawn and possible directions for future research are proposed.

2. Evolution of SOE reform and Party leadership in SOEs

Political governance in China's SOEs originated from the nature of the public economic system. Before 1978, SOEs served as the "basic production units run directly by the government" under a highly centralized economic system (Wu, 2005, Page 139). Their sole function was executing the instructions of government planners (Wang, 2014). Neither costs nor profits aroused their concern. At this stage, SOEs were affiliates of government agencies. Their governance was dominated by political control. Party committees formed the core of SOEs' leadership. Factory directors, who assumed overall responsibility for the work of SOEs, followed the directives of the Party committees.

China started implementing its economic reform and opening-up policy in 1978. In urban areas, this reform aimed to increase the independence and vitality of SOEs. The government's initial measure was to "expand enterprise autonomy" by giving enterprise managers certain rights in terms of production, selling, and profit retention (Wu, 2005, Page 144). Next, the "enterprise contracting system" was introduced, which specified the distribution of power, profits, and obligations between government organs and SOEs' management (Wu, 2005, Page 146). Both the expanding of enterprise autonomy and the enterprise contracting system were government efforts to delegate power to and share profits with SOEs (Wu, 2005, Page 148). During the middle to late 1980 s, a series of reforms separated the Party from the functions of both the government and enterprises (Chen, 2019). The role of Party committees shifted from directing to supervising and supporting the work of factory directors.

In 1993, the Third Plenary Session of the 14th CCCPC established the socialist market economy as China's economic system. With this development, the main goal of SOE reform shifted from power-delegating and profit-sharing to institutional innovation (Wu, 2005, Page 154). The corporatization of SOEs arose in this context. A series of measures established the modern enterprise system, such as the transformation of allocation funds into loans, debt-to-equity swap, privatization of small SOEs, corporatization of large SOEs, and partial privatization through initial public offerings (IPO). The modern enterprise system was characterized as "clearly established property rights, well-defined power and responsibility, separation of enterprise from government, and scientific management" (Wu, 2005, Page 154). With the enactment of the Company Law in 1993, corporate governance structures were gradually established in SOEs. This brought a new challenge, namely, balancing political governance and corporate governance. However, since 1989, the Party has moved decisively to reaffirm its authority over the reforms (Chen, 2019). Party organizations/committees were the political core of SOEs, ensuring the execution of Party policies in SOEs.[3,4]

SOEs are inherently subject to political costs arising from government interference and agency costs because of the insufficient oversight of managers (Qian, 1996). In the 2000s, the focus of SOE reform was to battle political and agency costs arising under the modern enterprise system. The solutions included establishing an effective state asset management system to reduce political costs and an effective corporate governance system to reduce agency costs. The cornerstone of this reform was the establishment of the State-Owned Assets Supervision and Administration Commission (SASAC hereafter) of the State Council in 2003. To improve the performance and competitive power of SOEs, they were stripped of their social functions and strategically restructured, and market mechanisms were cultivated. At the same time, mechanisms enhancing Party leadership were adopted, including the two-way entry and cross-appointment system.[5] Under this system, the secretary of the Party committee also serves as the chair of the board of directors. Party committee members can serve on the board of directors, the board of supervisors, and the top management team. Likewise, Party members on the board of directors, the board of supervisors, and the top management team can serve on the Party committee. In this way, political governance and corporate governance are integrated, and Party members can participate in decision-making. Besides, for "three-important and one-large" decisions, a group discussion system is adopted.[6] The Party committee/organizations, the board of directors, and the management team jointly discuss and determine such decisions.

Since 2013, SOE reform in China has entered a new era, in which Party leadership has been given full play. To deepen SOE reform, classified management based on functions, a capital-based management system, and mixed-ownership reform were introduced. In 2015, the CCCPC and the State Council issued "Guiding Opinions on Deepening the SOE Reform," requiring SOEs to incorporate Party-building work into their corporate charters (CCCPC and State Council, 2015). This served not only to institutionalize the leadership role of Party organizations in SOEs (ACGA, 2018) but also to clearly define the boundaries between and interactions of the work of Party organizations and of corporate governance entities (the board of directors, supervisors, and the management). The governance structure of SOEs has thus become "three boards and one management" under the leadership of the Party. "Three boards" refers to the Party committee, the board of directors, and the board of supervisors, and "one management" refers to the management team.[7] The Party committee formally

[3] As stipulated in the Constitution of the Communist Party of China (National Congress of CPC, 1992/2002/2007/2012/2017), the "Notice of the CCCPC on Further Strengthening and Improving the Party Building Work of State-Owned Enterprises" (CCCPC, 1997), the "Decisions on Several Important Issues Regarding Reform and Development of State-Owned Enterprises" (CCCPC, 1999), etc.

[4] According to the Article 2 of the Working Rules of the Communist Party of China (CCCPC, 2015/2019), Party organizations are the leadership institutions established by the Party at central and local state organs, people's organizations, economic organizations, cultural organizations, social organizations, and other organizations. The Party organizations play leadership role in their organizations. According to the Article 32 of the Working Rules of the Communist Party of China (CCCPC, 2015/2019), the Party committees are the leadership institutions established by the Party at the subordinate state department. The Party committees play leadership role in their departments. Therefore, both Party organizations and Party committees are leadership institutions within their organizations or departments. Some SOEs establish Party organizations and some Party committees. In this study, the two are used interchangeably.

[5] As stipulated in "Opinions on Strengthening and Improving the Party-Building Work of Central State-Owned Enterprises" (OD of CCCPC and State Council, 2004).

[6] "Three-important and one-large decisions" refers to decisions on "important issues," on the appointment and dismissal of "important cadres," investment in "important projects," and the use of large amounts of funds (General Office of CCCPC and General Office of State Council, 2010).

[7] The congress of workers and the trade union may also participate in the governance of SOEs. However, their roles are limited.

Table 1
Evolution of SOE reform and the role of the Party.

Period	SOE Reform	Period	Party's Role
1950–1977	• Highly centralized demand economy SOEs are "basic production units" run directly by the government • Profits and taxes submitted to governments	1950–1983	• Party committee as the leadership organization in SOEs • Factory director responsibility system under the leadership of the Party committee
1978–1992	• Power-delegating and profit-sharing to boost SOE vitality • Expanding enterprise autonomy and implementing the enterprise contracting system	1984–1988	• Attempt to separate Party and SOEs • Factory director responsibility system • Party committees serve supporting, monitoring, and consulting roles
1993–2002	• Establishing the modern enterprise system—i.e., corporatization—with clearly established property rights, well-defined powers and responsibilities, separation of enterprise and government, and scientific management • Enactment of the Company Law, establishment of corporate governance • Transformation of allocation funds into loans; debt-to-equity swap; privatization of small SOEs, corporatization of large SOEs; partial privatization (IPO)	1989–1998	• Party leadership as SOEs' political nucleus • Improvement of factory director responsibility system • Guarantee and supervision of the implementation of Party and state principles and policies in SOEs
2003–2012	• Establishment of state asset management system to reduce political costs • Establishment of corporate governance system to reduce agency costs • Improvement of SOEs' competitive power via strategic restructuring, desocialization, cultivation of market mechanism	1999–2012	• Enhancement of Party leadership • Two-way entry and cross-appointment • Party participation in decision-making of "three-important and one-large" affairs
2013–present	• Deepening SOE reform • Classified management based on functions of SOEs • Capital-based management • Mixed-ownership reform • Enhancement of Party's leadership role	2013–present	• Full play to Party leadership • Incorporation of Party-building work into corporate charters • Ex-ante procedure

discusses and votes on "three-important and one-large" decisions before the board of directors meet to vote on such decisions, which is called the "ex-ante procedure".

The evolution of SOE reforms and the role of the Party are summarized in Table 1. Note that the stages along the two lines are similar but not identical. Both progressions are the result of crossing the river by feeling the stones. Party committees were established to ensure that enterprises' significant decisions do not deviate from national laws and regulations, Party lines, and basic political principles. As the CPC constitution (Article 33) states, the Party committee is responsible for steering its SOE in the right direction, focusing on the big picture while ensuring the implementation of Party policies and principles, and rendering decisions on major issues (National Congress of CPC, 2017). The role and the effectiveness of political governance are yet to be discovered. The rest of this paper addresses these matters.

3. The Party's role in Chinese SOEs: A theoretical underpinning

There has been continuous debate on the objective functions of firms (e.g., Friedman, 1962, 1970; Freeman, 1984; Jensen, 2001). The shareholder wealth maximization theory argues that the objective of a business is to maximize profits and thus shareholder value (Friedman, 1962). Social welfare is maximized when each firm in an economy maximizes its total market value (Jensen, 2001). For private firms, social welfare may be a secondary objective if pursuing it does not adversely affect profit or if it is helpful in maximizing long-term value.

Under the shareholder wealth maximization theory, corporate governance is designed to protect shareholder interests in agency-controlled firms. Alternatively, stakeholder theory argues that business is a set of value-creating relationships between groups with a legitimate interest in the activities and outcomes of the firm and upon which the firm depends to achieve its objectives (Freeman, 1984). Managers' decisions should consider the interests of all of the firm's stakeholders and thereby maximize social welfare.

We argue that the objective functions of a firm depend on the type and nature of the firm's ultimate beneficiaries. For private firms, shareholder value maximization is the primary goal because the ultimate beneficiaries of the firm's success are its shareholders. Private firms assume social responsibilities, but only as a means to maximize shareholder value. For state-owned firms, the ultimate beneficiaries are the people. The state represents the interests of the people, and maximizing social welfare is its ultimate goal. Social welfare is a function of multiple variables, such as employment, environment protection, poverty relief, and also profits. Therefore, stakeholder theory better explains the objective functions of state-owned firms.

Stakeholder theory is difficult to apply to private firms because of the obstacles that their multiple objectives pose to consistent, purposeful managerial decisions and accountability (Jensen, 2001). For state-owned firms, however, these obstacles can be overcome by political governance. The Party represents the fundamental interests of the greatest possible majority of the Chinese people, and it keeps close ties with the masses. Public views are collected through a democratic-centralism process and then reflected in the Party's decisions (Yao and Xi, 2018). The Party remains neutral in its governance, which aggregates and reconciles the conflicting interests between individuals and groups (Yao and Xi, 2018). Thus, political governance is embedded in the governance structure of SOEs to ensure that they establish objectives that maximize social welfare, to determine the means of achieving such objectives, and to ensure SOEs are appropriately monitored.

Both economic development and social and political stability benefit the public. If the economic and noneconomic objectives of SOEs are mutually supportive, no tradeoffs are necessary (Lankoski and Smith, 2018). Both tasks can be achieved simultaneously because of their complementary natures. However, conflicts between the two objectives are witnessed in a wide range of corporate activities, especially when viewed from a short-term perspective. For example, redundant employment promotes social stability but reduces economic efficiency, and protecting the environment and social security generates expenses. Thus, we assume that the multiple objectives of SOEs conflict, even though they can coexist. The dynamic state asset management system reflects the Party's and state's efforts to balance the multiple objectives of SOEs. The following model illustrates how to balance diverse interests by transforming the multi-objective problem into a new, single-objective problem:

$$\frac{dS(E)}{dE} > 0, \frac{d^2S(E)}{dE^2} < 0; \frac{dS(NE)}{d(NE)} > 0, \frac{d^2S(NE)}{dNE^2} < 0 \tag{1}$$

SOEs' efforts to meet economic and noneconomic objectives are denoted by E and NE, respectively. Both types of efforts contribute to social welfare (S) with a diminishing marginal return, as assumed by most studies.

Equation (2), shows the objective function of SOEs:

$$S = S(E) + S(NE) - (E + NE) \tag{2}$$

There is no obvious evidence that either a concave or a convex relation exists between efforts and costs. Therefore, for the convenience of analysis, we adopt the simplest form, a linear relation. The marginal cost of efforts is assumed to be a constant of 1 for both objectives. Thus, the total costs equal ($E + NE$).

At the beginning of each decision-making stage, there are certain given conditions, including the level of effort exerted so far, denoted as E_0 and NE_0, respectively. According to the above information, the Party and state decide how to allocate new efforts (T) to the tasks, that is, they determine the values of ΔE and ΔNE. If new efforts is devoted to economic objectives to a larger degree, the corresponding theme of SOE reform emphasizes economic efficiency and corporate governance. Alternatively, if noneconomic objectives are emphasized, so is political governance.

The proportion of new efforts to meet economic objectives is denoted as p. The remaining proportion, 1-p, represents efforts toward noneconomic tasks. Thus, the total effort for each type of objective equals the sum of the previous and new efforts (Equation (3)). Equation (4) restates the objective function.

$$E = E_0 + T * p; NE = NE_0 + T * (1 - p) \tag{3}$$

$$S = S(E_0 + T * p) + S(NE_0 + T * (1 - p)) - (E_0 + NE_0 + T) \tag{4}$$

The first-order derivative is calculated to obtain the relation between S and p in Equation (5). Consider a marginal effort distribution, that is, when T is given number infinitely close to 0, the first-order derivative of S with respect to p is (almost) independent of p but largely depends on the value of $[dS(E)/dE - dS(NE)/dNE]$, where $E = E_0$ and $NE = NE_0$. As the marginal new efforts of both objectives ($\Delta E + \Delta NE$) are infinitely close to 0, they have a negligible effect on the first-order derivative regardless of their relative value.

$$\frac{dS}{dp} = \left[\frac{dS(E)}{dE} - \frac{dS(NE)}{dNE}\right] * T \tag{5}$$

If $dS(E)/dE < dS(NE)/dNE$ when $E = E_0$ and $NE = NE_0$, ds/dp is negative. S decreases with p. In such case, SOEs are better organized to pursue social and political stability. This was the situation after the founding of the People's Republic of China in 1949 until 1978, when the governance structure of SOEs were dominated by political control. However, as NE_0 increases, the marginal return from noneconomic efforts decreases. This leads to the following phenomenon: $dS(E)/dE > dS(NE)/dNE$ if $E = E_0$ and $NE = NE_0$, suggesting a positive relation between S and p. In this case, the theme of SOE reform changed to boost economic efficiency, as witnessed in SOE reform since 1980 s. The measures taken included expanding enterprise autonomy, corporatization, and the establishment of the state asset management system.

More recently, the value of $dS(E)/dE$ when $E = E_0$ and that of $dS(NE)/dNE$ when $NE = NE_0$ are very close. Thus, SOE reform since 2013 has stressed both corporate objectives, without a clear preference. To strike a balance between the two, the integration of Party leadership and corporate governance is emphasized, SOEs are classified into categories to fulfill different functions, and SOE executives are evaluated on multiple dimensions.

Overall, SOE reform in China has dynamically balanced multiple objectives. Party leadership is essential to the success of SOE reform, not only because it provides guidance but also because it corrects deviations, especially in noneconomic areas, in which corporate governance frequently fails.

4. Overview of political governance in Chinese SOEs

As discussed, SOEs shoulder political, social, and economic goals. The political governance of SOEs involves mechanisms to ensure the realization of these goals. Political governance of SOEs is carried out via a CPC-dominated governance structure, with Party leadership at its core, realized through state ownership, the Party cadre management system, the Party's participation in corporate decision-making, and intra-Party supervision (Fig. 1). Party leadership is the foundation of political governance and constitutes both the basis and spirit of SOEs (Xi, 2016). Each pillar of political governance has a role. For example, the state ownership provides legitimacy, the Party cadre management system keeps the Party's and SOEs' goals aligned, the Party's participation in corporate decision-making serves as process control, and intra-Party supervision is the monitoring mechanism.

SOEs are the economic and political bases of the Party and state. State ownership grants the state and the Party rights over SOEs as both capital providers and monitors. Ownership reforms in SOEs must therefore be conducted under Party leadership. The Party cadre management system determines SOE managers' selection, evaluation, promotion, training, and monitoring. Party organizations are established in SOEs as governance bodies, and they play a leadership role and participate in major decision-making. The DICs of Party organizations participate in the monitoring of SOEs. Since 2013, Party leadership in SOEs has been greatly strengthened. To emphasize Party leadership, Party-building work is required to be written into the corporate charters of SOEs.

[8] Article 2 of the Law on Industrial Enterprises Owned by the Whole People states, "The properties of the enterprises belong to the whole people; the state grants the enterprise to manage the properties according to the separation of ownership and control" (National People's Congress, 1988/2009).

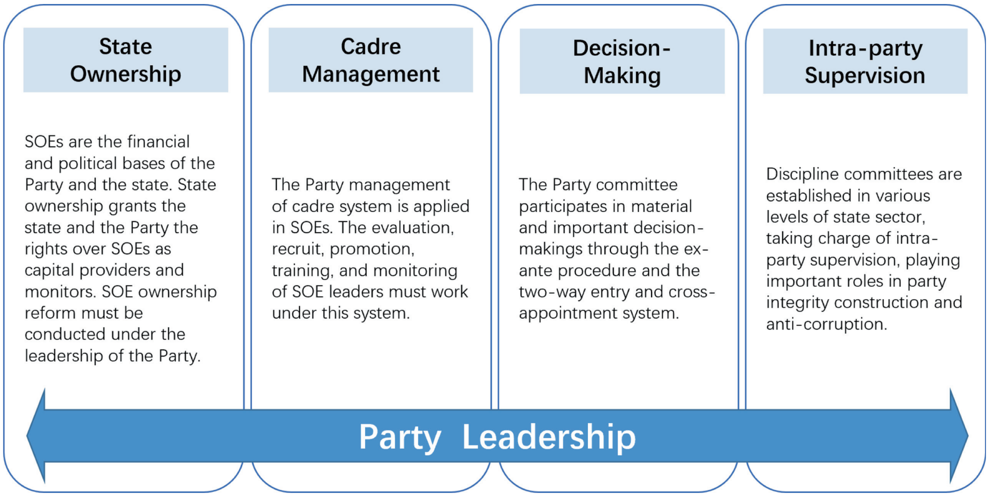

Fig. 1. Political governance in China's SOEs.

Political governance gains its legitimacy from state ownership. The Chinese people, as a whole, are the owners of SOEs in China by law.[8] However, practically, their ownership rights are delegated to the central and local governments; therefore, governments are the *de facto* owners of SOEs. Party organizations/committees comprise leadership agencies at all levels of the government. Therefore, Party organizations/committees have a leadership role in exercising state ownership rights and formulating SOEs' governance systems.

Brødsgaard (2012) argues that personnel control is the key factor that holds the Chinese system together and makes it work in both government and business. The Party cadre management system operates in both government agencies and the state's corporate sector (Brødsgaard, 2012; Li, 2016). This systems' functions are to recruit, develop, train, promote, discipline, and move leadership personnel through the Party's organization departments. At the state level, SOE ownership rights are exercised by government officials who are Party

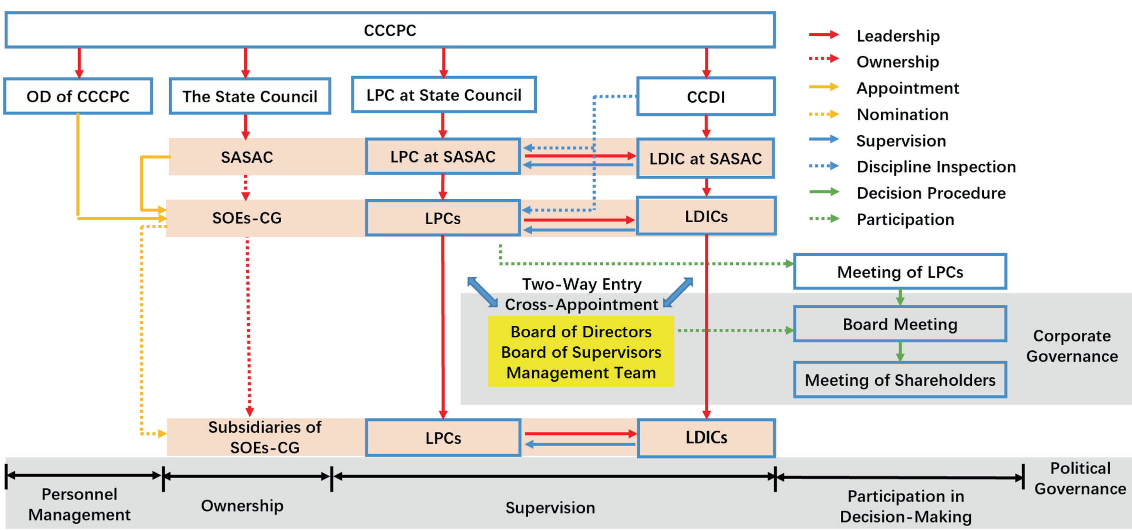

Fig. 2. Political governance in central SOEs. This figure illustrates the four channels through which the Party controls SOEs. Organization names are abbreviated as follows: Central Committee of the Communist Party of China (CCCPC); Organizational Department (OD); Central Commission for Discipline Inspection (CCDI); State-Owned Assets Supervision and Administration Commission (SASAC); local Party committee (LPC); local discipline inspection committee (LDIC); state-owned enterprises owned by the central government (SOEs-CG).

members on behalf of the state. At the corporate level, the leaders of key SOEs (chairmen and general managers) are appointed by the OD of the Party. Furthermore, as stipulated in the Company Law (National People's Congress, 1993), owners have the right to elect the board of directors, which in turn appoints the top management. SASAC, as the capital provider, appoints the leaders of some SOEs. The selection of managers by the board of directors is also encouraged. However, the main personnel management system is the Party cadre management system.

As mentioned, the Party participates in decision-making through two channels. One is the ex-ante procedure, and the other is the two-way entry and cross-appointment system. Under this leadership framework, Party members who also serve on the board participate directly in the decision-making procedure required by corporate governance. Decision-making on "three-important and one-large" affairs must go through both structures – the Party committee and the board.

The final pillar of the Party's leadership over SOEs is intra-Party supervision. The DICs of the CPC exercise their supervisory role in two ways. Each level of the government has a Party disciplinary subcommittee, including the State Council, the SASAC, and central SOEs (Li, 2016). Horizontally, local DICs supervise the LPCs in SOEs at the same level. Vertically, the Central Commission for Discipline Inspection (CCDI's hereafter) has greater authority and can directly inspect the LPCs of central SOEs. Party members in LPCs and the top management appointed by the OD of the CCCPC are targets of such inspections. The main functions of the DICs include safeguarding the Party's rules, inspecting the implementation of the Party's policies, organizing and coordinating anti-corruption work, monitoring the exercise of power by leading cadres, investigating breaches of Party rules, and determining the punishment for Party members in such cases (Li, 2016).

Fig. 2 illustrates the workflow of these channels, taking central SOEs as an example. At the top of the figure is the highest level of the Party, the CCCPC. Under the leadership of the CCCPC, the State Council established the SASAC to be the owner of central SOEs. At each level of the government and SOEs, Party organizations/committees (LPCs) were established to implement the Party's policies. The OD of the CCCPC has the right to appoint and evaluate the leaders of the SASAC and the backbone central SOEs.[9,10] The personnel appointed by the OD of the CCCPC are Party members and hold ranks within the bureaucratic hierarchy; they must follow not only the rules of corporate governance in their daily work but also the CPC's discipline rules. Party participation in decision-making in central SOEs occurs under the two-way entry and cross-appointment rule and the ex-ante procedure. The CCDI and local DICs at the SASAC and SOEs have monitoring roles.

5. State ownership and reforms

State ownership profoundly influences firm objectives, governance, compensation systems, decision-making, resource allocation, transparency, and firm performance (for relevant reviews, see Wong, 2014; Xin et al., 2019; Lin et al., 2020b). Since 2013, three reforms regarding ownership arrangements of SOEs have been launched involving the classification of SOEs by function, the adoption of a capital-management-based approach, and the development of mixed ownership. As these reforms are still in progress, their outcomes remain to be seen. In this section, we discuss the influence of these new ownership arrangements, focusing on the roles and mechanisms of political governance.

5.1. Heterogeneity of governance systems among SOE categories

The objective functions of SOEs in the current stage of reform is a combination of economic and noneconomic goals. These contrasting goals, however, may generate operational problems and create difficulties in

[9] The Organizational Department of the CCCPC has been called the world's largest human resources department. The appointment of personnel in central SOEs is part of the CPC's *nomenklatura* system. This system comprises a set of rules that establish lists of leading personnel positions across various institutional spheres, such as government, industry, finance, and education, over which various Party committees exercise control (Li, 2016).

[10] The backbone central SOEs refer to the largest 53 central SOEs whose leaders are appointed by the OD of CCCPC and the First Managerial Bureau of Enterprise Leaders of SASAC. These leaders had the political identity of vice-ministerial level.

monitoring SOEs. For example, it may be difficult for the SASAC to determine whether an SOE's poor performance is because of policy burdens or managerial incompetence (Jiang and Kim, 2020). Such confusion over accountability requires the state to pay for failures by providing assistance to SOEs (Lin and Tan, 1999). This results in soft-budget constraints, which exacerbate agency conflicts.

To solve the problems caused by conflicting objectives, the objective functions of SOEs are to be refined under a relatively new reform measure. Accordingly, SOEs have been sorted into three categories according to their functions. The first category consists of commercial SOEs in competitive industries whose objective function is maximizing profit, meaning that their social welfare contributions must stay within an acceptable range. The second category includes commercial SOEs in strategic industries with the aim of safeguarding national security and the national economy. The objective functions of these firms are first to maximize social welfare contributions, then to maximize profit without adversely affecting social welfare. The third category involves SOEs in utility industries providing public goods and services. Their objective functions entail maximizing social welfare contributions while maintaining profit outcomes within an acceptable range. According to the "Guiding Opinions on Functional Definition and Classification of State-Owned Enterprises" (GO-FDCSOE hereafter) issued in 2015, these categories of SOEs are treated differently in terms of ownership, development, governance, and evaluation. A summary of the GO-FDCSOE is provided in Table 2. The following discussions focus on its effects on SOE governance.

Commercial SOEs in competitive industries must operate independently under the rule of survival of the fittest. The market decides the allocation of resources in this category of SOEs. Thus, their political governance is relatively limited. No guideline has been established regarding whether the state shall hold a majority, controlling, or minority ownership in these firms. Equity investment from nongovernmental shareholders is welcomed. To better adapt to the competitive business environment, the governance systems of these SOEs are similar to those of other market participants: the decision rights lie with the board, and managerial autonomy is valued.

Although commercial SOEs in strategic industries are also market-oriented, their importance and special role in the state's strategies cannot be overstated. Therefore, they must be controlled by the state. Their composite roles in safeguarding both national security and the national economy imply that both political and corporate governance are indispensable to their governance structures. While the Party pays attention to their achievements in terms of social and political benefits, the focus of their corporate governance lies in their economic performance (Qiang, 2018).

Different from commercial SOEs, public welfare SOEs are less concerned about profitability. Their focus is coping with market failures caused by the free-rider problem associated with public goods (Huang and Yu, 2013). Therefore, these firms are meant to be wholly state-owned and managed by a political governance–dominated approach (Wei et al., 2017). Moreover, as the disclosure of information on public welfare SOEs improves, the public will play a part in their governance.

In summary, the governance systems of the SOE categories are heterogenous. Specifically, the Party maintains strong control over SOEs in the strategic and public welfare sectors, while more market-based mechanisms are applied to the governance of commercial SOEs in competitive industries (Wei et al., 2017).

5.2. Role of Party organizations in a capital-based management system

Since China's economic reform and opening-up policy began in 1978, Chinese SOEs have gradually transformed from affiliates of government agencies into separate legal entities. The ownership arrangements of transformed SOEs were decentralized during the 1990s (Qi et al., 2017). Multiple government agencies performed certain ownership functions over SOEs simultaneously. However, no single agency actively oversaw SOEs (World Bank, 2014). Consequently, insider control problems prevailed and SOE performance was poor at this stage. To address this, the SASAC was created in 2003 as a centralized representative of the state investor to consolidate control rights over SOEs (Wang, 2014). The SASAC is charged with the supervision and

Table 2
SOE reform based on classification by function.

	Commercial SOEs in Competitive Industries	Commercial SOEs in Strategic Industries	SOEs of Public Welfare: Utility Industries
Function	• Enhance the vitality of the state economy • Amplify the function of state capital • Preserve and increase the value of state assets	• Safeguard national security and national economic operation	• Protect people's livelihood • Serve the society at large • Provide public goods and services
Ownership Structure	• The modern enterprise system • State-controlled or partially state-owned • IPO encouraged	• State-controlled, minority non-state capital • Reforming principle: separation of government and enterprises, separation of politics and capital, franchise system, and government monitoring	• Wholly state-owned • Investment entity pluralism allowed • Non-state capital is encouraged under franchising, delegating, and service purchasing models
Development Strategy	• Optimize resource allocation • Develop industries with competitive edges • Improve market competitiveness by enhancing the efficiency of state assets management	• Increase state capital • Reasonably determine the scope of main business	• Promote the quality and efficiency of public services • Strictly limit the scope and focus of operation
Governance and Monitoring Focus	• Capital-based management • Establish and improve monitoring system • Board endowed with the rights to make material decisions, select and appoint personnel, and distribute remunerations • Management has operating autonomy • Professional manager system encouraged	• Capital-based management • Establish and improve monitoring system • Strengthen regulations on the layout of state capital • Guide SOEs to highlight their primary business	• Focus on supervision over the quality and efficiency of providing public goods and services • Improve information disclosure • Accept public oversight
Bases of Performance Evaluation	• Operating performance • Preservation and appreciation of state assets value • Market competitiveness	• Operating performance • Preservation and appreciation of state assets value • Performance in serving national strategies, safeguarding national security and national economic operation, developing strategic industries, and accomplishing special tasks	• Cost control • Product quality • Service level • Operating efficiency and preservation • Appreciation of state assets value • Evaluation from the public

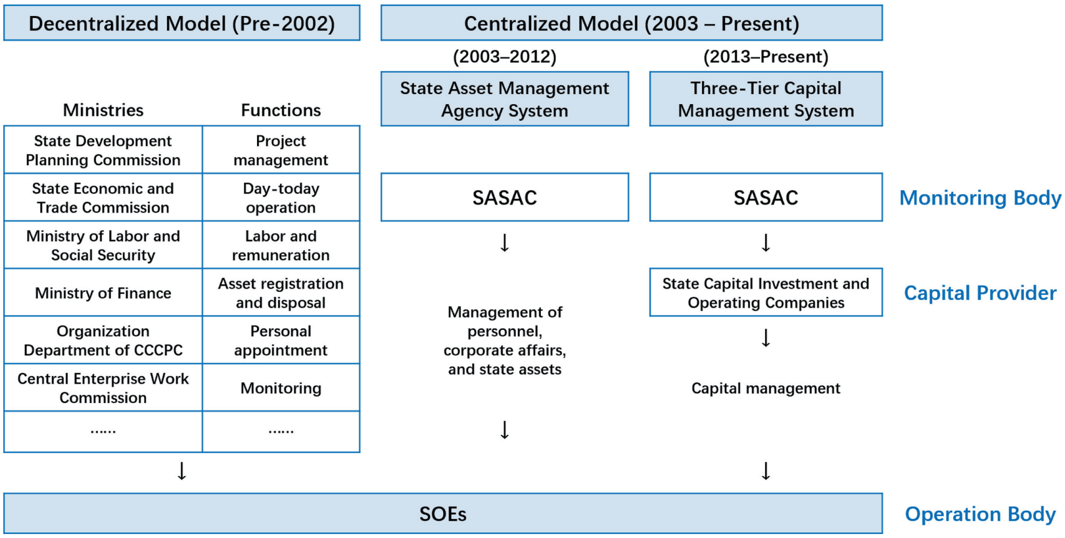

Fig. 3. The evolution of ownership arrangements of Chinese SOEs.

management of personnel, corporate affairs, and state assets. This centralized ownership arrangement has improved SOEs' performance (Sheng and Liu, 2016). However, certain inherent problems have arisen. As it is both a referee and a player, the SASAC may interfere excessively with the management of SOEs and thus fail to exercise effective monitoring (Liu et al., 2020a; Zhang and Cai, 2021).

To address the dilemma caused by the SASAC's dual roles, the Party decided to adopt a capital-based management approach to SOE management through a three-tier governance structure.[11] The SASAC is at the top tier, serving as the regulator. State Capital Investment and Operating Companies (SCIOCs) are in the middle tier. They are wholly owned by the SASAC and act as shareholders of the SOEs. SOEs are in the bottom tier. In this governance structure, the SASAC mainly plays a monitoring role, as SOEs' shareholder functions have, to a large extent, been delegated to SCIOCs. This structure is conducive to preventing direct government intervention and increasing the management autonomy of SOEs (Zhang and Cai, 2021). As the three tiers are linked by capital, the focus of governance in this structure appears to have moved toward capital management, focusing on the layout, liquidity, allocation, and operating efficiency of state capital. The evolution of the SOE ownership arrangement is illustrated in Fig. 3. The system works similarly at the central and local governments managed SOEs.

The three-tier governance structure in China is widely considered to have been inspired by the Temasek model in Singapore (Zhang and Cai, 2021). There is no denying that these two governance systems share some common characteristics, at least in form. However, their differences should be noted (Liu et al., 2020a). The most salient difference is that in China, Party organizations are embedded in the governance structure of each tier. Their role is to push SOEs to better serve national strategies while preserving and increasing the value of state assets. Furthermore, Party organizations also assume a coordinating role. Their involvement in all three tiers enables the entire governance system to operate more smoothly. For example, communication between the tiers of Party organizations helps reduce the information asymmetry caused by the increase in principal–agent chains in the three-tier governance structure.

The capital-management approach creates new problems, however. Under this approach, the role of the SASAC is weakened. The Ministry of Audit assumes some of the SASAC's former monitoring functions, the OD of the CPC takes charge of personnel management, the Ministry of Human Resources and Social Security regulates salary and compensation, and the National Development and Reform Commission assumes planning responsibilities. The SASAC maintains the remaining monitoring and management functions,

[11] The capital-based management approach was first adopted in the "Decision on Major Issues Pertaining to Deepening Reform" (CCCPC, 2013) and has been continually refined through subsequent regulations.

including Party-building. In this sense, the structure resembles that of the pre-2003 period and the role of SASAC is unclear.

5.3. Political governance in mixed-ownership companies

Corporatization and the establishment of the modern enterprise system have been the main themes of SOE reform since 1993. Initially, this was carried out on a small scale as a pilot project. The experimental SOEs were transformed into wholly state-owned companies. Corporate structures were established according to the Company Law. However, the fact that these SOEs bore characteristics of modern corporations only in form was far from satisfactory (Wu, 2005, Page 155). Large-scale corporatization launched in 1999, when the CCCPC issued the "Decisions on Several Important Issues Regarding Reform and Development of State-owned Enterprises." Ownership diversification was encouraged and carried out in several forms, including initial public offerings, joint ventures, and mutual shareholding (Wu, 2005, Page 155). Since then, mixed ownership appeared in corporatized companies. As of the end of 2012, more than 1,000 state-controlled companies had been listed. The proportion of non-state-owned shares in these listed companies exceeded 50 percent on average (Cai et al., 2018b).[12]

The development of mixed ownership has become a centerpiece of SOE reform since 2013. The mixed-ownership reform in the new era differs from previous reforms in the following aspects.[13] First, more emphasis is placed on improving the governance and operating mechanisms of SOEs, which can be achieved through the participation of noncontrolling shareholders in management (Liu et al., 2016b; Cai et al., 2018a; Lu et al., 2019). Second, a one-size-fits-all approach is no longer used. Instead, the requirements for mixed ownership vary by SOE function. Non-state equity investments are actively encouraged in commercial SOEs in competitive industries. Commercial SOEs in strategic industries, however, remain state-controlled, despite selling shares to non-state investors is allowed. SOEs involved in public welfare are only permitted to diversify ownership within the state sector. Third, mixed-ownership reform applies not only to SOE subsidiaries but also at the group company level. Fourth, mixed-ownership reform can be realized via various forms, such as convertible bonds, employee shareholding plan, public–private partnership, and preferred shares.

There are numerous studies on the performance of mixed-ownership reform. In general, positive effects from the reform are documented. For example, mixed-ownership reform is associated with high levels of innovation and risk-taking (Li and Yu, 2015; Xie, 2019; Wang et al., 2020), strong monitoring from directors nominated by noncontrolling shareholders (Zhu et al., 2015; Lu and Zhu, 2020), improvements in internal controls (Liu et al., 2016b; Cao et al., 2020) and in the design of executive incentive contracts (Cai et al., 2018a), an increase in mergers and acquisitions (M&A) efficiency (Lu et al., 2019), a decrease in both redundant employees (Geng and Ma, 2020) and low-efficiency diversification (Yang et al., 2020), and better corporate performance (Hao and Gong, 2017; Zhou et al., 2020). These positive effects are more significant when noncontrolling shareholders can appoint directors to participate in SOE governance (Liu et al., 2016b; Cai et al., 2018a; Lu et al., 2019; Zhou et al., 2020).

So far, little research investigates the effect of political governance on mixed ownership. However, certain challenges have emerged in practice. For example, non-state investors, especially foreign investors, may vote against revising corporate charters to incorporate Party-building provisions. There are two main reasons for this. First, non-state investors have little understanding of political governance because of the limited disclosure of the leadership role of Party organizations in SOEs in the past (ACGA, 2018).[14] Second, these investors may have concerns about whether the formalization of political governance will subordinate SOEs' commercial goals to the government's social and political objectives. It is necessary for the state to consider the opinions of such shareholders and relieve their doubts with more active communication. In particular, the fact that Party organizations are not beholden to any special interest groups and thus can remain neutral in SOE gov-

[12] See https://www.cscec.com/zgjz_new/xwzx_new/gzdt_new/201312/2652791.html.

[13] See the "Opinions of the State Council on the Development of Mixed-Ownership Economy of State-Owned Enterprises" (State Council, 2015).

[14] In an ACGA survey of foreign institutional investors, only 3% of the respondents agreed that the Party's role in listed Chinese companies is clear and 21% of the respondents were unaware of the existence of Party organizations (ACGA, 2018).

ernance should be made clear (Yao and Xi, 2018). This can boost non-state investors' confidence that the Party can successfully balance the interests of groups of various backgrounds.

6. Party cadre management in Chinese SOEs

Party cadre management is an essential mechanism through which the Party leads SOEs in China (Brødsgaard, 2012). SOE executives are both managers and quasi-officials with political ranks (Liang et al., 2015). As members of the Party's personnel system, they are selected, trained, appointed, and disciplined by the Party's OD departments (Chen, 2019). To improve their political performance and advance their careers, they are motivated to actively implement the Party's principles, policies, and resolutions in SOEs. This political personnel management system makes SOE executives in China different from their Western counterparts. In this section, we discuss SOE manager recruitment, evaluation, promotion, and incentivization under the Party cadre management system.

6.1. Recruitment system of SOE executives

SOEs are extensions of the government (Xin et al., 2019). Before 2003, SOE leaders were appointed under the Party cadre management system, the same system used to appoint government officials. The ODs of the CPC were the agencies in charge of this system. Under this appointment system, SOE managers had administrative ranks and they received lower salaries than their non-SOE counterparts but enjoyed political promotions within the government sector (Xin et al., 2019). This system changed following the establishment of the SASAC in 2003. The Party secretaries, chairpersons of the board, and CEOs of 53 backbone central SOEs were still appointed by the OD of the CCCPC; however, the lower positions in these SOEs and the leaders of the other central SOEs were appointed by the SASAC (Liu and Zhang, 2018). For local SOEs, the ODs of the LPCs directly appoint the leaders of SOEs that were wholly owned by local governments, and leaders of other SOEs could be appointed by local SASACs or recruited via market-oriented methods. However, under the new capital-based state asset management system since 2013, the right to appoint personnel to all SOEs has returned to the ODs of the CPC.

In addition to the direct appointment of cadres by ODs, the market-oriented recruitment of SOE managers has also been tried. Starting in 2003, the SASAC carried out a selection system in which executives were selected from the labor market or through internal competitions for posts. The ODs of the LPCs were responsible for such appointments. The final decisions were made by the LPCs of SOEs. By 2012, central SOEs had offered 141 management positions and selected 600,000 managers at all levels using this approach.[15] Note that the selected executives enjoy political identity, as those directly appointed do.

To further introduce market mechanisms into the SOE manager appointment process, two new systems have been put forward since 2013. The key to both systems is that recruitment decisions are made by the boards of directors and selected executives are treated like their counterparts in private firms, with a comparable salary and no political identity. One of these systems is the market recruitment system, under which managers retain jobs as nonexecutive employees if they perform poorly. The other is the professional managers system, under which managers can be dismissed from their jobs for incompetence. Table 3 compares the four SOE leadership recruitment systems. Executives in the selection, market recruitment, and professional manager systems generally have a term of three years and are evaluated, incentivized, and punished according to the contracts they sign at the time of employment.

The ongoing changes to the SOE leadership recruitment system reflect the Party's desire to combine the principle of Party cadre management and the legal role of the board in selecting executives. However, the appointment system still plays a dominant role, especially in SOEs under direct state oversight (Liu and Zhang, 2018). Consequently, the turnover of SOE executives corresponds to both the firms' economic performance and their political performance, such as creating jobs and paying taxes (Yang et al., 2013; Zhang et al.,

[15] See "The Report of State Council on the Reform and Development of State-Owned Enterprises" (State Council, 2012), available at https://www.npc.gov.cn/zgrdw/huiyi/ztbg/gwygygyqyggyfzgzqkdbg/2012–10/26/content_1741236.htm.

Table 3
Appointment and management systems of SOE executives.

	Appointment System (委任制)	Selection System (选任制)	Market Recruitment System (市场化选聘)	Professional Manager System (职业经理人)
Department in Charge	OD of CPC	ODs of LPCs	Board of directors	Board of directors
Posts	Party Secretary, Board Chair, CEO, Secretary of DICs of SOEs controlled directly by state ministries or SASAC	CEO, Members of top management	CEO, Members of top management	CEO, Members of top management
Political Identity	Yes	Yes	No	No
Tenure and Contract Management?	No	Yes	Yes	Yes
Labor Contract Registration	OD	SOE	SOE	Labor market
Compensation	Administration-based	Administration-based	Market-based	Market-based

2015; Bradshaw et al., 2019). At any point, the Party secretary and the chair of the board is to be appointed by the ODs of the CPC. Under the two-way entry and cross-appointment system, the two positions are to be held by the same person. Party leadership is realized first through the appointment system and then through the Party-building work.

6.2. Evaluation of SOE executives

Consistent with SOEs' multiple objectives, their executives are evaluated on multiple dimensions (Xin et al., 2019). The indicators used to measure their performance include not only profits and economic value added but also the extent to which SOEs fulfill their functions.[16] As the functions of SOEs became clearer following the classification reform, the evaluation system for executives is expected to differ dramatically between SOE categories.[17]

To gain more insight into executive evaluation, we interviewed anonymous officials of a municipal SASAC. The interviews revealed that measures for Party-building work in SOEs have gradually gained importance in the evaluation system. The officials stated that the performance in Party-building work for the SOEs under supervision accounts for 20% of the total evaluation score. The elements used to assess Party-building work include the amendment of corporate charters to incorporate Party-building, the operation of the two-way entry and cross-appointment leadership system, the LPCs' decision-making power, and the application of the Party cadre management system.

In addition to multiple objective indicators, the SASAC incorporates non-contracted information in performance evaluations by making subjective adjustments (Du et al., 2018). However, subjective adjustments are likely to be influenced by both subordinates' activities and superiors' preferences because of such adjustments' discretionary nature and low verifiability. Du et al. (2012) find that having CFOs with political connections and locating firms' headquarters in proximity to the evaluator help SOEs obtain higher evaluation scores and ratings. They also find that SOEs with higher political rankings are favored by the SASAC in evaluations.

Overall, the evaluation of SOE executives in China is complex. Both economic and noneconomic achievements are considered, and both objective and subjective elements are evaluated. Political governance is embedded in the design of the evaluation system. The indicators of Party-building work included in such evaluations push executives to strengthen the Party's leadership in SOEs.

6.3. Political promotion–dominated executive incentive system

Executive compensation is strictly regulated in Chinese SOEs because of social discontent regarding pay inequality (Su et al., 2020).[18] The regulated low compensation is insufficient to incentivize executives and thus has produced a wide range of negative consequences, including over-investment (Xin et al., 2007), reduced risk-taking (Su et al., 2020), corruption (Chen et al., 2009; Xu and Liu, 2013), high stock price crash risk (Bai et al., 2019), and low operating performance (Yang et al., 2019).

The restriction on executive pay has also led to the prevalence of executive perks in SOEs (Chen et al., 2005). Chen et al. (2016) argue that perks represent a suboptimal incentive arrangement, motivating executives to work in the shareholders' interest at a relatively high cost. Consistent with this argument, Chen et al. (2016) find that perks may positively affect firm value but to a much lesser extent than monetary compensation. In contrast, Li and Chi (2015) view perks as a reflection of agency conflicts. They find that perks have no association with firm performance but are positively associated with managerial power in SOEs. Despite these

[16] According to the "Provisions on Performance Evaluations for Principals of Central Enterprises" (SASAC, 2019), profits and economic value added are the two basic indictors applied to measure the performances of all executives in central SOEs. The special indicators for each category of SOEs shall be designed differently according to their functions and characteristics.

[17] The differences in performance evaluation among SOE categories are formally described in the GO-FDCSOE, which are summarized in Table 2.

[18] According to the "Executive Compensation Reform Plan for Central SOEs", the compensation of SOE executives shall be no more than seven to eight times the average salary of the SOE's employees (Su et al., 2020).

divergent academic opinions, the Party regards perks as a form of corruption. Since 2013, as a result of the anti-corruption campaign launched by the Party, perks have been greatly reduced (Ke et al., 2017).

Political promotion is fundamental to SOE executives' incentive system (Xin et al., 2019). Unlike CEOs in Western countries, who enjoy ample outside job opportunities, most executives of Chinese SOEs under the Party cadre management system work within the political personnel system entirely and therefore are locked into the system (Liu and Zhang, 2018). Fig. 4 illustrates the career path of central SOE leaders. The political ranks of SOE leaders appointed by the OD of CCCPC are higher than the ranks of those appointed by SASAC. Within the corporate sector, the promotion path starts at the position of deputy leader of a non-backbone central SOE and proceeds to deputy leader of a backbone central SOE, then to principal leader of a non-backbone central SOE, and finally to principal leader of a backbone SOE. Leaders also move between the corporate and government sectors. Exchanges between OD-appointed backbone SOE leaders and ministerial and provincial officials are not uncommon. For example, the prior minister of the Ministry of Finance (MOF), Lou Jiwei, was the Chairman of China Investment Corporation before moving to the MOF. Principal leaders at the department and bureau levels can be promoted to backbone central SOEs as deputy leaders. They can also move to non-backbone SOEs, but this is rare. Deputy leaders at the department and bureau levels can be promoted to non-backbone central SOEs as deputy leaders.

The SOE leaders appointed by the OD of the CPC have political ranks, which is perhaps why they can be transferred to the government sector. Their ranks are related to not only compensation but also implicit incentives, such as power, status, reputation, and other non-pecuniary rewards and benefits (Chen et al., 2018). The benefits accorded to higher-ranking employees have motivated executives to seek promotions (Liang et al., 2015). They must strive for better performance to win the fierce tournament-style competitions for higher political ranks. The political promotion–dominated incentive system facilitates the state's control over SOEs, prevents managers from overzealous risk-taking, and reduces earnings management and managerial myopia (Xin et al., 2019). However, it also leads to the following problems: executives' high tendency for corruption when they lose hope for promotion, low flexibility in cadre management, a strong incentive to build image projects, and other short-sighted behaviors (Xin et al., 2019).

7. Party committees' participation in SOE decision-making

The participation of LPCs in decision-making ensures that the principles and policies of the Party and the state are strictly followed in SOEs (Wang, 2014). The first channel through which the Party participates in SOE decision-making is the ex-ante procedure discussed above, in which LPCs' discussion is a prerequisite for "three-important and one-large" decisions' submission to the board and management. The second channel is the two-way entry and cross-appointment system, in which Party members who serve as directors or man-

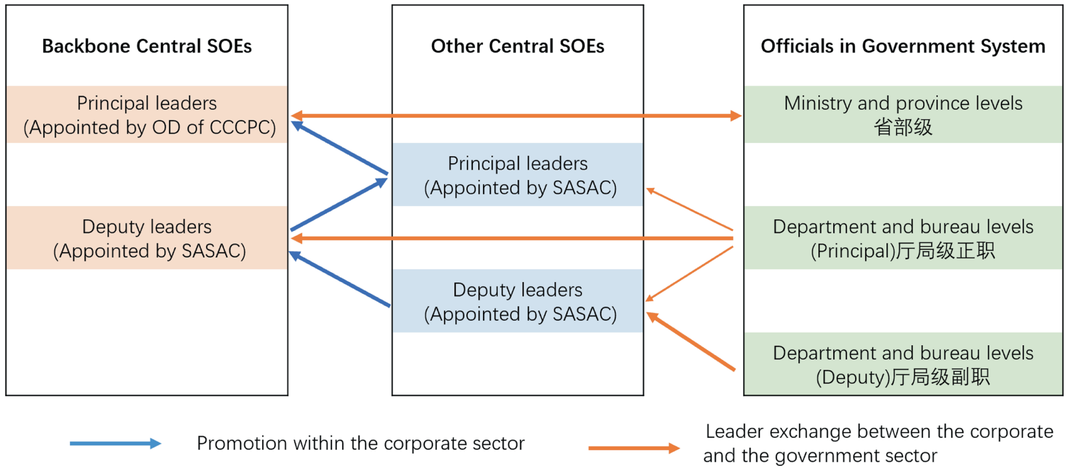

Fig. 4. Career path of central SOE leaders.

Table 4
Two-way entry and cross-appointment system in A-share, state-controlled, listed firms, 2007–2019.

Year	Obs.	Two-Way Entry (Mean)				Cross-Appointment (Mean)
		Two-Way Entry	Entry-BOD	Entry-BOS	Entry-TM	
2007	944	4.7%	4.5%	6.6%	5.1%	13.1%
2008	960	4.9%	5.0%	6.9%	5.5%	13.8%
2009	977	5.4%	5.7%	7.0%	6.2%	14.6%
2010	1,016	5.9%	6.1%	6.8%	7.3%	15.0%
2011	1,015	6.0%	6.2%	7.2%	7.6%	16.3%
2012	1,020	6.5%	6.5%	7.8%	8.1%	17.4%
2013	1,012	6.5%	6.5%	7.4%	8.5%	17.4%
2014	1,014	6.8%	7.0%	7.5%	9.2%	18.4%
2015	1,017	6.9%	7.1%	7.4%	9.2%	19.3%
2016	1,044	7.2%	7.5%	7.5%	10.3%	21.3%
2017	1,069	8.6%	8.9%	8.1%	12.8%	26.8%
2018	1,086	9.3%	9.7%	7.9%	14.2%	31.0%
2019	1,145	9.5%	10.0%	7.7%	14.6%	31.5%

Notes: "Two-Way Entry" represents the proportion of LPC members on boards of directors, on boards of supervisors, and in top management, combined. "Entry-BOD," "Entry-BOS," and "Entry-TM" represent the proportions of LPC members on boards of directors, on boards of supervisors, and in top management, respectively. "Cross-Appointment" is a dummy variable coded as 1 if the secretary of the LPC serves as the board chair or the deputy secretary of the LPC serves as the board chair while the secretary of the LPC serves as the vice-chair of the board, and 0 otherwise.

agers cast their vote in line with the LPCs' decisions. This section first introduces the evolution of these two mechanisms, then presents the empirical evidence of the effect of Party participation in decision-making on firm performance.

7.1. LPCs' decision-making participation mechanisms

It was in 1997 that the Party explicitly stated the role of LPCs in SOE decision-making (Wang, 2014). The "Notice of the CCCPC on Further Strengthening and Improving the Party Building Work of State-Owned Enterprises" listed the material matters that LPCs are to render decisions on and that require the board and the general manager to "consult and respect the opinion of the Party organization before making any important decision" on them (CCCPC, 1997). However, this list was relatively broad and unclear.[19] LPCs' opinions were limited and treated as mere references. In 2010, to clarify the decision list, the Party and the state released a document to provide guidance on matters to be decided by leading groups including LPCs, or the "three-important and one-large" matters.[20]

To further increase LPCs' decision-making power, the two-way entry and cross-appointment leadership system was advocated in 2004 (Wang, 2014). This system creates opportunities for the Party members who also serve on the board or as management to represent the Party's collective will through their voting on corporate decisions. Table 4 reports the extent of two-way entry and cross-appointment in partially privatized, A-share, state-controlled, listed firms during 2007–2019. As shown in the table, the average proportion of two-way entry and the average frequency of cross-appointment grew steadily over these years. The proportion of LPC members in boards of directors increased from 4.5% to 10%, in boards of supervisors from 6.6% to 7.7%, and in top management from 5.1% to 14.6%. The proportion of LPC members in the three corporate governance entities as a whole increased from 4.7% to 9.5%. In 2007, cross-appointment presented in 13.1% A-share, state-controlled firms; in 2019, the number grew to 31.5%. Table 4 thus indicates a trend of enhanced political governance in state-controlled listed firms over these years.

[19] According to the Notice, the material matters include the SOE's operation policies, development strategy, annual planning, major technology improvement plans, financial budgets, asset restructuring, major personnel arrangement, formulation and revisions of major reform plans and key management systems, and issues of vital interests to the workers.

[20] See the "Opinions on Further Promoting the Implementation of the 'Three-important and One-large' Decision-Making System in State-owned Enterprises" (General Office of CCCPC and General Office of State Council, 2010).

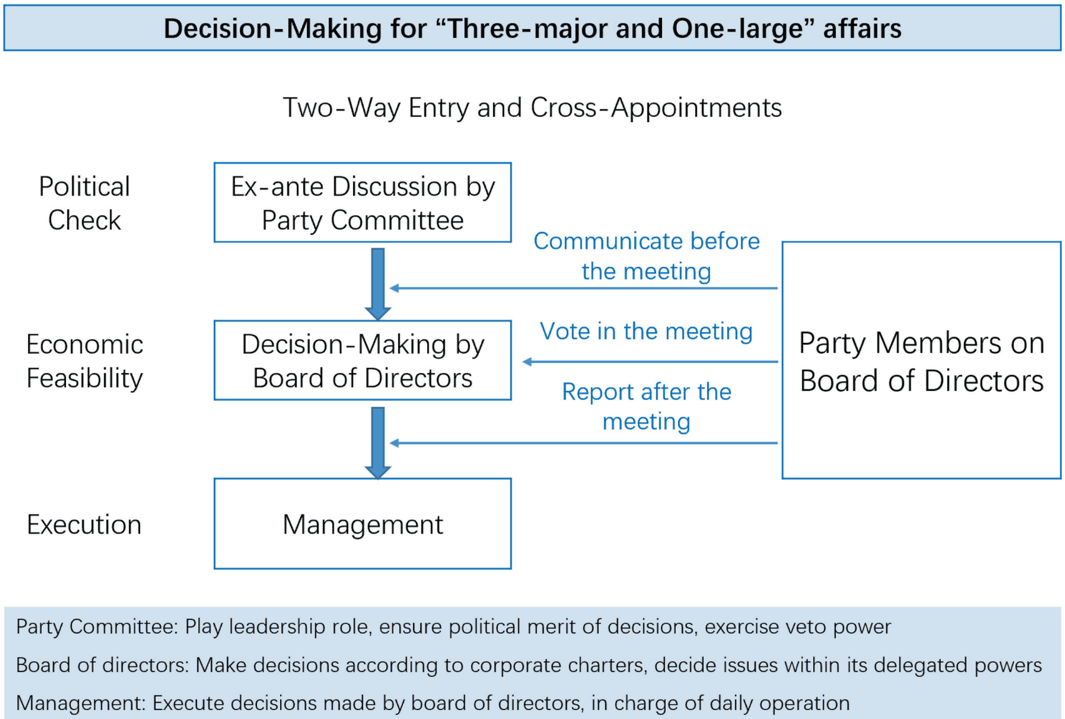

Fig. 5. Party participation in major decision-making.

The participation of LPCs in SOE decision-making has been strengthened in the new era of SOE reform. According to the "Working Rules of the Party Group of CPC (Trial)", LPCs' discussion of major issues in advance of the board's and management's decision-making is mandatory (CCCPC, 2015).[21] Therefore, only matters approved by LPCs can move to the decision-making procedure as required by corporate governance. LPCs exercise veto rights when the issue in question violates the principles and policies of the Party and state. This improves the legitimacy and compliance of corporate decisions. However, approval by LPCs does not excuse directors or managers for the failure of their final decisions (Tan et al., 2020); because LPCs check proposals mainly from a political standpoint, whereas executives are responsible for economic consequences (Qiang, 2018). Fig. 5 presents the decision-making procedure for "three-important and one-large" affairs. As shown, the Party members on the board of directors play three roles during the process: communicating before the board of directors meeting, voting in the meeting, and reporting after the meeting.

For issues that do not qualify as "three-important and one-large" decisions, the Party committee/organization only has the power to make suggestions. The decision rights lie in the board of directors. In terms of accountability, the Party committee takes primary responsibility for political issues, and the board of directors has responsibility for operational issues (Qiang, 2018). Other responsibilities are undertaken by the person in charge.

7.2. Effects of LPCs' participation in SOE decision-making

Political involvement in decision-making has two conflicting effects on firm performance (Chang and Wong, 2004). The grabbing hand theory predicts that the decision-making power of LPCs ensures the achievement of social and political objectives, which negatively affects SOEs' economic performance (Qian, 1996).

[21] This arrangement was first stipulated in the "Working Rules of the Party Group of CPC (Trial)" (CCCPC, 2015) and was refined by the notice on "Implementing the Key Tasks Set in the National Conference on the Party-Building Work in State-Owned Enterprises" (OD of CCCPC and Party Committee of State Council, 2016).

Consistent with this prediction, Ma et al. (2013) find that SOEs with more LPC members in director, supervisor, and management roles are characterized by redundant employees and pay equality.

In contrast, the helping hand theory suggests that the participation of LPCs in decision-making may improve firm performance through monitoring (Shen et al., 2020). Liu et al. (2020b) provide direct evidence that more dissent is raised in board meetings when leaders of LPCs also lead corporate governance entities. This phenomenon is more significant in SOEs with poor performance and weak state control. Liu et al. (2020b) find that increasing dissent in decision-making leads to better performance of SOEs. Since 2015, LPCs have veto rights and problematic proposals could been rejected directly. Dissent in board meetings has occurred less frequently. In addition to Liu et al. (2020b), Shen et al. (2020) and Chen and Lu (2014) document the monitoring effects of political involvement in investment and M&A activities.

However, both the grabbing hand and helping hand theories are consistent with the stakeholder view of SOEs. That is, the Party's participation in decision-making facilitates the realization of the multiple objectives of SOEs.

8. Intra-Party supervision and anti-corruption

To solve the monitoring problem of SOEs, a multi-dimensional monitoring system has been established in China. The system includes discipline inspections conducted by the Party's DICs, auditing (internal, external [conducted by CPAs], and governmental), democratic supervision by society and SOE employees, and monitoring by providers of capital. Of these monitoring methods, discipline inspection targets the Party cadres in SOEs. In discipline inspections, both the inspector and the inspected subjects are within the Party. Therefore, the inspections are referred to as "intra-Party supervision." Intra-Party supervision ensures that Party cadres abide by Party rules. It is part of the political governance system.

The DICs of the CPC are installed in Party organizations/committees within the state sector. Their job is to maintain the legitimacy, organizational integrity, and sustainability of the Party (Yeo, 2016). Although the discipline inspection system has been in effect since the founding of the CPC, its role was limited before 2012. Its limited role is reflected in the rampant corruption observed before 2012. As local DICs are attached to local Party committees in terms of personnel management and funds acquisition, they lack independence and thus fail to exercise effective supervision (Nie and Wang, 2016). The resulting uncontrolled corruption aroused wide public concern. According to a survey conducted by the PEW Research Center in 2013, "corrupt officials" was ranked second on a list of "big problems" by Chinese respondents (Lin et al., 2020a).

To win back public trust, President Xi launched an unprecedented anti-corruption reform soon after his inauguration at the 18th National Congress of the CPC in November 2012. Since then, China has witnessed great anti-corruption efforts. Anti-corruption regulations were issued to provide guidelines. Discipline inspections were conducted to enforce these regulations (Cao et al., 2018), resulting in the ousting of corrupt cadres. This reform facilitated the proper functioning of the intra-Party supervisory mechanism, which, in turn, became an effective tool for the enforcement of anti-corruption regulations. This section first presents the regulations launched in the anti-corruption era, then examines how discipline inspection affects the government-firm relations, ends with an investigation on the impact of the ousting of corrupt government officials.

8.1. Anti-corruption regulations

8.1.1. Eight-Point policy (八项规定)

The Eight-Point Policy was the first anti-corruption regulation, launched by the political bureau of the CCCPC on December 4, 2012. It aims at curtailing extravagant perks by or for Party cadres in the state sector. The eight points are: (1) leaders must keep in close contact with the grassroots, without inspection tours or formality; (2) meetings and major events are to be strictly regulated and efficiently arranged, and empty grand gestures are to be avoided; (3) the issuance of official documents must be reduced; (4) official overseas visits and related formalities are to be restricted; (5) leaders traveling by car must avoid disrupting traffic; (6) media stories about official events are to be limited to events with real news value; (7) government leaders should not publish self-authored works or congratulatory letters; and (8) leaders must practice thrift and strictly obey regulations regarding accommodation and cars (CCCPC, 2012). During the first eight years after the enactment of this policy, 375,000 cases involving hedonism and extravagance were rectified and 518,000 Party members who had violated the Eight-Point Policy were punished, 326,000 of them receiving Party discipline and administrative sanctions.[22]

Most SOE executives are Party cadres who must follow the Eight-Point Policy. If they are found guilty of violating the policy, their careers are immediately put to an end. Thus, to keep their jobs, SOE executives must forego the perks they used to enjoy. Ke et al. (2017) capture the declining trend in perks among SOEs. However, Ye and Zang (2016) argue that this trend was not achieved by anti-corruption efforts but rather are a result of firms' shifts in classification. For example, firms may purposely report business entertainment expenses as "other expenses."[23].

Lin et al. (2020a) investigate the effect of the Eight-Point Policy on firm value using an event study approach. They find that A-share listed firms earned a 2.77% and 3.86% increase in value in 3- and 5-day windows, respectively, around the event date.[24] SOE values increased broadly, regardless of market institutions. However, non-SOEs rose in value in liberalized provinces but lost value in less liberalized provinces. Lin et al. (2020a) argue that corruption in SOEs mainly caters to their executives. Thus, cutting waste boosts firm value. However, for non-SOEs, corruption is necessary to grease bureaucratic gears to "get things done." The Eight-Point Policy relieves non-SOEs from investment in official connections where resources are allocated by market forces but causes difficulty in pleasing bureaucrats in areas where the government still dominates in resource allocation. Thus, the market reactions differ among non-SOEs depending on the development of market institutions. Lin et al.'s (2020a) study shows a clear difference in the role that corruption plays between SOEs and non-SOEs. Because corruption erodes the value of state assets, SOEs are the beneficiaries of the Eight-Point Policy.

8.1.2. Rule 18

Before anti-corruption reform, hiring government officials as independent directors was a common practice in China (Liu et al., 2018). By 2013, 17.5% of independent directors had a political background and 42% of listed firms had hired at least one politically connected independent director (Liu et al., 2018). The political connections built by official directors enabled firms to seek political rents, such as preferential treatments in finance, tax, and subsidies (Ye et al., 2016). In 2013, the OD of CCCPC issued Rule 18, which forbids Party and government officials, either in office or within three years of their retirement, from employment by firms (OD of CCCPC, 2013; Liu et al., 2018; Hope et al., 2020).[25] This regulation forced a large number of directors with backgrounds as government official to immediately resign from their corporate positions. This caused the political connections and preferential treatments of the firms they had worked for to diminish. The market reacted negatively to this event (Ye et al., 2016; Liu et al., 2018). SOEs either did not suffer or suffered less than their private counterparts, thanks to the stable link to the government inherent in their state ownership (Deng et al., 2016; Liu et al., 2018). Without the government's protection, event firms are incentivized to improve the quality of their financial reporting (Hope et al., 2020). This effect is more pronounced in private firms as well as in firms that had received preferential credits and thus faced refinancing pressures.

Before the enactment of Rule 18, several regulations limiting government officials from taking positions in enterprises had been issued. However, Rule 18 was more seriously enforced than its predecessors. Rule 18 is aimed at reducing rent seeking and establishing a new type of cordial and clean relationship between the government and businesses.

[22] See https://www.xinhuanet.com/politics/2020–12/04/c_1126819392.htm.

[23] Ke et al. (2017) measure perks as excessive sales and administrative expenses. Business entertainment expense, reported as part of the sales and administrative expenses, is believed to be one source of perks.

[24] Using all other Hong Kong listings as a benchmark, the share prices of the 81 mainland-based firms trading in Hong Kong (H shares) rose by 1.59% and 2.26% in 3- and 5-day windows, respectively (Lin et al., 2020a).

[25] Rule 18 also requires university professors, leaders in publicly funded organizations, and senior managers in SOEs who have civil-service ranks to resign from director positions (Deng et al., 2016; Hope et al., 2020). Because these individuals have no substantial political influence, their resignations were treated as pseudo-events in the robustness check of related empirical studies (Ye et al., 2016; Hope et al., 2020).

8.2. CCDI's discipline inspections

To monitor and ensure the proper enforcement of the Eight-Point Policy and Rule 18, the highest discipline committee of the CPC, the CCDI, has conducted circuit inspections over all major state sectors since 2013. The target of the CCDI's inspections are the Party cadres in central ministries, provincial governments, central SOEs, and other major state sectors. The inspection detects breaches of Party rules and has a deterrent effect, aiming to build Party integrity and crack down on corruption. In addition to discipline inspections by the CCDI, the DICs of local government and local Party committees in the SASAC also conduct inspections of organizations and SOEs under their supervision.

The CCDI's discipline inspection has several advantages. First, as a form of top-down supervision, it has great authority and independence. Second, its on-site visits facilitate its information collection (Cao et al., 2018).[26] Third, it welcomes reports from the public in the form of calls, letters, and visits regarding the wrongdoings of Party members (Yeo, 2016). Fourth, the inspection process is designed to not only detect problems but rectify them as well.

The CCDI's discipline inspection has extensive influences on inspected targets and the related parties. It constrains the "grabbing hands" element of governments and thus improves their efficiency in resource allocation. Ding et al. (2020) find that the market reacted positively to the initial announcement of the CCDIs' inspections on May 17, 2013. In response to the announcement, private firms, small firms, and firms without political connections earned a higher return, as these firms benefit more from eliminating the governments' "grabbing hands." Hu and Xu (2021) find that firms in inspected provinces display an accelerated capital structure adjustment following inspection because of reduced transaction costs.

Local governments and firms have a reciprocal relationship and shared interests. Cao et al. (2018) find that firms, especially SOEs, suppress negative information disclosure when the province they are registered in is under inspection. This reflects the influence that politicians exert over firms to avoid the risks related to negative news that may provide clues about the politicians' wrongdoings (Cao et al., 2018). However, the CCDI's inspections of provinces can break the reciprocal relationship between the local government and firms. Hao et al. (2020) find that firms with political connections reduce charitable donations after inspections. As a result, they receive less in government subsidies. Yet, their productivity improves, as their corporate resources are invested in production activities. Kong et al. (2020) reach the same conclusion regarding an increase in firm productivity after inspections. They investigate channels from the perspectives of investment efficiency and innovation, which are the focus of firms' development strategy in the post-inspection era. Furthermore, Yang et al. (2021) find that heavily polluting enterprises increase their investment in environmental protection when bribery for avoiding social responsibility is prevented by discipline inspections.

8.3. Ousting of corrupt government officials

The ousting of corrupt government officials, especially those with high political ranks, shows the Party's strong determination to eliminate corruption. As of March 2022, more than 230 officials at the provincial (ministerial) level and above have been found guilty of corruption.[27] The downfall of high-ranking officials affects firm performance through two mechanisms. First, it brings political uncertainty regarding the government's future policies and the enforcement of existing regulations. Zhou (2017) finds negative market reactions to the ousting events. SOEs' value has been less affected by the ousting because the stable political ties inherent in state ownership shield them from such political uncertainty. Second, the ousting of high-ranking officials breaks firms' connections with corrupt officials. As a result, firms no longer enjoy favors from the government. Liu et al. (2016a) and Pan and Tian (2020) find that firms, especially non-SOEs, reduce their investment and M&A activities after the ousting of the corrupt officials they are connected with. Furthermore, He et al. (2017)

[26] Cao et al. (2018) provide a detailed description of the methods used by inspection teams to collect information. The methods include "meeting with or listening [to] briefings by local political leaders and officials, attending the meeting, receiving phone calls/mails/visits, small-scale workshop[s], private talk[s], document view/review, survey[s] and questionnaires, local visit[s] and field trip[s], [and] hiring professional[s] for expertise/advice.".

[27] See reports on the website of China Economy: https://district.ce.cn/newarea/sddy/201410/03/t20141003_3638299.shtml.

Table 5
A-share, state-controlled, listed firms' amendment of corporate charters to incorporate Party-building work: Progress as of 2019.

	Obs.
State-controlled listed firms at the end of 2019	1,145
State-controlled listed firms with amended corporate charters as of 2019	1,043
Subset of firms with amended corporate charters as of 2019	
-that made amendments before being listed or becoming state-controlled	39
-that made amendments when they were state-controlled listed firms	1,004
State-controlled listed firms that had not amended corporate charters by 2019	102

find that connected non-SOEs receive less favorable audit opinions and are less likely to hire local small auditors in the year of a corruption case. This indicates that when non-SOEs lose political connections, their auditing risks and their need to improve accounting transparency increase. However, He et al. (2017) find a contrary result for connected SOEs. In sum, the roles of political connections and corruption differ, depending on ownership type (He et al., 2017; Lin et al., 2020a).

To summarize, intra-Party supervision shapes firm behaviors profoundly. Through its anti-corruption measures, it curbs extravagant perks and terminates collusion between firms and the government. SOEs benefit from saving otherwise wasted resources and rectifying distorted decisions, while their valuable ties with the government stemming from their state ownership protect them from the loss of political connections and the ensuing political uncertainty. However, the evidence concerning the effects of anti-corruption on SOEs is indirect and more research is needed to reveal the real effect.

9. Incorporating Party-building work into corporate charters

Just as corporate governance fails to eliminate agency problems related to the separation of ownership and control, enforced political governance and anti-corruption campaigns are incapable of eliminating agency costs and corruption in SOEs. For example, the CCDI's feedback reports from the inspection of central SOEs reveals that the problems in SOEs include a lack of strictness in Party management and governance, irregularity in personnel selection, opaqueness in decision-making, violation of the Eight-Point Policy, and rent seeking. The government audit reports for central SOEs indicate that financial fraud, inappropriate decision-making procedure, Party-related transactions, tunneling, and poor management are common in SOEs (Chi et al., 2019).

One approach to solving such problems is to enhance the role of political governance. Accordingly, a recent initiative involves incorporating Party-building work into corporate charters. The Party has taken this measure to clearly define its leadership role, rights, and obligations in SOEs. This arrangement has several positive effects. First, it improves the transparency and legitimacy of the Party's leadership, as the passage of charter amendments calls for the support of the majority shareholders and must be made known to the public for listed firms. Second, it aggregates and unifies previously dispersed policies related to the Party's governance. Third, it provides SOEs with an opportunity to establish a constitutional framework in which political governance and corporate governance can run simultaneously and cohesively. However, this practice has puzzled non-state investors, especially foreign investors (ACGA, 2018).

The amendment of corporate charters concerning Party-building work has been successfully carried out in A-share markets. We collect information on first-time amendments to corporate charters to incorporate Party-building by A-share, state-controlled, listed firms from August 24, 2015, when the Party first announced its policy, to 2019.[28] The Party and the SASAC provided detailed guidance for incorporating Party-building provisions in corporate charters at the beginning of 2017 (OD of CCCPC and SASAC, 2017). By 2019, 91.1% (1043/1145) of state-controlled, listed firms had amended their corporate charters to formalize the Party's

[28] We observe that some firms have made second or third amendments since the first one. Because the first amendment best shows the responsiveness of SOEs to the Party's policy, our analysis centers on the first-time amendment of each listed SOE, if any.

Table 6
Contents of Party-building provisions written into corporate charters.

	No. (%) of amendments	No. of Chinese characters		
		Mean	Min.	Max.
(1) Organizational arrangement	1004 (100%)	236.03	22	1552
(2) Two-way entry and cross-appointment system	596 (59.4%)	43.01	0	186
(3) LPCs' discussion as an ex-ante procedure	789 (78.6%)	88.87	0	688
(4) Rights and obligations of LPCs	921 (91.7%)	365.09	0	2261
(5) Rights and obligations of Local DICs	240 (23.9%)	55.67	0	737
All provisions	1004 (100%)	788.68	27	3090

Note: This table reports descriptive statistics of the contents of Party-building provisions written in corporate charters for A-share, state-controlled, listed firms during 2015–2019.

leadership (as reported in Table 5). Among them, 39 firms made amendments before being listed or being state-controlled.[29]

9.1. Party-building provisions in amended corporate charters

Incorporating Party-building work into corporate charters is a move to institutionalize political governance and can be verified by new provisions written into the charters. We conduct a textual analysis on Party-building provisions and find that the provisions fall into five categories: (1) arrangement of the Party organization, including its leadership role, composition, and working expenses; (2) the two-way entry and cross-appointment system; (3) the ex-ante procedure; (4) the rights and obligations of LPCs, such as leading the ideological and political work, supervising the implementation of the Party's policies, and serving as a gatekeeper in personnel management; (5) the rights and obligations of local DICs, including enforcing Party discipline, supervising the exercise of power by cadres, coordinating anti-corruption work, and addressing violations of Party discipline.

The distribution of the charter contents is unbalanced, as shown in Table 6. All firms have put forward requirements for the arrangement of the Party organization. However, only 59.4% and 78.6% of firms clearly refer to the two-way entry and cross-appointment system and the ex-ante procedure, respectively. As expected, over 90% of firms have defined the rights and obligations of LPCs; however, only 23.9% have defined the role of local DICs. We conduct a word count to measure the magnitude of various Party-building provisions. The average number of Chinese characters used in the amendments is 789, of which 236 (30%) relate to the arrangement of the Party organization, 43 (5%) relate to the two-way entry and cross-appointment system, 89 (11%) relate to the ex-ante procedure, 365 (46%) relate to the rights and obligations of LPCs, and 56 (8%) relate to the rights and obligations of Local DICs, on average. There are great variations in the text length of amended provisions, with a maximum (3090) over 100 times the minimum (27). The contents or scope of an amendment may be of concern when the amendment is submitted to the shareholder's congress (ACGA, 2018).

9.2. Shareholder voting on amendments to corporate charters to incorporate Party-building work

In partially owned SOEs, the implementation of Party leadership must be approved by other shareholders. To explore shareholders' attitudes toward the amendment of corporate charters to accommodate Party-building work, we collect the voting results of A-share listed firms, as shown in Table 7. An amendment can only be passed if it receives more than two thirds (a super majority) of the shareholders' votes. There is only one SOE that failed to obtain a super majority of votes.[30] The passage rate of nearly 100% reflects

[29] Because we could not obtain detailed information on these amendments, we exclude them from our subsequent analysis.

[30] On January 6, 2017, the proposal incorporating Party-building work in the charters of Tianjin Real Estate Development (Group) (Stock Code: 600322) only received 62.5% "yes" votes in the general meeting, failing to meet the two-thirds super majority requirement. On May 5, 2017, the proposal was made again following certain adjustments to the amendment and passed with 99.99% "yes" votes (ACGA, 2018).

Table 7
Shareholder voting results for incorporating Party-building work into corporate charters.

	Obs.	Mean	Min	Max
Panel A: All shareholders				
% of "Yes" votes	1,004	98.8%	62.5%	100%
% of "No" votes	1,004	1.0%	0	36.1%
% of abstentions	1,004	0.2%	0	25.6%
Panel B: Minority shareholders				
% of "Yes" votes	652	75.0%	0	100%
% of "No" votes	652	23.0%	0	100%
% of abstentions	652	2.0%	0	96.2%
Panel C: Foreign shareholders				
% of "Yes" votes	105	51.6%	0%	100%
% of "No" votes	105	46.6%	0	100%
% of abstentions	105	1.8%	0	63.9%

Note: This table reports the descriptive statistics of shareholders' votes on incorporating Party-building work into corporate charters for A-share, state-controlled, listed firms during 2015–2019.

the efforts of SOEs to coordinate with other shareholders who may have voted against the amendments (Liu and Zhang, 2019). This is especially true for cross-listed firms.

Table 7 reports the descriptive statistics of the voting results from all shareholders, minority shareholders, and foreign shareholders in Panels A, B, and C, respectively. Note that not all of the firms in our sample disclosed the votes of minority and foreign shareholders. As shown in Panel A, 98.8% of all votes were yeses. The mean percentage of noes (1%) and abstentions (0.2%) is quite small. Because the state holds a large proportion of the shares in listed SOEs, it is reasonable to see such overwhelming approval. For minority shareholders, the number of votes in favor of the amendment was about three times that of those opposed (75% to 23%). This shows that most but not all minority shareholders supported Party-building work in listed SOEs. For foreign shareholders, the proportions of votes for and against were very close, at 51.6% and 46.6%, respectively. Such an outcome is consistent with the Party's concern that its policy on Party-building charter amendments may face legal risks overseas. In the H-Share market, although foreign investors may have voted in opposition, the overall opposition rate was low (ACGA, 2018). Overall, shareholders applauded the amendments of corporate charters to institutionalize Party leadership in SOEs.

9.3. Effects of incorporating Party-building work into corporate charters

This section addresses whether incorporating Party-building work into corporate charters benefits SOEs. Li et al. (2021) find that the cost stickiness of SOEs declines after they amend their charters to incorporate Party-building work provisions. Jin et al. (2021) investigate the effects of incorporating Party-building work into corporate charters on the normative operation of SOEs by examining changes in the effectives of internal control. They find an improvement in internal control after such amendment. This improvement is more significant as the revision frequency, breadth, and depth increase and when shareholders give more support. The positive effects are associated with the Party-building provisions regarding the organizational arrangements, the ex-ante procedure, and the rights and obligations of the Party organization/committee. Jin et al. (2021) further analyze stakeholders' reactions to charter amendment and find a positive market reaction. Following the amendments, SOEs experienced a decrease in debt costs and an increase in trade credits. This shows that creditors, suppliers, and customers expected positive effects from the amendments. Overall, the above empirical evidence supports the institutionalization of Party-building work and thus relieves the concerns of non-state investors.

10. Conclusions and future studies

The Party's leadership of SOEs, i.e., political governance, is the least understood aspect of governance with Chinese characteristics (ACGA, 2018). This study investigates how the Party plays a leadership role in SOEs through its ownership, cadre management, participation in decision-making, and intra-Party supervision. According to the stakeholder theory of SOE governance, political governance in the form of Party leadership ensures that the ultimate goal of maximizing social welfare is pursued by SOEs. Yet, political governance is not omnipotent and is unable to entirely eliminate incentive and agency problems, perks, and corruption. The state assets management systems and anti-corruption campaigns are efforts to combat these problems. The political governance is formally institutionalized when Party-building work is written into corporate charters. By discussing these issues, this study hopes to provide a big-picture perspective as well as information about the finer details of political governance in China's SOEs.

The main findings of this study are as follows. (1) State ownership lays the foundation for the Party's leadership. Ongoing ownership reforms will bring heterogeneity, new patterns, and challenges to SOE governance. (2) Under the principle of Party cadre management, SOE executives prioritize political performance and strive for political promotions. (3) The involvement of Party organizations in SOE decision-making facilitates political intervention and also mitigates agency problems. (4) Intra-Party supervision benefits SOEs by conserving resources. (5) By 2019, most state-controlled listed firms had amended their corporate charters to endorse the Party's leadership. The contents of the amendments and shareholders' votes varied. The positive effects of such amendments have appeared gradually.

Although research provides some insight into political governance in Chinese SOEs, many potential topics for future studies remain. First, the interaction between political governance and corporate governance should be clarified. The two governance systems may substitute or complement each other. Second, more research is needed to examine the role of political governance in new state asset management reforms, such as classified management, capital-based management, and mixed-ownership reforms. Third, further investigation of the problems related to compensation and incentives under the SOE management appointment and evaluation systems is needed. Little is known about the evaluation system for SOE executives, especially the newly added requirement for Party-building work. Fourth, the accountability for and efficiency of decision-making under the ex-ante procedure and the two-way entry and cross-appointment system require exploration. Fifth, discipline inspections of SOEs and the ousting of corrupt executives have yet to be investigated. Doing so will improve the understanding of how intra-Party supervision affects SOEs directly. Sixth, it is important to investigate the determinants and consequences of corporate charter amendments that incorporate Party-building work. Finally, most empirical studies on political governance use listed SOEs as the research sample. Because of the difficulties in obtaining data, unlisted SOEs and wholly state-owned firms remain relatively unexplored. Future research could overcome the data-availability problem and probe the governance problem in such firms.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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The price of carbon risk: Evidence from China's bond market

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ABSTRACT

Using a 2009–2019 sample of Chinese bond issuers, we examine the effect of carbon risk on bond financing costs. Relative to low carbon risk issuers, high carbon risk issuers have substantially larger bond credit spreads, mainly because their credit risk is greater and they invest the funds in non-green projects. This positive relationship is more pronounced for issuers with financing constraints, those not making a green transition and those in cities with stringent environmental regulations. We find a reversed effect during the COVID-19 pandemic. However, China's carbon peak and carbon neutral goals have renewed the focus on carbon risk. Carbon risk also causes bond issuers to scale back production and negatively affects their likelihood of receiving long-term financial support. Our findings suggest that investors consider carbon risk and charge a corresponding risk premium.

1. Introduction

Excessive greenhouse gas emissions from human activities have caused global climate change, which is a serious challenge for the global community. Since the Paris Agreement was adopted, carbon neutrality has become an important goal for countries worldwide. As China is the world's largest producer of coal, General Secretary Xi Jinping solemnly announced at the General Debate of the 75th Session of the UN General Assembly that "China will scale up its Intended Nationally Determined Contributions by adopting more vigorous policies and measures. We aim to have CO_2 emissions peak before 2030 and achieve carbon neutrality before 2060." Carbon neutrality requires most industries to significantly reduce their carbon emissions over

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time or even achieve net zero. Thus, carbon-intensive industries bear the brunt of carbon-related policies. We refer to the policy uncertainty risk that firms face regarding carbon regulations as "carbon risk" (Kim et al., 2015).

Carbon-intensive firms face various carbon risks. First, global warming concerns prompt regulators to implement policies to reduce carbon emissions. Uncertainty regarding such policies is greater for carbon-intensive firms than for non-carbon-intensive firms (Seltzer et al., 2020). Second, regulations that limit carbon emissions can lead to stranded assets or a large increase in operating costs (Nguyen et al., 2020). Third, according to Porter's hypothesis, environmental regulatory policies that promote the advancement of energy-saving and emission-reducing technologies have substitution and crowding-out effects on carbon-intensive firms, reducing their market share and thus creating technological risks. Finally, institutional investors and banks may also reduce their investment in and lending to carbon-intensive firms because of the minimum capital requirements imposed on non-green financing by climate regulations (Jiang et al., 2019; Krueger et al., 2020).

Securities issued by carbon-intensive firms may be riskier than those issued by other firms. Evidence of carbon risk pricing is found in options markets (Ilhan et al., 2021), credit markets (Delis et al., 2018) and equity markets (Chava, 2014; Kim et al., 2015; Ferrell et al., 2016; Nguyen et al., 2020; Trinks et al., 2022), but the effect on bond markets remains unclear (Duan et al., 2020; Seltzer et al., 2020). In this study, we examine the pricing of carbon risk in China's corporate bond market. We focus on corporate bonds for several reasons. First, unlike stocks, corporate bonds have limited upside potential but significant downside risk (Ilhan et al., 2020). As future carbon policies and regulations are mainly a downside risk for bond issuers with high carbon risk (Bai et al., 2019), such policy uncertainty is likely to concern bond investors more than it concerns equity investors. Second, corporate bond buyers in China are mainly institutional investors, who are sophisticated and likely to consider carbon risk in their investment decisions. Third, corporate bonds differ from stocks along important dimensions, such as credit ratings and maturities. The heterogeneity in bond characteristics allows us to better explore the channels underlying the pricing of carbon risk.

Using a 2009–2019 sample of bond issuers in China, we find that first, the bond market responds to carbon risk, with investors demanding a higher risk premium from high carbon risk issuers than from low carbon risk issuers. This finding holds for various measures of carbon risk, the addition of possibly omitted variables, various types of fixed effects and the use of exogenous shocks to mitigate potential endogeneity. This carbon risk premium effect has important economic implications: relative to low carbon risk issuers, bond credit spreads are 4.1072% higher for high carbon risk issuers. Second, we analyze three channels that drive the relationship between carbon risk and bond credit spreads: credit risk, rating agency messaging and how the funds raised are invested. The results show that relative to issuers with low carbon risk, issuers with high carbon risk have greater credit risks and raise less funds for green projects, prompting investors to demand a higher risk premium. Third, we also find that the carbon risk premium in the bond market is higher for issuers with financing constraints. Similarly, the positive effect of carbon risk on bond credit spreads is stronger when the enforcement of environmental regulations is strict in the bond issuer's location. However, the carbon risk premium in the bond market is mitigated when bond issuers issue green bonds, increase the greenness of their primary business or participate in the Clean Development Mechanism (CDM). We also explore whether the effect of carbon risk on bond credit spreads differs if investors expect weaker carbon regulations in the future. We find that the effect of carbon risk on bond financing costs reversed during the COVID-19 pandemic, but the introduction of China's carbon peak and carbon neutral goals has returned investors' attention to carbon risk. Finally, we analyze how issuers respond to carbon risk. We find that issuers with high carbon risk scale back production and reduce their long-term capital allocations.

We make several contributions to the literature on carbon risk pricing in the bond market. First, our findings have great practical significance in that they call attention to the effects of climate risk on financial stability, signifying the need for regulators to establish financial policy tools to support carbon emissions reduction. Second, it is critical to determine whether financial markets accurately predict and effectively price climate change risks because the financial markets play a supporting role in alleviating the effects of climate change. Despite the proliferation of academic studies on the pricing of climate risk in the equity market (Hong et al., 2019; Engle et al., 2020; Bolton and Kacperczyk, 2021), few studies explore the role of firms' carbon risk in the expected returns of corporate bonds. We thus enrich the literature on how climate and environmental risk affect the pricing of corporate securities and on the factors influencing bond credit spreads (Yang and Pan, 2019; Wu et al., 2020). General credit bonds are increasingly important in institutional investors' portfolios (Wu et al., 2020), so properly pricing carbon risk not only reduces the possibility of wealth transfers from high carbon risk issuers but also reduces the likelihood of extreme price movements in the future.

Third, unlike studies that find that equity markets reallocate investments to carbon-efficient sectors and that strong regulation promotes the implementation of green innovations by carbon-intensive firms (De Haas and Popov, 2019; Wang and Wang, 2021), we find that issuers suspend some production activities after the bond market prices carbon risk. Finally, closely related to this study, Seltzer et al. (2020) examine how state-level environmental regulations affect the credit ratings and yield spreads of corporate bonds. This study differs from theirs in that we focus on carbon risk and find that credit risk and how the funds raised are invested are potential channels through which carbon risk affects bond credit spreads.

The remainder of this paper proceeds as follows. Section 2 reviews the literature and develops a testable hypothesis. Section 3 discusses the carbon risk measure and empirical methodology. Section 4 presents and discusses the results. Section 5 presents the results of the additional tests. Section 6 concludes the paper.

2. Related literature and hypothesis development

2.1. Literature review

2.1.1. Climate risk

Climate change is currently one of the greatest ecological and social challenges facing the world. There are three climate risks in finance (Seltzer et al., 2020; Giglio et al., 2021). The first is physical risk, which refers to the risks arising from the physical effects of climate change, such as droughts, floods, storms, and sea level rise, on assets and production activities. The second is regulatory risk, which refers to the risks arising from the introduction of government policies related to climate change and the effects of regulatory costs on future cash flows and asset prices. The third is transition risk, which refers to the cash flow risk arising from the transition to a low-carbon economy.

How do external stakeholders, who play an important role in driving corporate emissions reductions, perceive and respond to climate risk? Some of the literature provides survey evidence that investors consider climate risk in their investment decisions. Through a survey of 861 finance academics, professionals and public sector regulators and policy economists on climate finance topics, Stroebel and Wurgler (2021) find that regulatory risk is considered the top climate risk to businesses and investors over the next 5 years but they view physical risk as the top risk over the next 30 years. In a recent survey, Krueger et al. (2020) find that institutional investors indeed consider climate risk an important factor in their investment portfolios. Ilhan et al. (2020) conclude that many institutional investors consider climate risk reporting as important as financial reporting because it allows them to assess the physical and technological risks of their portfolio firms. Painter (2020) documents that the municipal bond market prices climate change risks, especially for long-term bonds issued by counties that are more likely to be affected by sea level rise. Bernstein et al. (2019) show that homebuyers consider the negative effect of sea level rise on real estate prices in coastal areas and that homes exposed to sea level rise sell for approximately 7% less than observably equivalent unexposed properties equidistant from the ocean.

However, scholars also find that climate risk may not be accurately priced in financial markets. Ilhan et al. (2020) find that investors perceive climate risk to be mispriced in the stock market. By an overwhelming margin, respondents believe that asset prices underestimate rather than overestimate climate risks (Stroebel and Wurgler, 2021). Krueger et al. (2020) document that the average survey respondent believes that equity valuations do not fully reflect the risks from climate change and that respondents with larger ESG shares, and those who engage portfolio firms along more dimensions, generally see greater underpricing of climate risks. Pankratz et al. (2019) examine how extreme heat affects stock prices and find that investors do not fully incorporate this risk in pricing. Baldauf et al. (2020) show that expected sea level rise affects real asset values in coastal areas, whereas Murfin and Spiegel (2020) reach the opposite conclusion in their analysis.

2.1.2. Carbon risk

Carbon risk represents current debts or potential future losses due to the increasingly severe regulation of greenhouse gas emissions worldwide (Kim et al., 2015), and thus it represents potential losses from climate change or fossil fuel use (Hoffmann and Busch, 2008). Massari et al. (2016) indicate that carbon risk levels vary among firms and industries and that carbon risk mainly affects firms whose greenhouse gas emissions are restricted, such as those in the fossil fuel industry.

A growing body of literature focuses on the pricing of carbon risk in financial markets. Ilhan et al. (2021) find that climate policy uncertainty is priced in the options market. The findings of Delis et al. (2018) are consistent with a carbon bubble in the corporate loan market; since the Paris Agreement, banks have started to charge significantly higher loan spreads to fossil fuel firms. They also provide some evidence that green banks charge marginally higher loan rates to fossil fuel firms. Compared with banks, stock markets may be better suited to financing (green) innovations that are characterized by both high risk and high potential returns. Equity investors may also care more about future pollution such that stock prices rationally discount the future cash flows of polluting industries. Indeed, Trinks et al. (2022) show that for a cross-country firm-level data set, low-emission firms benefit from lower costs of equity, especially in carbon-intensive industries. De Haas and Popov (2019) find that for given levels of economic and financial development and environmental regulation, carbon dioxide (CO_2) emissions per capita are lower in economies with relatively more equity funding. The authors believe that stock markets reallocate investments toward less polluting sectors and push carbon-intensive sectors to implement greener technologies. Chava (2014) shows how the environmental profile of a firm affects both its costs of equity and debt capital, suggesting that both banks and equity investors consider environmental concerns. Kim et al. (2015) suggest that carbon risk is positively related to the cost of equity capital and that the effect of carbon intensity on the cost of equity capital does not differ between companies that voluntarily issue sustainability reports and those that do not.

2.2. Hypothesis development

Equity investors consider carbon emissions when assessing the risk of a firm. Bolton and Kacperczyk (2021) find that the stocks of firms with higher total CO_2 emissions earn higher returns. As firms with disproportionately high CO_2 emissions may be exposed to carbon pricing risk and other regulatory interventions to limit emissions, they are also more exposed to technology risks from lower-cost renewable energy. Therefore, forward-looking investors may seek compensation for holding the stocks of disproportionately high CO_2 emitters. However, some studies also find that stock markets underreact to carbon news. Setbacks in carbon capture and storage (CCS) technologies have a negative but insignificant effect on the abnormal returns of coal companies. Some researchers conclude that either investors have already priced in the potential risk of climate-related stranded fossil fuels or investors believe that governments will not limit the production of coal (Batten et al., 2016).

Whether the return predictability patterns of equities extend to bonds is an open question given the markedly different clienteles for equities and bonds. Bond investors may expect carbon risk to affect bond credit spreads in three ways. First, according to the carbon risk premium hypothesis, bond issuers with high carbon risk may be subject to future climate policy constraints and face technology risk from renewable energy firms. Thus, carbon risk may be positively priced in a cross-section of bond credit spreads. Seltzer et al. (2020) find that carbon regulations significantly affect the yield of corporate bonds and that investors charge higher yields to issuers with greater environmental risk.

Second, from a market inefficiency perspective, carbon risk may not be fully integrated by most investors, who by force of habit look at future cash-flow projections. The findings of Pedersen et al. (2021) imply that financial markets may price carbon risk inefficiently. The findings of In et al. (2017) show that the stocks of low carbon intensity firms significantly outperform those of high carbon intensity firms since 2010, consistent with the investor underreaction hypothesis. Duan et al. (2020) find evidence to support the bond market underreaction assumption that most investors and credit analysts do not fully integrate carbon risk.

Finally, according to the disinvestment hypothesis, bonds issued by carbon-intensive firms are shunned by socially responsible or ethical investors to such an extent that these issuers have higher credit spreads. Pedersen et al. (2021) propose a theory in which a positive carbon risk premium arises because of exclusionary screening by institutional investors with an ESG mandate. To the extent that this occurs, risk sharing is limited, and idiosyncratic risk may be priced. That is, there may be a higher return premium for bond issuers with high carbon risk if there is a high degree of disinvestment by institutional investors. However, Duan et al. (2020) find no support for the disinvestment hypothesis in the bond market. Bolton and Kacperczyk (2021) also argue that the economic effect of disinvestment is relatively modest, and they conjecture that certain institutions, such as insurance companies, investment advisers and pension funds, are more likely to face investor pressure, and thus they avoid high-emissions companies, as opposed to mutual funds and hedge funds, which are natural arbitrageurs. Krueger et al. (2020) find that institutional investors do not divest when faced with climate risks but actively engage in climate risk management. Similarly, Huynh and Xia (2021) find that bond investors do not abandon carbon-intensive issuers and continue to invest in bonds with higher climate change news betas to hedge against climate risk.

Investors focus on the default risk of the issuer when evaluating bond credit spreads, and carbon regulatory risk increases firms' risk of default (Capasso et al., 2020). Issuers with high carbon risk are vulnerable to increasingly stringent carbon regulation. Strengthened regulation of such issuers can include actions such as shutting them down, imposing a deadline for emissions reduction and imposing large fines. Admittedly, carbon regulations bring uncertainty and risk to the ongoing operations of bond issuers, reducing their financing sources, profitability and cash flow and thus increasing the difficulty of making debt service payments.

However, the risks associated with the carbon transition can increase uncertainty for firms (Delis et al., 2018). Although carbon risk directly increases the survival risk of bond issuers, it also provides an opportunity for a green transformation. Issuers can invest the funds raised in green projects to achieve clean production and gain the advantages of a green transformation. However, green projects have long durations, high costs and high risks, which may increase the information asymmetry between the issuer and investors. Meanwhile, the issuer's increased investment in emissions reduction also increases the cost of daily operations. Thus, bond issuers that focus on economic performance are likely to invest the funds raised in lucrative but risky carbon projects, leading to a divergence in the carbon-related objectives of investors and bond issuers. Investors are indirectly exposed to carbon risk by holding bonds, and they expect issuers to actively participate in carbon risk management, comply with carbon emissions regulations and meet recognized industry standards. However, issuers invest in carbon-intensive projects that typically externalize pollution, and the corresponding risk is transferred back to the firm as carbon regulation increases. Moreover, if a carbon-intensive project loses money, investors bear the risk of default.

Overall, the risks associated with carbon regulations and low-carbon transitions motivate investors to incorporate carbon risk into their investment decisions and demand a higher risk premium for credit bonds, consistent with the carbon risk premium hypothesis. Based on this analysis, we formulate our research hypothesis as follows:

Hypothesis 1. The higher an issuer's carbon risk is, the higher its bond credit spread is.

3. Sample and empirical strategy

3.1. Sample and data source

Our sample includes corporate debentures, enterprise bonds and corporate medium-term notes issued by Chinese firms during the 2009–2017[1] period. We obtain data on these bonds and the issuing firms from the Wind and CSMAR databases. We exclude observations from financial issuers, ST issuers and bonds rated by foreign rating agencies. We also remove observations with missing values, such as incomplete financial or industry information. Our final sample contains 3,074 bond issuers, 10,694 credit bonds and 30,347 credit rating observations. All of the continuous financial variables are winsorized at the 1st and 99th percentiles to reduce the influence of extreme values.

[1] As the Pilot Scheme for Issuance of Corporate Bonds was implemented in August 2007 and the issuance of medium-term notes began in April 2008, our sample begins in 2009.

3.2. Variables and empirical models

Our baseline tests examine the relation between carbon risk and bond credit spreads using the following specification (Nguyen and Phan, 2020; Seltzer et al., 2020):

$$CS_{it} = \alpha_0 + \alpha_1 Carbon\ Risk_{it} + \alpha_i Controls_{it} + \varepsilon_{it} \tag{1}$$

where i and t index firms and years, respectively. The dependent variable is the bond credit spread (*CS*), expressed as the difference between the expected yield of the bond and the yield of the Treasury bond with the same remaining maturity, and the bond credit spread for a given year is equal to the average credit spread for all trading days that year (Shi et al., 2021).

The lack of firm-level carbon-related data, such as greenhouse gas emissions or energy consumption, typically results in a small sample size and prevents researchers from drawing valid inferences or generalizing their findings. Moreover, even if carbon emissions data were available, it would reflect current or past carbon performance. Therefore, to solve the small sample problem, we define *Carbon Risk* according to the carbon emissions of the issuer's industry (Nguyen and Phan, 2020). We identify high carbon risk issuers using the *List of Listed Companies' Environmental Verification Industry Classification and Management*. For bond issuers in the 16 industries[2] with high carbon risk, such as the thermal power, pulp and paper and fermentation industries, *Carbon Risk* is assigned a value of 1; otherwise, it is set to 0 (Chang and Zeng, 2019). As an issuer's industry classification does not change with variations in its firm characteristics over time, this helps alleviate the concern that an issuer may decide on its level of carbon risk exposure conditional on its bond issuance costs. Furthermore, to address the possibility that industry classifications may pick up the effects of industry characteristics other than carbon risk, such as business risk, we control for industry fixed effects and other time-varying determinants of the cost of bond issuance in Eq. (1). The t-statistics are based on robust standard errors clustered at the firm level.

Controls is a vector of control variables, and *Year*, *Industry* (*Issuer*), *Agency* and *Bond-type* are year, industry (issuer), rating agency and bond-type fixed effects, respectively. For the issuer-level control variables, we use firm size, leverage, profitability, operating income growth rate, SOE, and audit quality. For the bond-level control variables, we use credit rating, bond issue volume, issue term and whether the issue is guaranteed (Wu et al., 2020). Detailed definitions of the variables are provided in Table 1.

3.3. Descriptive statistics

Table 2 provides the summary statistics of the main variables shown in Table 1. The mean value of *Carbon Risk* is 0.1287, indicating that 12.87% of the bond issuers in the sample have carbon risk. The mean value of *CS* is 2.2984, suggesting that overall, there is some default risk in general credit bonds relative to Treasury yields, reflecting a certain risk premium. For the control variables, the mean value of *Credit Rating* is 11.0509, indicating that most of the issuers in the sample have high credit ratings, mainly AA and AA+. The mean (maximum) value of *Lev* is 57.72% (86.77%), implying that the most of issuers are highly leveraged. The mean value of *ROA* is 2.72%, indicating that most of the issuers are not highly profitable. The mean values of *Size*, *Turnover* and *Growth* are 24.6461, 22.48% and 16.35%, respectively.

4. Empirical results

4.1. Baseline multivariate regression results

Table 3 presents the results for the effect of carbon risk on bond credit spreads. As shown in column (1), the coefficient of *Carbon Risk* is −0.2443, suggesting a negative association between carbon risk and bond credit spreads. However, the coefficient is positive and significant at the 1% level in column (2) with firm fixed effects included, suggesting that greater carbon risk is associated with higher bond credit spreads. This result also

[2] The following are the 16 high-polluting industries: thermal power, iron and steel, cement, electrolytic aluminum, coal, metallurgy, building materials, mining, chemical, petrochemical, pharmaceutical, brewing, paper, fermentation, textiles and tannery.

Table 1
Variable definitions.

Variable	Label	Definition
Dependent variable	*CS*	The difference between expected bond yields and Treasury yields
Independent variable	*Carbon risk*	An indicator variable that equals 1 if a bond issuer is in one of the 16 high carbon risk industries, such as thermal power, pulp and paper or fermentation, and 0 otherwise
Issuer-level control variables	*Size*	The natural logarithm of total assets
	Lev	Total debt/total assets
	ROA	Earnings/total assets
	Growth	(Operating income – prior period operating income)/prior period operating income
	Turnover	Operating income/total assets
	Cash	(Monetary cash + financial assets held for trading)/total assets
	Property	The net value of fixed assets/total assets
	SOE	An indicator variable that equals 1 if the issuer is a state-owned firm and 0 otherwise
	Big4	An indicator variable that equals 1 if the issuer's financial report is audited by an international Big 4 accounting firm and 0 otherwise
	Opinion	An indicator variable that equals 1 if the issuer receives a standard unqualified opinion and 0 otherwise
Bond-level control variables	*Credit Rating*	Issuer bond ratings from CCC to AAA, with "+" and "–" for fine tuning, and assignments 1–12 for low to high ratings
	Maturity	The natural logarithm of the bond issue term
	Proceeds	The natural logarithm of the bond issue amount
	Guarantee	An indicator variable that equals 1 if the bonds are pledged, secured or guaranteed and 0 otherwise

Table 2
Summary statistics.

Variable	N	Mean	Median	Std. Dev.	Min.	Max.
Carbon Risk	30,347	0.1287	0.0000	0.3349	0.0000	1.0000
CS	30,347	2.2984	2.1651	1.0850	0.4528	7.5793
Credit Rating	30,347	11.0509	11.0000	1.0112	0.0000	12.0000
Size	30,166	24.6461	24.3765	1.3784	22.2299	28.7648
Lev	30,347	0.5772	0.5934	0.1467	0.1260	0.8677
ROA	30,347	0.0272	0.0210	0.0223	–0.0061	0.1165
Growth	30,347	0.1635	0.0866	0.4158	–0.6237	2.4393
Turnover	30,068	0.2248	0.0877	0.3019	0.0071	1.6123
Cash	30,166	0.0983	0.0878	0.0631	0.0052	0.3319
Property	30,166	0.1288	0.0429	0.1796	0.0000	0.7476
SOE	30,242	0.8994	1.0000	0.3008	0.0000	1.0000
Big4	29,899	0.058	0.0000	0.2337	0.0000	1.0000
Opinion	29,899	0.9813	1.0000	0.1353	0.0000	1.0000
Maturity	30,347	1.7842	1.9459	0.3552	1.0986	2.7081
Proceeds	30,347	6.9355	6.9078	0.6638	5.2983	8.8537
Guarantee	30,347	0.4740	0.0000	0.4993	0.0000	1.0000

Note: This table presents the descriptive statistics for the variables in the main tests. The variable definitions are provided in Table 1.

suggests that certain time-invariant variables omitted from the regression negatively affect both carbon risk and bond credit spreads and thus, bias the coefficient estimate of *Carbon Risk* downward. Including firm fixed effects removes the effects of such time-invariant omitted variables, and the coefficient estimate of *Carbon Risk* is higher (i.e., it becomes positive and marginally significant; He and Tian, 2013). The literature identifies several time-varying firm characteristics that directly affect bond credit spreads. Omitting these characteristics from the regression could also lead to biases. In column (3), we add a set of controls that are documented in the literature as important determinants of bond credit spreads: firm size, leverage, profitability, operating income growth rate, SOE, audit quality, rating, bond issue volume, issue term and whether the issue is guaranteed. The coefficient estimate of *Carbon Risk* is still statistically significant but much more positive at 0.1268. In column (4), we further include firm fixed effects, and the coefficient estimate of *Carbon Risk* remains positive

Table 3
Carbon risk and bond credit spreads.

Variable	CS			
	(1)	(2)	(3)	(4)
Carbon Risk	−0.2443*	0.6561***	0.1268*	0.7335***
	(−1.72)	(3.12)	(1.90)	(3.52)
Credit Rating			−0.2928***	−0.1546***
			(−15.44)	(−3.86)
Size			−0.1231***	−0.0490
			(−9.96)	(−0.87)
Lev			0.5179***	−0.3119*
			(6.26)	(−1.83)
ROA			−5.3714***	−4.1896***
			(−9.93)	(−3.93)
Growth			−0.0065	0.0042
			(−0.49)	(0.31)
Turnover			0.2160***	−0.5340***
			(5.03)	(−3.25)
Cash			−1.3729***	−1.1193***
			(−9.06)	(−5.03)
Property			−0.3426***	0.0764
			(−4.92)	(0.35)
SOE			−1.4088***	−0.0776
			(−30.31)	(−0.60)
Big4			−0.1837***	0.1136
			(−3.71)	(0.50)
Opinion			−0.5316***	−0.5354***
			(−6.26)	(−3.83)
Maturity			−0.3335***	−0.3412***
			(−8.97)	(−5.53)
Proceeds			−0.1346***	−0.0587**
			(−6.99)	(−2.36)
Guarantee			−0.0804***	−0.1022**
			(−2.90)	(−2.07)
_cons	2.4501***	2.3342***	12.0121***	7.4022***
	(85.14)	(86.34)	(49.85)	(5.39)
Year	Yes	Yes	Yes	Yes
Industry	Yes	No	Yes	No
Agency	Yes	Yes	Yes	Yes
Bond-type	Yes	Yes	Yes	Yes
Issuer	No	Yes	No	Yes
R^2	0.1131	0.6570	0.3410	0.6660
Adj. R^2	0.1122	0.6206	0.3400	0.6302
N	30,347	30,347	29,792	29,792

Note: This table provides the results for the effect of carbon risk on bond credit spreads. The t-statistics based on standard errors clustered at the firm level are reported in brackets. The variable definitions are provided in Table 1. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

and significant at the 1% level with a slightly larger magnitude (i.e., 0.7335). In economic terms, the bond credit spread is 4.1072% higher for high carbon risk issuers, compared with low carbon risk issuers. These results support our hypothesis that the higher an issuer's carbon risk is, the higher its bond credit spread is, suggesting that investors think carbon policies have a stronger negative effect on bond issuers with high carbon risk when regulations are more strictly enforced.

Regarding the control variables, larger and more profitable issuers and those with higher credit ratings have lower credit spreads (Hu et al., 2019).

Table 4
Robustness tests.

Panel A: Alternative measure of carbon risk

Variable	CS						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Carbon Emission	0.0713**	0.0779***					
	(2.19)	(3.14)					
CO_2 Emission			0.7337***				
			(3.36)				
CSR				−0.2634*	−0.2535*		
				(−1.73)	(−1.75)		
ESG						−0.0559***	−0.0725***
						(−4.34)	(−3.44)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	No	No	Yes	No	Yes	No
Agency	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bond-type	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Issuer	No	Yes	Yes	No	Yes	No	Yes
R^2	0.3804	0.7065	0.6658	0.4725	0.7342	0.4750	0.7350
Adj. R^2	0.3790	0.6628	0.6301	0.4655	0.6928	0.4680	0.6937
N	19,924	19,924	29,792	3,342	3,342	3,342	3,342

Panel B: Difference-in-Differences: The Paris Agreement

Variable	CS							
			PSM		PSM-DID		CEM	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Carbon Risk	−0.2115	0.3444	0.2475**	0.6810***	−0.2937	0.3380	0.2689**	1.2631***
	(−1.43)	(1.46)	(2.11)	(2.94)	(−1.37)	(1.16)	(2.14)	(2.77)
Carbon Risk*Paris	0.3593***	0.4132***			0.4520**	0.3571*		
	(2.87)	(3.19)			(2.35)	(1.84)		
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	No	Yes	No	Yes	No	Yes	No
Agency	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bond-type	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Issuer	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.3415	0.6665	0.4059	0.7264	0.4133	0.7268	0.4762	0.7549
Adj. R^2	0.3405	0.6308	0.4018	0.6687	0.4089	0.6691	0.4609	0.6783
N	29,792	29,792	6,140	6,140	6,140	6,140	1,303	1,303

Panel C: Other robustness tests

Variable	CS				
	Additional control variables		Different fixed effects		Placebo test
	(1)	(2)	(3)	(4)	(5)
Carbon Risk	0.1636*	0.7504***	0.1297*	0.6801***	0.0001
	(1.91)	(3.57)	(1.95)	(2.97)	(0.01)
Bond index	−0.0040***	−0.0111***			
	(−2.99)	(−7.61)			
Per-GDP	−0.0000**	−0.0000***			
	(−1.99)	(−3.78)			
GDP-growth	−0.2792	0.3110***			
	(−1.46)	(2.73)			
Marketization	−0.1024***	−0.0288			
	(−7.47)	(−0.97)			

(continued on next page)

Table 4 (*continued*)

Panel C: Other robustness tests					
Variable	CS				
	Additional control variables		Different fixed effects		Placebo test
	(1)	(2)	(3)	(4)	(5)
Controls	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	No	No
Bond-type	Yes	Yes	Yes	No	Yes
Agency	Yes	Yes	Yes	No	Yes
Issuer	No	Yes	No	Yes	Yes
Year*Agency	No	No	Yes	No	No
Year*Issuer	No	No	No	Yes	No
R^2	0.3647	0.6672	0.3457	0.7690	0.8033
Adj. R^2	0.3636	0.6337	0.3434	0.6382	0.7836
N	29,791	29,602	29,792	29,792	29,602

Note: This table presents several robustness tests, including an alternative measure of carbon risk, a difference-in-differences analysis, the addition of omitted variables, different fixed effects and a placebo test. "Controls" indicates whether the regression contains the control variables: *Credit Rating*, *Size*, *Lev*, *ROA*, *Growth*, *Turnover*, *Cash*, *Property*, *SOE*, *Big4*, *Opinion*, *Maturity*, *Proceeds* and *Guarantee*. The t-statistics based on standard errors clustered at the firm level are reported in brackets. The variable definitions are provided in Table 1. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

4.2. Potential endogeneity and robustness checks

We conduct several tests to verify the robustness of our results. First, we classify issuers into high and low carbon risk firms according to median industry coal consumption. Columns (1) and (2) in Panel A of Table 4 show the results based on the actual industry coal consumption measure of carbon risk, and the coefficient of *Carbon Emission* is significantly positive at least at the 5% level. Then, we identify issuers in the six high-energy-consuming industries as high carbon risk issuers (CO_2 *Emission*) based on the CO_2 emission factor.[3] The results in column (3) show that the coefficient of CO_2 *Emission* is significantly positive, indicating that bond financing costs are higher for issuers with high carbon emissions. Although an industry-based classification of heavy and light emitters mitigates the small sample size issue caused by the lack of firm-level carbon emissions data, our results may merely capture industry effects rather than firms' exposure to carbon risk. To rule out this possibility, we rerun our tests using two alternative proxies for firm-level carbon risk. Given that the level of carbon emissions is an important criterion for firms' ESG ratings, we use ESG ratings as an assessment of issuer carbon risk (Seltzer et al., 2020; Wang and Mai, 2019; Liu and Lu, 2019). On the one hand, we select the evaluation score of Social Responsibility Report for Listed Companies (*CSR*) released by Hexun.com, which presents ESG factors in a more detailed way from five evaluations: shareholder responsibility, employee responsibility, supplier, customer and consumer rights responsibility, environmental responsibility, and social donation responsibility. On the other hand, we also adopted the ESG rating (*ESG*) published by SynTao Green Finance as a measure of carbon risk at the firm level. Columns (4) to (7) of Table 4 Panel A show the results using these alternative measures of carbon risk, and the coefficients of *CSR* and *ESG* are significantly negative, indicating that environmentally friendly issuers have lower bond credit spreads.

Second, firms' exposure to carbon risk and bond credit spreads may be jointly determined by or correlated with unobservable firm characteristics. To mitigate this potential endogeneity, we exploit a shock that increased the climate regulatory risks faced by issuers without changing either their performance or environmental

[3] According to the Second Biennial Update on Climate Change in the People's Republic of China 2018 approved by the State Council, the six major energy-consuming industries are (1) petroleum processing, coking and nuclear fuel processing industries, (2) chemical raw materials and chemical products manufacturing industries, (3) non-metallic mineral products industries, (4) ferrous metal smelting and rolling processing industries, (5) non-ferrous metal smelting and rolling processing industries and (6) electricity, heat power production and supply industries.

profile, that is, without affecting firms' fundamentals. Thus, we use the Paris Agreement, announced on 12 December 2015, as an exogenous shock. The Paris Agreement's primary goal is to limit global temperature rise in this century to 1.5 degrees Celsius above pre-industrial levels. It calls for the signing countries to submit national action plans that will reduce emissions with sufficient speed to achieve that goal. Such plans imply the development of more stringent environmental regulations as such national action plans need to include regulatory responses to induce firms to help achieve the climate goal. We hypothesize that the Paris Agreement subjects issuers with high carbon risk to greater carbon regulatory risk relative to other firms and that this effect is reflected in their bond spreads. To test this hypothesis, we conduct difference-in-differences analyses to compare changes in the credit spreads of bonds from issuers with high carbon risk with those of other issuers before and after the Paris Agreement.

We use the following Eq. (2):

$$CS_{it} = \alpha_0 + \alpha_1 Carbon\ Risk_{it} \times Paris_t + \alpha_2 Carbon\ Risk_{it} + \alpha_3 Paris_t + \alpha_i Controls_{it} + \varepsilon_{it} \quad (2)$$

where $Paris_t$ is a dummy variable that equals 1 for years after 2015 and 0 otherwise. Panel B of Table 4 displays the results of the difference-in-differences regressions. In column (1), firm and time fixed effects are controlled, and bonds from issuers with high carbon risk, on average, experience an increase of 39.53 basis points in bond spread following the Paris Agreement relative to other bonds. The results in column (2) demonstrate that the results are similar with or without firm fixed effects. The increase in carbon regulatory risk leads to higher bond spreads and thus, these issuers' cost of bonds rises relative to that of more environmentally friendly issuers. These results are consistent with research showing that environmental policies are related to firms' debt costs (Chava, 2014).

To exclude the influence of differences in firm characteristics and to test the robustness of our baseline results, we create treatment and control groups using the propensity score matching (PSM) approach. Using firm size (*Size*), leverage (*Lev*) and return on assets (*ROA*), we perform one-to-one nearest neighbor matching to construct matched pairs in which the firms' characteristics are as similar as possible. The results in columns (3) to (6) show that our results are robust. It is difficult to achieve equilibrium when matching covariates using the PSM approach. Therefore, we use a coarsened exact matching (CEM) method that does not require the covariates to be balanced and has less model dependence (Connelly et al., 2017). Columns (7) and (8) show the regression results using the CEM sample, which are generally consistent with the results in Table 3.

To mitigate potential endogeneity driven by omitted variables, we further include regional economic development, marketization and other urbanization variables: regional GDP per capita (*Per-GDP*), GDP growth rate (*GDP-growth*) and regional marketization level (*Marketization*). Columns (1) and (2) in Panel C of Table 4 show the regression results, and the coefficient of *Carbon Risk* is significantly positive at least at the 10% level, showing that our findings remain robust after controlling for various observable omitted variables.

Third, we change the model fixed effects. Although we control for time, industry, rating agency and firm fixed effects in Eq. (1), the internal structures and external environments of rating agencies and issuers change over time, leading to differences in the development of rating agencies and issuers. Such differences may affect bond credit spreads. Therefore, we further control for differences over time in rating agencies and issuers, and the results in columns (3) and (4) in Panel C of Table 4 show that the coefficient of *Carbon Risk* remains significantly positive.

Finally, we conduct a set of placebo tests to address the concern that our observed results are driven by unobservable time-variant characteristics. Conceptually, we randomly assign values to high carbon risk issuers. The advantage of this randomization is that we retain the effects of time-variant characteristics in our data structure. If our findings are mainly driven by carbon risk, our baseline results should be much stronger than the estimates from the placebo tests. Column (5) in Panel C presents the results of randomizing *Carbon Risk*. The coefficient of *Carbon Risk* is 0.0001, which is only 0.01% of the coefficient in column (4) of Table 3, indicating that the identified effect of carbon risk on bond credit spreads is not driven by randomness. We also plot the distribution of 200 estimated coefficients and their associated p-values (un-tabulated); the results are concentrated near zero, and most of the estimates have a p-value greater than 0.1.

4.3. Possible channels

Identifying the channels of the effect is important because policy recommendations are based on the relevant channels. We propose three channels through which carbon risk affects bond credit spreads: credit risk, rating agency messaging and how the funds raised are invested.

4.3.1. Credit risk channel

Default risk is a key factor affecting bond credit spreads. Capasso et al. (2020) find that firms with larger carbon footprints are relatively more exposed to progressively stricter climate regulations, and thus their future cash flows are likely to be affected to a greater extent than those of firms with smaller carbon footprints. Lower expected cash flows imply lower firm asset values, which in turn leads to a lower perceived ability to repay debt and thus reduced creditworthiness. To test this channel, we use the firms' Z-score[4] values to measure the risk of issuer default (Altman, 1968). We classify issuers into two groups with high and low default risk, according to the Z-score quartiles, and perform group tests (Nguyen and Phan, 2020).

4.3.2. Information transmission channel

Rating agencies, as financial gatekeepers, are an important reference for investors, who make decisions based on agencies' ratings. Seltzer et al. (2020) find that regulatory changes are considered in credit rating analysts' evaluations of the potential effects of climate risk on firms' default risk. Rating agencies use carbon risk to form a forward-looking opinion of issuers' default risk, which helps reduce information asymmetry in the capital market (Chang and Zeng, 2019; Capasso et al., 2020). In doing so, rating agencies focus on carbon risk information that affects the risk of bond default and reduce firms' credit ratings to alert investors to increased risk. To test this channel, we first explore whether rating agencies reduce the credit ratings of high carbon risk issuers. Then we divide the issuers into high and low groups according to the median credit rating and conduct group tests.

4.3.3. Investment channel

The greenness of how bond proceeds are used is an important factor for investors in pricing bonds. Issuers that invest bond proceeds in green projects are noticed by stakeholders, including environmental regulators, the public and investors, which reduces environmental regulatory pressure on the issuer, reducing the potential for lawsuits and fines for environmental violations. However, carbon regulations result in carbon-intensive firms being unable to use most of their fossil fuel reserve assets, leaving them stranded (Delis et al., 2018). Restrictions on fossil fuel use can pose a significant financial risk to issuers. Issuers focused on economic performance are likely to continue to invest the funds raised in carbon-intensive projects that are lucrative and involve significant carbon risk. These projects increase issuers' environmental litigation costs, reducing their cash flow for debt service. As a result, investors require higher bond credit spreads as compensation. To test this channel, we use the proportion of bonds invested in green projects (*Real green*), as identified by China Central Depository & Clearing Co., Ltd. (CCDC) and CECEP Consulting Co., Ltd., and test the issuers grouped according to whether they invested the bond proceeds in green projects.

Table 5 shows the results for the tests of the channels through which carbon risk affects bond credit spreads. We follow the research design of Dessaint et al. (2017) to examine the channels. The results in Panel A of Table 5 show that relative to low carbon risk issuers, high carbon risk issuers have greater credit risk, lower credit ratings and a smaller proportion of green investment projects. Columns (1) and (2) in Panel B show the results for the test of the credit risk channel. The extent to which carbon risk increases bond credit spreads is more significant in the high default risk group, and the difference between the groups is significant at the 1% level. Columns (3) and (4) in Panel B show the results for the tests of the rating agency information transmission channel, which are nonsignificant, suggesting that the information transmission channel is not relevant. This indicates that the market does not have immediate access to more information through credit ratings.

[4] The formula is $Z = 6.56 * X1 + 3.26 * X2 + 1.00 * X3 + 6.72 * X4$, where $X1$ = working capital/total assets, $X2$ = retained earnings/total assets, $X3$ = EBIT/total assets and $X4$ = firm book value/book leverage.

Table 5
Channel tests.

Panel A: Carbon Risk and Credit Risk, Credit Ratings and Capital Investment

Variable	Z-score (1)	Credit Rating (2)	Real green (3)
Carbon Risk	−0.4291***	−0.1816***	−5.2680***
	(−2.79)	(−6.82)	(−7.77)
Controls	Yes	Yes	Yes
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Agency	Yes	Yes	Yes
Bond-type	Yes	Yes	Yes
R^2	0.2371	0.5027	0.0595
Adj. R^2	0.2360	0.5020	0.0581
N	29,792	29,792	29,792

Panel B: Channel test: credit risk, credit rating and investment of funds raised

Variable	CS					
	(1) Q1 Z-score	(2) Q4 Z-score	(3) CreditRating (>M)	(4) CreditRating (<M)	(5) Realgreen = 0	(6) Realgreen = 1
Carbon Risk	0.3259*	0.1515	0.7094**	0.7796***	0.4986***	−0.1675
	(1.82)	(1.18)	(2.54)	(4.73)	(2.67)	(−1.12)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	No	No	No	No	Yes	Yes
Agency	Yes	Yes	Yes	Yes	Yes	Yes
Bond-type	Yes	Yes	Yes	Yes	Yes	Yes
Issuer	Yes	Yes	Yes	Yes	No	No
Diff		0.601***		0.070		0.261***
R^2	0.7737	0.6941	0.6466	0.6625	0.6991	0.5343
Adj. R^2	0.7176	0.6108	0.6073	0.6109	0.6534	0.5121
N	7,559	7,309	20,112	9,680	19,059	815

Note: This table reports the tests of the channels through which carbon risk affects bond credit spreads including the credit risk channel, information transmission channel and investment channel. "Controls" indicates whether the regression includes the control variables: *Credit Rating*, *Size*, *Lev*, *ROA*, *Growth*, *Turnover*, *Cash*, *Property*, *SOE*, *Big4*, *Opinion*, *Maturity*, *Proceeds* and *Guarantee*. The t-statistics based on standard errors clustered at the firm level are reported in brackets. The variable definitions are provided in Table 1. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Columns (5) and (6) in Panel B show the results for the investment channel;[5] when bond funds are invested in non-green projects, investors demand a higher risk premium from high carbon risk issuers. Overall, our empirical results suggest that the credit risk and investment channels, rather than the information transmission channel, explain the relationship between carbon risk and bond credit spreads.

4.4. Cross-sectional tests

4.4.1. Financing constraints

Bond financing is an important source of exogenous financing. Firms with severe financing constraints have difficulty obtaining bond financing (Agrawal and Matsa, 2013). Carbon risk increases the financing constraints of issuers, pushing them to reduce their investment in carbon risk management and discouraging them

[5] The subsample of firms that used bond proceeds for green projects is small, and *Carbon Risk* is omitted after controlling for firm fixed effects. To make columns (5) and (6) in Panel B of Table 5 comparable, we do not control for firm fixed effects.

Table 6
Carbon risk, financing constraints and credit spreads.

Variable	CS	
	(1)	(2)
Carbon Risk	0.2925**	0.7301***
	(2.41)	(2.84)
SA	0.0245	−0.0172
	(0.52)	(−0.41)
Carbon Risk*SA	0.0876	0.7517***
	(0.84)	(3.52)
Controls	Yes	Yes
Year	Yes	Yes
Industry	Yes	No
Bond-type	Yes	Yes
Agency	Yes	Yes
Issuer	No	Yes
R^2	0.3426	0.6689
Adj. R^2	0.3415	0.6333
N	29,792	29,792

Note: This table presents the estimation results for the moderating effects of financial constraints. "Controls" indicates whether the regression includes the control variables: *Credit Rating*, *Size*, *Lev*, *ROA*, *Growth*, *Turnover*, *Cash*, *Property*, *SOE*, *Big4*, *Opinion*, *Maturity*, *Proceeds* and *Guarantee*. The t-statistics based on standard errors clustered at the firm level are reported in brackets. The variable definitions are provided in Table 1. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 7
Carbon risk, regional enforcement efforts and credit spreads.

Variable	CS			
	(1)	(2)	(3)	(4)
Carbon Risk	0.1633***	0.6412***	−0.0952	−0.0087
	(5.02)	(3.01)	(−0.64)	(−1.53)
HighReg	−1.1641***	0.0198***		
	(−5.31)	(4.38)		
Carbon Risk*HighReg	0.1740***	0.0242**		
	(5.12)	(2.45)		
PITI			−0.0184***	0.0006
			(−17.09)	(0.33)
Carbon Risk*PITI			0.0047*	0.3325***
			(1.95)	(2.86)
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Industry	Yes	No	Yes	No
Agency	Yes	Yes	Yes	Yes
Bond-type	Yes	Yes	Yes	Yes
Issuer	No	Yes	No	Yes
R^2	0.3361	0.6663	0.3687	0.6639
Adj. R^2	0.3351	0.6305	0.3677	0.6278
N	29,792	29,792	29,612	29,612

Note: This table presents the estimation results for the moderating effect of regional enforcement efforts. "Controls" indicates whether the regression contains the control variables: *Credit Rating*, *Size*, *Lev*, *ROA*, *Growth*, *Turnover*, *Cash*, *Property*, *SOE*, *Big4*, *Opinion*, *Maturity*, *Proceeds* and *Guarantee*. The t-statistics based on standard errors clustered at the firm level are reported in brackets. The variable definitions are provided in Table 1. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 8
Carbon risk, green transformation and credit spreads.

Variable	CS			
	(1)	(2)	(3)	(4)
Carbon Risk	0.7204***	0.7305***	0.3929***	0.6880***
	(3.75)	(3.51)	(2.63)	(3.09)
Green bond	0.2080			
	(0.65)			
Carbon Risk*Green bond	−0.2739*			
	(−1.85)			
S-Green		0.0031		
		(0.06)		
Carbon Risk*S-Green		0.2176		
		(1.15)		
Green			−2.2695***	
			(−4.63)	
Carbon Risk*Green			−1.4014***	
			(−2.70)	
Carbon Risk*CDM				−0.4711**
				(−2.49)
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Agency	Yes	Yes	Yes	Yes
Bond-type	Yes	Yes	Yes	Yes
Issuer	Yes	Yes	Yes	Yes
R^2	0.6663	0.6663	0.6662	0.6628
Adj. R^2	0.6308	0.6304	0.6305	0.6268
N	30,206	29,792	29,792	29,792

Note: This table presents the estimation results for the moderating effect of green transformation. "Controls" indicates whether the regression contains the control variables: *Credit Rating*, *Size*, *Lev*, *ROA*, *Growth*, *Turnover*, *Cash*, *Property*, *SOE*, *Big4*, *Opinion*, *Maturity*, *Proceeds* and *Guarantee*. The t-statistics based on standard errors clustered at the firm level are reported in brackets. The variable definitions are provided in Table 1. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

from switching to carbon-efficient technologies (Nguyen and Phan, 2020). Following this analysis, we predict that the positive effect of carbon risk on credit spreads is more pronounced for financially constrained issuers.

We introduce an interaction between carbon risk and firm financial constraints (i.e., *Carbon Risk*SA*) into Eq. (1) to examine the interactive effect on bond credit spreads. The SA index is widely used to measure financial constraints (Hadlock and Pierce, 2010) and is calculated as follows: $SA = -0.737 \times Size + 0.043 \times Size^2 - 0.04 \times Age$, where *Age* is the firm age of the bond issuers. The coefficient of *Carbon Risk*SA* in column (1) of Table 6 is 0.0876 but not significant. The coefficient of *Carbon Risk*SA* in column (2) is significantly positive at the 1% level, indicating that the positive effect of carbon risk on bond financing costs is stronger for financially constrained issuers.

4.4.2. Regional enforcement efforts

Areas with strict environmental enforcement have better environmental performance than areas with less strict enforcement (Bao et al., 2013). For example, green credit policies enhance green innovation (Wang and Wang, 2021). Environmental legislation also induces firms to internalize environmental costs (Ji and Su, 2016). The reserve assets of high carbon risk firms are likely to become stranded assets (Delis et al., 2018). Specifically, firms in areas with strict regulatory conditions are more likely to face heightened carbon regulatory risk. Consequently, we test the hypothesis that the effect of an issuer's environmental profile on their bond credit spread is stronger when regulatory risks are heightened.

To test the influence of regional enforcement efforts, we use two related variables as moderators: *HighReg*, which shows the number of local green finance regulations (Seltzer et al., 2020), and *PITI*, which represents the pollution source regulatory information disclosure index of the issuer's location. A high value for *PITI* indi-

Table 9
Reversal during the COVID-19 pandemic.

Variable	CS			
	(1)	(2)	(3)	(4)
Carbon Risk	0.0216	0.0402**	−0.1123	0.1127*
	(0.70)	(2.17)	(−1.16)	(1.69)
COVID-19 Shock	−0.1599***	−0.0202	−0.2544***	−0.0627
	(−5.08)	(−1.09)	(−6.46)	(−1.27)
Carbon Risk*COVID-19 Shock	−0.1124***	0.0244	−0.1596***	−0.1132**
	(−2.95)	(1.09)	(−3.57)	(−2.38)
Controls	Yes	Yes	Yes	Yes
Industry	Yes	No	Yes	No
Agency	Yes	Yes	Yes	Yes
Bond-type	Yes	Yes	Yes	Yes
Season	Yes	Yes	No	No
Issuer	No	Yes	No	Yes
R^2	0.3424	0.8384	0.3365	0.8233
Adj. R^2	0.3414	0.8203	0.3349	0.7988
N	24,561	24,561	14,416	14,416

Note: This table presents the estimation results for the effects of the COVID-19 pandemic. "Controls" indicates whether the regression contains the control variables: *Credit Rating*, *Size*, *Lev*, *ROA*, *Growth*, *Turnover*, *Cash*, *Property*, *SOE*, *Big4*, *Opinion*, *Maturity*, *Proceeds* and *Guarantee*. The t-statistics based on standard errors clustered at the firm level are reported in brackets. The variable definitions are provided in Table 1. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

cates more transparent and comprehensive information disclosure and strict local enforcement. The coefficients of *Carbon Risk*HighReg* in columns (1) and (2) of Table 7 are significantly positive at least at the 5% level, and the coefficients of *Carbon Risk*PITI* in columns (3) and (4) are significantly positive at least at the 10% level. These results support our hypothesis that bond investors consider carbon regulatory risk when estimating bond costs, suggesting that strict enforcement forces bond issuers to internalize pollution costs (Ji and Su, 2016; Seltzer et al., 2020).

4.4.3. Green transformation

Investors pay attention to the green transformations of bond issuers, rewarding green and low-carbon issuers while punishing those with high emissions. First, issuers can signal their green transformation to investors by issuing green bonds. There is an issue discount for green bonds relative to other bonds (Hachenberg and Schiereck, 2018; Zerbib, 2019; Wang et al., 2020). Agliardi and Agliardi (2021) find that green bonds are more valuable than brown bonds because they have lower default risk and they increase market liquidity, alleviate financial market dysfunction, and increase financial stability. The funds raised by green bonds are invested in environmentally friendly projects, which reflects the social responsibility of the issuers and mitigates the effect of carbon risk on bond credit spreads. We include green bonds (*Green bonds*) in the sample and identify substantial green bonds[6] (*S-Green*) according to CCDC and CECEP to test the effect of carbon risk on the bond credit spreads of different bond types. The coefficient of *Carbon Risk*Green bonds* in column (1) of Table 8 is −0.2739 and is significant at the 10% level, indicating that the degree of a bond's greenness mitigates the positive effect of carbon risk on its credit spread. The coefficient of *Carbon Risk*S-Green* in column (2) is 0.2176 and insignificant, indicating that substantial green bonds do not mitigate the positive effect of carbon risk on bond credit spreads, suggesting that investors are not currently paying attention to non-labeled green bonds. Therefore, enhanced information disclosure of firms' green footprints is needed to reduce information asymmetry with investors.

Second, issuers can increase the greenness of their main business to enact a green transformation. For example, more and more power firms are working to become carbon neutral by introducing renewable energy sources, such as distributed photovoltaic systems, energy storage technologies and smart grids. Therefore, we

[6] Green bonds that are not specifically labeled as such but raise funds to invest in green industries.

Table 10
Market reaction to the carbon peak and carbon neutral announcement.

Variable	CAR(−5, 5)	CAR(−3, 3)	CAR(−1, 1)
	(1)	(2)	(3)
Means test	−0.0290***	−0.0290***	−0.0106*
	(−4.83)	(−4.83)	(−1.80)
N	103,880	103,880	47,220

Note: This table presents the market response to the introduction of the carbon peak and carbon neutral goals. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

identify green-transformation issuers (*Green*) using the Green Industry Guidance Catalogue (2019 version) and assign a value of 1 to this variable if the main business of an issuer is the focus of green development, such as the energy conservation and environmental protection industry, the clean production industry, the clean energy industry, the ecological and environmental industry, green upgrading of infrastructure or green services, and 0 otherwise. The coefficient of *Carbon Risk*Green* in column (3) of Table 8 is significantly negative at the 1% level, indicating that the firms' green transitions mitigate the effect of carbon risk on bond credit spreads.

Finally, issuers can seek transformation through participation in the CDM, which promotes low-carbon transitions and carbon-emission reductions in China's power sector (Stua, 2013). Registering CDM projects enhances firms' reputations (Lin et al., 2016). Therefore, issuers that have registered CDM projects are more likely to make a green transition, which can mitigate the effect of carbon risk on their bond credit spreads. *CDM* is an indicator variable that equals 1 if the issuers have registered CDM projects and 0 otherwise. The coefficient of *Carbon Risk*CDM* in column (4) of Table 8 is significantly negative at the 5% level, indicating that investors can distinguish issuers pursuing a green transformation and claim a lower risk premium.

5. Additional analyses

5.1. Impact of COVID-19

Next, we examine whether the changes in credit spreads reverse if the market expects carbon regulatory requirements to decrease in the future. The outbreak of COVID-19 in January 2020 was a "black swan" event that significantly weakened the focus on environmental and climate issues and forced the postponement of many relevant international conferences, including the UN Climate Conference. Moreover, neither CSR nor ESG effectively protected shareholder wealth from the crisis (Hu, 2020; Bae et al., 2021; Demers et al., 2021). The COVID-19 pandemic has negatively affected firms' revenue and profitability, but the intensive introduction of various financial support measures[7] has provided support for the affected firms. Moreover, at the policy level, regulators have tried to help issuers withstand the difficulties by relaxing regulatory requirements on carbon emissions and improving the financing environment. Therefore, we expect the effect of carbon risk on bond credit spreads to weaken or even reverse during the COVID-19 pandemic.

We test this hypothesis by treating the start of the COVID-19 pandemic in January 2020 as an exogenous shock. *COVID-19 Shock* equals 1 for observations after January 2020 and 0 otherwise. Columns (1) and (2) of Table 9 show the regression results using subsamples[8] from 1 year before and after the onset of the COVID-19 pandemic. The coefficient of *Carbon Risk*COVID-19 Shock* in column (1) is significantly negative at the 1% level, but the coefficient of *Carbon Risk*COVID-19 Shock* in column (2) is no longer significant after controlling for firm fixed effects. Columns (3) and (4) show the regression results for the 6 months before and after the

[7] For example, on 31 January 2020, the Central Bank and five other departments jointly issued the Notice on Further Strengthening Financial Support for the Prevention and Control of COVID-19. Various departments have also introduced measures to increase financial support for affected firms. For example, issuers are allowed to issue new bonds to repay old bonds, set up green channels and communicate with investors during COVID-19.

[8] The subsample is quarterly data. *Season* is quarterly fixed effects.

start of the COVID-19 pandemic, and the coefficient of *Carbon Risk*COVID-19 Shock* is significantly negative at least at the 5% level. We find evidence of a reversal, with credit spreads for high carbon risk issuers decreasing by 11.3 basis points relative to low carbon risk issuers during the COVID-19 pandemic.

5.2. Carbon peak and carbon neutral

Due to the realities of China's situation, General Secretary Xi Jinping announced at the General Debate of the 75th Session of the United Nations General Assembly that "China will strive to peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060." These carbon peak and carbon neutral targets present new opportunities and challenges for the low-carbon operation of firms. The low-carbon transformation is an important opportunity to break the inertia of development and reshape core competitiveness. For example, large, traditional power generation firms are gradually expanding their wind power and photovoltaic operations and are gaining financial support by issuing carbon neutral bonds for hydropower and wind power stations. However, the carbon neutrality goal will be followed by tightened environmental laws and regulations. Reducing carbon emissions and firms' carbon footprints may become basic environmental governance requirements for issuers, yet most issuers lack the internal capacity to calculate and assess their carbon footprint. In addition, there are bottlenecks in the development of carbon absorption technology, and the carbon peak and carbon neutral goals will be achieved mainly by subtraction (i.e., reducing the production of high emissions).

We use the event study method to explore the effect of the carbon peak and carbon neutral targets on the bond market. Specifically, 22 September 2020, is defined as the event date. We use a market model to calculate the abnormal returns (*AR*) and cumulative abnormal returns (*CAR*) for each day of the event (Dodd and Warner, 1983; Yang and Liu, 2018).

$$AR_{i,t} = R_{i,t} - \hat{R}_{i,t} = R_{i,t} - \hat{\alpha}_{i,t} - \hat{\beta}_{i,t}MR_t \tag{3}$$

$$CAR_{i,\tau,T} = \sum_{t=\tau}^{T} AR_{i,t} \tag{4}$$

where R is the daily bond return and MR is the daily increase or decrease of the SSE 5-year credit bond index (full price), which represents the daily return of the bond market. Subscript i represents each bond, and t represents the number of days. $\hat{\alpha}_{i,t}$ and $\hat{\beta}_{i,t}$ are the model parameters obtained from the market model. $CARi,\tau,_T$ represents the cumulative abnormal return of bond i from day τ to day T. We use an estimation window from 210 days before to 21 days before the event. The event window periods are (−1, 1), (−2, 2) and (−5, 5).

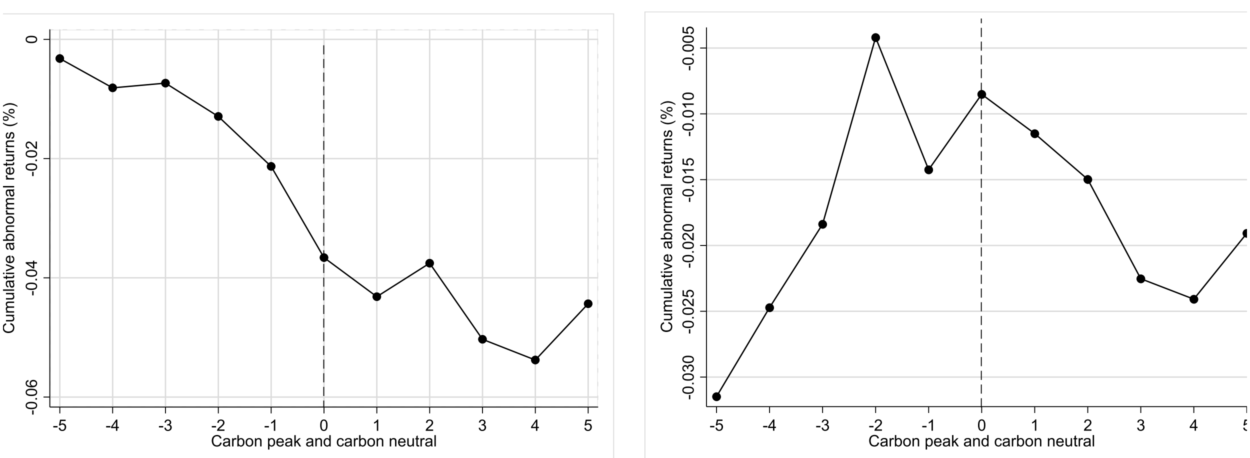

Fig. 1. Market reaction to the announcement of the carbon peak and carbon neutral goals.

Table 10 shows that *CAR* is −0.0290%, −0.0290% and −0.0106% during the event windows of (−1, 1), (−2, 2) and (−5, 5), respectively, and these coefficients are significant at least at the 10% level. This indicates that the introduction of the carbon peak and carbon neutral targets had a significant negative impact on the bond market, but this negative effect gradually reduced after the announcement.

Fig. 1 plots the cumulative abnormal returns for the bond market as a whole and for high carbon risk issuers during the period around the announcement of the carbon peak and carbon neutral targets. The bond market achieved a cumulative abnormal return of more than −0.04% during the period when the targets were proposed (Fig. 1, left). During the same period, the high carbon risk issuers received a cumulative abnormal return of more than −0.03% (Fig. 1, right), suggesting that the introduction of the carbon peak and carbon neutral targets has renewed investors' focus on carbon risk. However, the overall negative shock is less significant, probably because the high carbon risk issuers must reduce their carbon emissions in the short term, which is mainly achieved by controlling production to reduce emissions. If production is restricted but demand is not reduced, the earnings of high carbon risk issuers will improve.

5.3. Carbon risk and production scale

Whether firms actively address carbon emissions depends on the cost-benefit trade-off. In the short term, the costs of reducing carbon emissions are greater than the benefits, so issuers will not take the initiative to reduce carbon emissions. However, to reduce the costs associated with carbon regulations, issuers may suspend some of their high carbon-emission production activities, leading to a reduction in production scale. In addition, more and more investors focus not only on issuers' ability to repay debt but also on the social and environmental effects of issuers' actions (Han et al., 2017). Martin and Moser (2016) find that firms with better social and environmental performance are more likely to receive investor support. However, once an issuer has environmental pollution problems, it may become the focus of public opinion, which directly affects investors' risk expectations of the issuer causing them to demand a higher risk premium (Chava, 2014). To prevent this from happening, issuers try to control their carbon emissions as much as possible. With investors' environmental awareness gradually increasing, carbon reduction facilities and innovative green technologies are becoming more and more expensive, making it difficult for issuers to achieve clean production in the short term. Issuers responding to restrictive measures by introducing advanced energy-efficient equipment and investing in green innovation may crowd out investments in production technology. As a result, issuers with high carbon risk may be forced to scale back production.

Table 11
Carbon risk and production scale.

Variable	Growth			
	(1)	(2)	(3)	(4)
Carbon Risk	−0.0477***	−0.0064	−0.0343	−0.2394***
	(−2.83)	(−0.10)	(−1.05)	(−3.41)
Carbon Risk*Paris			−0.2471***	−0.2503***
			(−5.20)	(−3.25)
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Industry	Yes	No	Yes	No
Agency	Yes	Yes	Yes	Yes
Bond-type	Yes	Yes	Yes	Yes
Issuer	No	Yes	No	Yes
R^2	0.0204	0.2915	0.0204	0.2933
Adj. R^2	0.0190	0.2158	0.0190	0.2178
N	29,792	29,792	29,792	29,792

Note: This table provides the results of the effect of carbon risk on production scale. "Controls" indicates whether the regression contains the control variables: *Credit Rating*, *Size*, *Lev*, *ROA*, *Turnover*, *Cash*, *Property*, *SOE*, *Big4*, *Opinion*, *Maturity*, *Proceeds* and *Guarantee*. The t-statistics based on standard errors clustered at the firm level are reported in brackets. The variable definitions are provided in Table 1. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Issuers with high carbon risk face increasingly strict regulations on carbon emissions and have fewer factor inputs for production due to limited resources. Since the Paris Agreement, carbon regulation has resulted in issuers having greater carbon compliance costs than carbon emissions governance costs. Therefore, to minimize costs, high carbon risk issuers may scale back their production activities for compliance purposes.

We use the change in operating revenue from the previous period to the current period to measure the change in firms' production scale (*Growth*; Liu and Zhang, 2018). The coefficient of *Carbon Risk* in column (1) of Table 11 is significantly negative at the 1% level. In column (2), further controls for firm fixed effects are included, and the coefficient of *Carbon Risk* is −0.0064 but not significant. The coefficients of *Carbon Risk*Paris* in columns (3) and (4) are both significantly negative at the 1% level, indicating that the implementation of the Paris Agreement has not significantly increased high carbon risk issuers' motivation to reduce carbon emissions but instead has led to a negative coping behavior of scaling down production. As issuers' marginal cost of carbon emissions reduction is greater than the marginal benefits in the short term, their motivation to participate in carbon governance may be low.

5.4. Carbon risk and corporate capital structure

The relation between carbon risk and capital structure is unclear ex ante. One view is that firms with high carbon risk will invest in cleaner technologies in the future and thus access external capital markets to increase bond financing. For example, Kovacs et al. (2020) find that firms headquartered in states with finalized state climate adaptation plans (SCAPs) increase their net financial leverage significantly more in the post- SCAP adaptation period than firms in neighboring states without SCAPs. Such firms also take on greater long-term leverage following the finalization of SCAPs, suggesting that firms adjust their capital structure to address the long-term impacts of climate change and meet their long-term financing needs.

Another view is that high carbon risk firms with high fixed costs, which increase the risk of financial distress, reduce their financial leverage. Nguyen and Phan (2020) find that the Kyoto Protocol ratification led to a decrease in financial leverage for heavy carbon emitting firms and that such decrease is more pronounced for financially constrained firms. Ginglinger and Moreau (2019) find that greater climate risk leads to lower leverage in the post-2015 period (i.e., after the Paris Agreement). High climate risk firms tend to have higher loan spreads, especially for bank loans, which suggests that the debt reduction related to climate risk is partly due to lenders becoming increasingly aware of climate risks.

Table 12
Carbon risk and capital structure.

Variable	Short-lev			Long-lev		
	(1)	(2)	(3)	(4)	(5)	(6)
Carbon Risk	0.0621***	0.0535***		−0.0630***	−0.0543***	
	(8.41)	(3.80)		(−8.54)	(−3.86)	
Carbon Risk*Paris		0.0577***	0.0534***		−0.0585***	−0.0533***
		(5.87)	(7.82)		(−5.97)	(−7.85)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	No	Yes	Yes	No
Agency	Yes	Yes	Yes	Yes	Yes	Yes
Bond-type	Yes	Yes	Yes	Yes	Yes	Yes
Issuer	No	No	Yes	No	No	Yes
R^2	0.4356	0.4326	0.8872	0.4370	0.4340	0.8884
Adj. R^2	0.4344	0.4315	0.8728	0.4358	0.4329	0.8742
N	22,773	22,773	22,773	22,769	22,769	22,769

Note: This table provides the results for the effect of carbon risk on corporate capital structure. "Controls" indicates whether the regression includes the control variables: *Credit Rating*, *Size*, *Lev*, *ROA*, *Growth, Turnover*, *Cash*, *Property*, *SOE*, *Big4*, *Opinion*, *Maturity*, *Proceeds* and *Guarantee*. The t-statistics based on standard errors clustered at the firm level are reported in brackets. The variable definitions are provided in Table 1. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

The foregoing discussion demonstrates the need for an empirical analysis of how to adjust the capital structure of high carbon risk issuers. To do this, following Kovacs et al. (2020), we classify financial leverage into short-term financial leverage (*Short-lev*) and long-term financial leverage (*Long-lev*). The coefficient of *Carbon Risk* in column (1) of Table 12 is significantly positive at the 1% level, indicating that issuers with high carbon risk improve their short-term financial leverage. Column (2) considers the effects of the Paris Agreement, and the coefficient of *Carbon Risk*Paris* is significantly positive at the 1% level. Column (3) adds corporate fixed effects, and the coefficient of *Carbon Risk*Paris* remains significantly positive at the 1% level, indicating that high carbon risk issuers improve their short-term financial leverage after the Paris Agreement. The coefficient of *Carbon Risk* in column (4) is significantly negative at the 1% level, and the coefficients of *Carbon Risk*Paris* in columns (5) and (6) are both significantly negative at the 1% level. These results indicate that issuers with high carbon risk do not receive long-term financial support after the implementation of the Paris Agreement. They also suggest that carbon risk is a long-term challenge. Moreover, investors not only price bonds according to carbon risk but also divest their portfolios of bonds from issuers with high carbon risk.

6. Conclusion

Using a 2009–2019 sample of Chinese bond issuers, we examine whether carbon risk affects bond credit spreads. Our results reveal a significant increase in bond credit spreads for issuers with high carbon risk. The findings remain robust after a series of robustness tests with alternative measures of the main variables, PSM-DID models, additional control variables and alternative fixed effects. We propose three possible channels to explain the relationship between carbon risk and bond credit spreads: credit risk, information transfer from credit rating agencies and how the raised funds are invested. Our empirical results suggest that the credit risk and investment channels are stronger than the information transfer channel. That is, carbon risk leads to an increased risk of default by bond issuers and high carbon risk issuers are likely to invest the funds raised in non-green projects, both of which prompt investors to demand a higher risk premium.

Moreover, we analyze whether the positive association between carbon risk and bond credit spreads varies with cross-sectional characteristics, specifically, financing constraints, regional enforcement efforts and green transformation. We find that financing constraints and strict regional environmental enforcement strengthen the positive influence of carbon risk on bond credit spreads. Issuers can signal their green transitions to investors by issuing green bonds, increasing the greenness of their main business and participating in the CDM, thereby weakening the positive effect of carbon risk on bond credit spreads. In addition, we find that investors respond to policy changes that potentially affect carbon risk. During the COVID-19 pandemic, the effect of carbon risk on bond credit spreads was reversed because investors re-evaluated potential carbon regulations. However, the introduction of the carbon peak and carbon neutral targets have prompted investors to consider the carbon risk of bond issuers again, negatively affecting the bond market and resulting in cumulative abnormal returns of over −0.04%. Further analysis shows that issuers with high carbon risk have scaled back production, especially since the Paris Agreement, suggesting that the Paris Agreement has increased expectations of regulatory interventions to limit carbon emissions. Finally, we find that compared with issuers with low carbon risk, those with high carbon risk are less likely to receive long-term funding and more likely to receive short-term loans. Overall, we find that regulation-related carbon risk is reflected in bond credit spreads.

Our results have three policy implications. First, the government should consider dedicating resources to increase issuers' willingness to participate in carbon emissions reduction and achieve high-quality sustainable development. For example, (1) the government could help issuers actively transform their businesses and production processes with advanced technologies to reduce carbon emissions at the source; (2) regulators should accelerate supply-side structural reforms in the energy sector, actively promote the use of clean energy and subsidize issuers that use clean energy; and (3) to achieve peak carbon and carbon neutrality targets, regulators can encourage financial innovations such as the issuance of green and blue bonds.

Second, achieving carbon emissions reduction is not a short-term effort, and thus it requires not only stronger government supervision but also an active response from issuers. Issuers with high carbon risk could enhance creditors' confidence through low-carbon production and thus reduce their bond financing costs. In addition, they should strengthen corporate green governance and enhance green innovation by improving investment efficiency.

Third, to achieve the carbon peak and carbon neutral targets, investors should increase their awareness of carbon risk and establish corresponding risk management mechanisms to actively deal with it. Investors should develop a forward-looking financing plan to exit high carbon investments, gradually reduce their asset allocation to high carbon risk issuers and force high carbon risk issuers to make green transformations by increasing support for new energy technologies and efficient energy storage low-carbon projects.

Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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Directors' and Officers' liability insurance and bond credit spreads: Evidence from China

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ABSTRACT

Using hand-collected data on purchases of D&O insurance by Chinese listed firms for the period from 2008 to 2019, we empirically find that D&O insurance negatively associates with credit spreads. The negative relationship still holds after conducting a series of robustness tests and is not driven by the eyeball effect. We also show that D&O insurance can reduce credit spreads via the channels of internal controls, external monitoring, information asymmetry and default risk. Moreover, the negative effect of D&O insurance on credit spreads is more pronounced for non-state-owned firms, those located in regions with a low level of marketization or that employ rating agencies with a bad reputation. Our study complements the literature on the credit spreads and corporate governance.

1. Introduction

Directors' and officers' liability insurance (hereinafter referred to as "D&O insurance"), also known as "the General's Helmet," is a kind of professional liability insurance. With the purchase of D&O insurance, directors, supervisors and senior management are protected from personal liability if they are accused by shareholders and other stakeholders (e.g., creditors) of wrongdoing or misconduct. The insurance company will cover the cost of defense as well as civil liability for directors, supervisors and senior management, depending on the contract. Since its introduction in the 1930s, D&O insurance has become increasingly popular among firms in developed economies, with a coverage rate of 96%, 90% and 86% in the U.S., Europe and Canada,

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respectively. As for Asia, 88% of Singapore firms are covered by D&O insurance, followed by a coverage rate of 85% in Hong Kong, China and 60% in Taiwan, China.[1]

The development of D&O insurance is still in its early stages in mainland China. Although D&O insurance has been available since 2002, only 10% of A-share listed firms had purchased D&O coverage by the end of 2019.[2] As the terms of the D&O contracts in the Chinese market are a direct translation of the terms in foreign contracts, firms find it costly to understand the policies, especially with regard to the boundary of the insurer's liability. Chinese investors' reluctance to bring lawsuits also lowers the probability of claims being triggered against D&O policies due to management misconduct. This explains why the first claim occurred in 2011, almost 10 years after the launch of D&O insurance in the Chinese market. This may lead to a biased perception of the costs and benefits associated with D&O coverage. Furthermore, firms may hesitate to propose the purchase of D&O insurance in shareholder meetings if the shareholders misunderstand D&O insurance as being part of management compensation. In summary, the high cost of information and misunderstandings about D&O insurance reduce a firm's willingness to purchase it.[3]

However, the purchase of D&O insurance increased sharply in 2020 following Luckin's claim against Ping An China and other insurance companies when Luckin faced class actions for financial fraud from multiple U. S. law firms.[4] Furthermore, the revised "Securities Law of the People's Republic of China" in 2020 further strengthens investor protections.[5] The law not only clarifies and regulates the behaviors, obligations and responsibilities of managements in disclosing information but also increases the penalties for violations. The increased risks that managers are now taking on in discharging their duties may further increase the demand for D&O coverage, making it necessary to investigate more closely the effect of D&O insurance in emerging markets.

Despite the popularity of D&O insurance in developed capital markets, studies of its economic consequences remain inconclusive. Some scholars emphasize the positive impact of D&O insurance in reducing management risk aversion and alleviating agency problems (Holderness, 1990; Romano, 1991; Core, 1997; O'Sullivan, 1997), factors that benefit the insured companies. The opposite view holds that the purchase of D&O insurance may cause or aggravate moral hazard due to the lower opportunity cost for management, which ultimately decreases the firm's value (Lin et al., 2011; Lin et al., 2013; Chen et al., 2016).

When studying corporate governance in emerging markets such as China, it is necessary to consider the peculiarities of the institutional environment. Due to the highly concentrated ownership structure of Chinese corporations, the conflicts of interest between controlling and minority shareholders are much more severe than those in developed economies (Jiang and Kim, 2020). The monitoring functions of the supervisory board and independent directors, as well as labor unions, are fatally compromised (Xiao et al., 2004; Liu, 2010; Tang et al., 2013), because they are subjected to the influence of block shareholders and must deal with ineffective board governance, leading to investors' urgent calls for improved corporate governance.

The purchase of D&O insurance gives the insurers a stake in the insured firm. This means that the insurer may be motivated to monitor corporate governance and control some of the risks of the insured firm to restrain opportunistic behavior by management and reduce agency costs (Holderness, 1990; O'Sullivan, 1997; Yuan et al., 2016). D&O insurance also protects senior management from personal liability, which helps to retain or attract management talent and encourages managers to act in the best interests of the enterprise (Priest, 1987; Wang et al., 2020). Accordingly, given China's special institutional context, by providing empirical evidence from the Chinese bond market, in this paper we investigate whether D&O insurance improves corporate governance.

[1] The data are collected from https://www.eastmoney.com/.

[2] The first D&O insurance in China was a joint policy written for Vanke Co., Ltd. by Ping An Insurance (Group) Company of China and Chubb Insurance Group in 2002. The first case of D&O insurance compensation was in 2011, when AIG compensated GAC Changfeng with the sum of 0.8 million Chinese yuan after civil lawsuits about GAC Changfeng's accounting misstatements.

[3] According to the Code of Corporate Governance for Listed Companies in China, the resolution to purchase D&O insurance must be voted on and approved by shareholder meeting before it can take effect.

[4] By the end of 2019, only about 400 A-share listed firms in the Chinese capital market were covered by D&O insurance. However, there were about 170 new purchases of D&O insurance in 2020, accounting for almost half of the total number in 2019.

[5] A series of items, including investor suitability management, derivatives litigation and some securities litigation, have been supplemented in the revised "Security Law of the People's Republic of China.".

The Chinese bond market is increasingly important for enterprise financing, given its fast and constant development, but it is immature. Since 2013, the "three–phase superposition" has increased the downward pressure on China's economy and the economic environment faced by Chinese enterprises has deteriorated.[6] Since Chaori Solar Co., Ltd. defaulted on its bonds in 2014, 184 companies had defaulted on a total of 576 bonds with a face value of 5.1 trillion Chinese yuan by the end of 2020. In particular, in late 2020 the consecutive defaults of Brilliance Group followed by Yongmei Holdings seriously undermined investor confidence, leading to an increase in the risk premiums of corporate bonds.[7] Therefore, reducing the cost of debt financing is not only an urgent issue at the corporate level but also the key to preventing or resolving systemic financial risk and promoting steady economic development in China.

Studies use bond credit spreads as a measure of risk and identify reductions in credit spreads to gauge the effectiveness of corporate governance in protecting investors' interests (Bhojraj and Sengupta, 2003; Anderson et al., 2004; Tang et al., 2015; Gao et al., 2020). We therefore investigate whether bond market investors perceive D&O insurance coverage as an effective governance mechanism by examining the relationship between the purchase of D&O insurance and bond credit spreads. Using hand-collected data on the D&O insurance coverage of Chinese listed firms for the period from 2008 to 2019, we document how the purchase of D&O insurance is associated with narrower credit spreads. This negative association still holds after a series of robustness tests, including instrumentation, the Heckman two-stage procedure, propensity score matching (PSM), a placebo test, the use of alternative variables as well as several fixed effects models. Further analysis illustrates that the purchase of D&O insurance can reduce credit spreads via the channels of internal controls, external monitoring, information asymmetry and default risk. In addition, the negative impact of D&O insurance on credit spreads is more pronounced for non-state-owned enterprises (non-SOEs), firms that are located in regions with a low level of marketization or firms that employ rating agencies with a bad reputation. We also verify that the negative relationship is not driven by the eyeball effect.

Our study contributes to the literature in several ways. First, this study supplements the literature on the determinants of bond credit spreads. The literature not only identifies how external factors, such as the macroeconomic environment (Longstaff and Schwartz, 1995), analyst forecasts (Mansi et al., 2011) and media coverage (Gao et al., 2020) affect credit spreads, but also recognize the impacts of internal factors, including board structure (Anderson et al., 2004), personal traits of managers (Ma et al., 2021), internal controls (Tang et al., 2015) and leveraged buyouts (Eisenthal-Berkovitz et al., 2020). Our study examines how the purchase of D&O insurance affects credit spreads and further expands the literature on the determinants of bond credit spreads.

Second, our study enriches the literature that examine the economic consequences of D&O insurance. The literature investigates the impact of D&O insurance on M&A (Lin et al., 2011), diversification (Chi et al., 2013), investment efficiency (Li & Liao, 2014), audit pricing (Chung et al., 2015), the sensitivity of executive compensation to performance (Wang and Chen, 2016), loan spreads (Lin et al., 2013), the cost of equity (Chen et al., 2016), stock price crash risk (Yuan et al., 2016) and firm innovation (Wang et al., 2020). This study complements the literature by exploring how D&O insurance affects corporate bond credit spreads.

Third, our study enhances the understanding of D&O insurance as an effective governance mechanism by providing new evidence from an emerging market. The majority of the literature based on the situation in developed economies illustrates how D&O insurance negatively affects firm value through overinvestment, empire building behavior, lower post-acquisition performance, financial restatements and other opportunistic behaviors (Lin et al., 2011; Chi et al., 2013; Li and Liao, 2014; Weng et al., 2017). It is not clear how bond investors perceive D&O insurance when deciding credit spreads. Given the significant differences in both institutional contexts and D&O insurance coverage between China and developed countries (Jiang and Kim, 2020), it is necessary to explore how D&O insurance affects the corporate governance of Chinese firms. Our empirical study suggests that the purchase of D&O insurance can lower the cost of debt financing via the channels of internal governance, external supervision, information asymmetry and default risk.

[6] The "three–phase superposition" refers to the overlap of 3 phases including shift of economic growth, structural adjustment and the pre-stimulus digestion.

[7] The coupon rate of the "20 liantai 01" note issued by Guangdong liantai Group Co., Ltd. reached 6.5%, while the coupon rate of the "20 Jinhui 03" bond issued by Jinhui Group Co., Ltd. reached 6.95%.

The remainder of this study is organized as follows. Section 2 reviews relevant studies in the literature on D&O insurance and credit spreads. Section 3 develops our contrasting hypotheses. Section 4 describes the research methodology, variable definitions, and data. Section 5 presents the empirical results and explanations. Sections 6 to 8 provide robustness tests, channel analysis and further analysis, respectively. Section 9 concludes the paper.

2. Literature review

We explore the impact of D&O insurance on bond credit spreads from the perspective of corporate governance. The literature on the economic consequences of D&O insurance and the factors that influence credit spreads is reviewed, and contrasting hypotheses are developed accordingly.

Studies of the relationship between D&O insurance and corporate governance remain inconclusive. The main points are as follows. First, the purchase of D&O insurance may reduce managers' risk aversion by effectively transferring risk when making decisions (Romano, 1991; Core, 1997) and shielding managers from legal liability for wrongdoing when discharging their duties. This helps to attract or retain management talent (Priest, 1987) and encourages managers to dedicate themselves to innovation or some other activity that increases firm value. Second, the purchase of D&O insurance introduces insurers as external monitors of the insured firm, which restrains managerial opportunism and alleviates the agency conflicts between shareholders and management (Holderness, 1990; O'Sullivan, 1997). The literature shows that firms with D&O insurance coverage have more conservative earnings (Liao et al., 2016), better information disclosure (Li and Liao, 2014) and lower stock price crash risk (Yuan et al., 2016). However, the opposite view argues that D&O insurance may cause unintended moral hazard. D&O insurance protects management from litigation liability, weakens the deterrent effect of the law on managers and induces managerial opportunism. The literature based on developed capital markets indicates that D&O insurance coverage leads to higher M&A premiums, lower M&A synergy (Lin et al., 2011), reduced investment efficiency (Li and Liao, 2014), more empire building behavior through unrelated diversification (Chi et al., 2013), more financial restatements (Weng et al., 2017) and increases in the cost of debt and equity financing (Lin et al., 2013; Chen et al., 2016).

Credit risk significantly affects firms' cost of debt financing (Fisher, 1959) and is reflected in bond credit spreads. The literature explores both the internal and external factors that affect credit spreads. First, the macroeconomic environment systematically affects bond credit risk (Longstaff and Schwartz, 1995). For instance, an economic boom narrows the credit spread while uncertainty in economic policy significantly broadens it (Guha and Hiris, 2002). Second, the stakeholders, including analysts, institutional investors, banks, the media and labor unions, can influence credit spreads (Chen et al., 2011; Mansi et al., 2011; Cai et al., 2019; Ma et al., 2019; Gao et al., 2020). Third, firms' operating activities, such as innovation (Hsu et al., 2015), corporate social responsibility (CSR) disclosure (Gong et al., 2018) and the use of financial derivatives to hedge risk (Chen and King, 2014), can tighten credit spreads. Finally, studies investigating the impacts of ownership structure (Anderson et al., 2003), board structure (Anderson et al., 2004), internal controls (Tang et al., 2015), managerial characteristics (Ma et al., 2021) and Party organizations (Tong et al., 2021) attribute the decrease in bond credit risk to reduced information asymmetry via better corporate governance (Bhojraj and Sengupta, 2003).

In summary, studies demonstrate how to reduce credit spreads by improving corporate governance, whereas little is known about the effect of D&O insurance on bond spreads in the context of the Chinese institutional background. Therefore, we fill this gap by investigating how the purchase of D&O insurance affects corporate bond credit spreads.

3. Hypothesis development

The literature on the economic consequences of D&O insurance shows that there are conflicting views on how the purchase of D&O insurance affects bond credit spreads.

One view is that D&O insurance can reduce credit spreads through improved internal governance and enhanced external monitoring. First, D&O insurance covers management against legal liability as long as the executives perform their duties in the best interest of the firm. Such protection may attract talent with advanced management skills, which then strengthens the effectiveness and efficiency of internal governance (Priest, 1987). In addition, managers' risk tolerance will change to accept high-risk but valuable projects (Wang et al., 2008; Hwang and Kim, 2018), which in turn increases firm value, improves competitiveness and decreases bond default risk (Hsu et al., 2015). Second, D&O insurance introduces the insurer as an external supervisor, which restrains managerial opportunism and decreases agency costs (Holderness, 1990; O'Sullivan, 1997). D&O insurance works on a claims basis, which means that the insurer is obliged to cover the claims of a third party during the period of validity of the policy, even when the event leading to the litigation happens before the effective date of the policy. Therefore, insurance companies will carefully assess the overall riskiness of clients and conduct due diligence on executives before underwriting the policy. They may also reduce managerial opportunism through pricing and by drawing up specific clauses in the contract (Core, 1997). During the underwriting period, the insurer may continuously monitor both operations and managers' behaviors and prevent management from pursuing individual interests at the expense of the firm to reduce the risk of litigation by shareholders (Yuan et al., 2016). Third, management may improve information transparency to receive positive feedback from insurers and cut insurance premiums. Given the negative impact of information asymmetry on the cost of debt financing, the reduction of information asymmetry brought about by D&O insurance may lower the risk premium required by bond investors (Yu, 2005; Park and Wu, 2009). Finally, D&O insurance functions as risk control. D&O insurance is a component of liquidation assets if a firm files for bankruptcy, which lowers the probability of bond default and the cost of debt financing (Core, 1997; Zou and Adams, 2008).

The opposite view claims that the purchase of D&O insurance transfers potential litigation risk to the insurer and may induce more opportunism, thus increasing bond credit spreads. First, the purchase of D&O insurance may encourage aggressive financial policies, leading to more financial restatements (Weng et al., 2017), less conservative accounting (Chung and Wynn, 2008) and poorer information disclosure. In addition, the purchase of D&O insurance may encourage managers to behave irrationally (Chalmers et al., 2002), such as by overinvesting (Li and Liao, 2014), by paying higher M&A premiums (Lin et al., 2011) and by engaging in empire building behavior (Lin et al., 2011), all of which negatively affect firm value (Aguir and Aguir, 2020). Accordingly, bond investors will require higher risk premiums.

Therefore, we propose contrasting hypotheses regarding the impact of D&O insurance on bond credit spreads:

H1a: Ceteris paribus, the purchase of D&O insurance is negatively associated with bond credit spreads.
H1b: Ceteris paribus, the purchase of D&O insurance is positively associated with bond credit spreads.

4. Research design

4.1. Sample data

Our sample consists of corporate bonds and medium-term notes issued on the exchange or interbank market by companies listed on the Shanghai Stock Exchange and the Shenzhen Stock Exchange from 2008 to 2019. We choose 2008 as the beginning year of our sample for two reasons. First, the issuance of corporate bonds was initiated in late 2007. Second, the issuance of medium-term notes started after April 2008.

We manually collect D&O insurance coverage data from firms' annual reports and documents such as announcements by the board of directors and from shareholder meetings. The data on bond issuance are available from Wind and the data on corporate finance and governance are obtained from the China Stock Market and Accounting Research (CSMAR) database.

The sample construction process is as follows. First, we exclude financial firms as their reporting rules and capital structures differ from those of other companies. Second, we exclude floating-rate bonds as we cannot obtain the credit spread. We also exclude callable bonds given the uncertain influence of the embedded redemption option. After dropping observations with missing financial data or information on corporate governance, our sample consists of 7,783 bond-year observations, representing 2,301 bonds issued by 726 firms during the sample period. As shown in Fig. 1, 40.36% of the firms in the sample (that is, 293 out of 726 firms) issue only one bond while 0.69% of the firms (that is, five firms) issue more than 20 bonds.

4.2. Models

We construct the following model to empirically investigate the effect of D&O insurance on bond credit spreads.

$$CS_{i,t} = \beta_0 + \beta_1 Doins_{i,t} + \sum_{q=2}^{m} \beta_q (ControlVariable_{i,t}) + \delta_j + \tau_t + \varepsilon_{i,t} \quad (1)$$

The subscripts i and t stand for bond and year, respectively. β_1 represents regression the coefficient of interest and $\varepsilon_{i,t}$ is the error term. Our dependent variable $CS_{i,t}$ measures the credit spread. $Doins_{i,t}$ represents D&O insurance coverage. A negative (positive) β_1 suggests that D&O insurance leads to a decrease (increase) in the credit spread.

Three sets of controls are used in our model. The first set relates to the financial data of the sample firms, including firm size ($Size_{i,t}$), financial leverage ($Lev_{i,t}$), profitability ($ROA_{i,t}$), firm growth ($Growth_{i,t}$), operating cash flow ($CF_{i,t}$) and value of mortgaged assets ($Tang_{i,t}$). The second set controls for variations in corporate governance, including board size ($Board_{i,t}$), board independence ($Independent_{i,t}$) and CEO–chairman duality ($Dual_{i,t}$). The last set of controls refers to bond characteristics, including bond size ($BondSize_{i,t}$), bond maturity ($BondTerm_{i,t}$), the existence of collateral ($BondSecured_{i,t}$), put option embedding ($BondPut_{i,t}$) and bond credit ratings ($BondCredit_{i,t}$). Furthermore, we control for year fixed effects (τ_t) and industry fixed effects (δ_j) during the sample period. Appendix I summarizes the definitions of all of the variables used in our model.

4.3. Variable definitions

4.3.1. Explained variable: Bond credit spread

Following prior studies (Yu, 2005; Jiang, 2008; Chen et al., 2011; Byun et al., 2013; Gao et al., 2019), we define a bond credit spread ($CS_{i,t}$) as the difference in yield to maturity (YTM) between a corporate bond and the treasury bond with the closest maturity date. The yields of treasury bonds are obtained from the standard term information of the treasury bond yield curve published on ChinaBond.com.cn. Linear interpolation is used to calculate maturity if there is no close maturity match between treasury bonds and corporate bonds. In addition, we use alternative measures of bond credit spreads in robustness tests.

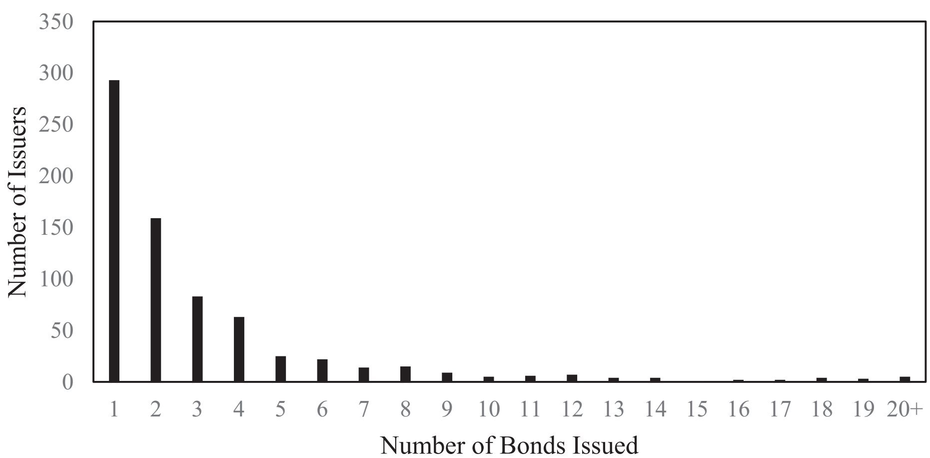

Fig. 1. Distribution of the number of bonds issued.

4.3.2. Explanatory variable: D&O insurance

The literature adopts two sets of D&O insurance measures (Lin et al., 2013; Chen et al., 2016). For continuous measurement, the intensity of D&O insurance coverage (the protection level of D&O insurance) is calculated using data on D&O insurance premiums (coverage). However, it is generally difficult to obtain this information given its lack of mandatory disclosure in the Chinese capital market. Following Jia et al. (2019), Yuan et al. (2016) and Zou et al. (2008), we adopt the dummy variable $Doins_{i,t}$ to measure D&O insurance, which equals 1 if a listed firm purchases D&O insurance and 0 otherwise.

4.3.3. Control variables

Drawing on the literature (Anderson et al., 2004; Gao et al., 2020; Tong et al., 2021), we use several sets of variables that affect bond credit spreads.

The first set relates to firms' financial characteristics. Large firms are usually associated with tighter bond credit spreads (Chen and King, 2014; Gao et al., 2020). Thus, we include the logarithm of total assets ($Size_{i,t}$) in the model. Chen and King (2014) and Gao et al. (2020) show that financial leverage is associated with wider bond credit spreads. We thus adopt the variable $Lev_{i,t}$, measured as total liabilities over total assets, to control for these effects. Given that greater profitability acts to tighten bond credit spreads (Chakravarty and Rutherford, 2017), we include $ROA_{i,t}$ as a control. Firm growth is also an important factor affecting bond credit spreads (Mansi et al., 2011; Jia et al., 2019; Tong et al., 2021); accordingly, we control for the operating revenue growth rate ($Growth_{i,t}$) in our model. Following Byun et al. (2013), we control for the impacts of operating cash flow ($CF_{i,t}$) and the value of mortgaged assets ($Tang_{i,t}$).

We adopt multiple corporate governance factors as the second set of controls. Among them, $Board_{i,t}$ is the natural logarithm of the total number of board members, $Independent_{i,t}$ is measured by the percentage of independent directors over the total number of board members. We also take into account the effect of CEO–chairmanCEO duality with the dummy variable $Dual_{i,t}$.

Moreover, we control for bond features. We measure bond size ($BondSize_{i,t}$) as the natural logarithm of the total issuance amount. Bond maturity ($BondTerm_{i,t}$) is measured as the natural logarithm of bond maturity at the observation point. $BondSecured_{i,t}$ is a dummy variable to control for the difference when a bond is secured with collateral. We also use the dummy variable $BondPut_{i,t}$ to control for the effect of put options embedded in bonds. The last bond feature is the credit rating. We construct the ordered variable $BondCredit_{i,t}$ by assigning values to different ratings. Specifically, $BondCredit_{i,t}$ equals 5 for AAA ratings, 4 for AA + ratings, 3 for AA ratings, 2 for AA- ratings and 1 for A + ratings. Detailed definitions of the variables can be found in Appendix I. To eliminate the effects of extreme values, we winsorize all continuous variables at the 1% and 99% levels.

5. Empirical results and discussion

5.1. Descriptive statistics

As shown in Panel A of Table 1, D&O insurance coverage increases continuously year on year. In Panel B, we report the distribution of D&O insurance coverage by industry. About 40.85% of the firms in the transportation, storage and postal industries purchase D&O insurance, followed by the mining sector with a coverage rate of 38.10%. Panel C of Table 1 provides descriptive statistics for the variables used in this study. $CS_{i,t}$ ranges from 0.2149% to 5.5162% and the average value is 2.2186%. The standard deviation of 1.4036% indicates a large variation in the credit risk of corporate bonds. Only about 19.77% of the firms in the sample have D&O insurance, illustrating the large differences in D&O coverage between China and developed economies. As for corporate finance controls, the average firm size is 24.3731, financial leverage is 60.97%, ROA is 2.89%, sales growth is 15.22% and operating cash flow is 4.5% of total assets. The average percentage of tangible assets is 44.61%. As for the boards of directors, the average board size is 2.2194, 38% of which are independent directors, while 82.06% of the firms have no CEO–chairman duality issue. With regard to bond features, the average issuance amount is 2.2814 with an average maturity of 0.7234. In addition, 30% of the bonds are issued with collateral and 45% have put options embedded. The average value of the credit rating is 3.9372. In Panel D, we report the results of the univariate analysis for the explained and control variables. The mean (median) of $CS_{i,t}$ is 1.5609 (1.3613) for insured firms and 2.3807 (2.0880) for firms without D&O

Table 1
Sample distribution and descriptive statistics.

Year	Insured firms ($Doins_{i,t} = 1$)	Uninsured firms ($Doins_{i,t} = 0$)	Total observations
Panel A: Sample Distribution by Year			
2008	12	39	51
2009	23	91	114
2010	30	133	163
2011	49	229	278
2012	86	389	475
2013	103	503	606
2014	109	560	669
2015	136	704	840
2016	195	927	1,122
2017	203	923	1,126
2018	256	923	1,179
2019	337	823	1,160
Total	1,539	6,244	7,783
Panel B: Sample Distribution by Industry			
Agriculture, forestry, animal husbandry and fishery	0	48	48
Mining	224	364	588
Manufacturing	452	2,495	2,947
Electricity, heat, gas and water production and supply	183	553	736
Construction	75	463	538
Wholesale and retail	53	314	367
Transport, warehousing and postal services	279	404	683
Accommodation and catering	0	6	6
Information transmission, software and information technology services	7	123	130
Real Estate	257	1,119	1,376
Leasing and business services	0	120	120
Scientific research and technology services	0	9	9
Water, environment and public facilities management	5	88	93
Residential services, repairs and other services	0	1	1
Health and social work	0	13	13
Culture, sports and entertainment industry	0	65	65
Comprehensive	4	59	63
Total	1,539	6,244	7,783

Panel C: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	P25	Median	P75	Max.
$CS_{i,t}$	7,783	2.2186	1.4036	0.2149	1.1853	1.9014	2.9887	5.5162
$Doins_{i,t}$	7,783	0.1977	0.3983	0.0000	0.0000	0.0000	0.0000	1.0000
$Size_{i,t}$	7,783	24.3731	1.5459	21.4402	23.1731	24.1587	25.4866	28.4820
$Lev_{i,t}$	7,783	0.6097	0.1540	0.2124	0.5024	0.6222	0.7308	0.8821
$ROA_{i,t}$	7,783	0.0289	0.0326	−0.1030	0.0131	0.0257	0.0432	0.1281
$Growth_{i,t}$	7,783	0.1522	0.2987	−0.4673	−0.0077	0.1048	0.2632	1.5114
$CF_{i,t}$	7,783	0.0450	0.0606	−0.1350	0.0115	0.0464	0.0824	0.1925
$Tang_{i,t}$	7,783	0.4461	0.1878	0.0431	0.3165	0.4456	0.5989	0.8349
$Board_{i,t}$	7,783	2.2194	0.2205	1.6094	2.0794	2.1972	2.3979	2.7081
$Independent_{i,t}$	7,783	0.3805	0.0645	0.3077	0.3333	0.3636	0.4286	0.6250
$Dual_{i,t}$	7,783	0.8206	0.3837	0.0000	1.0000	1.0000	1.0000	1.0000
$BondSize_{i,t}$	7,783	2.2814	0.8890	0.0000	1.6094	2.3026	2.8904	4.7005
$BondTerm_{i,t}$	7,783	0.7234	0.8822	−2.3167	0.3167	0.9102	1.3479	2.2407
$BondSecured_{i,t}$	7,783	0.2973	0.4571	0.0000	0.0000	0.0000	1.0000	1.0000
$BondPut_{i,t}$	7,783	0.4510	0.4976	0.0000	0.0000	0.0000	1.0000	1.0000
$BondCredit_{i,t}$	7,783	3.9372	1.0211	1.0000	3.0000	4.0000	5.0000	5.0000

Panel D: Univariate Analysis

Variable	Insured firms ($Doins_{i,t} = 1$)			Uninsured firms ($Doins_{i,t} = 0$)			t-value	chi^2 statistic
	Obs.	Mean	Median	Obs.	Mean	Median		
$CS_{i,t}$	1,539	1.5609	1.3613	6,244	2.3807	2.0880	−21.0993***	420.8020***
$Size_{i,t}$	1,539	25.4815	25.6209	6,244	24.0998	23.8810	33.6051***	687.3078***
$Lev_{i,t}$	1,539	0.6324	0.6588	6,244	0.6042	0.6156	6.4549***	30.2308***
$ROA_{i,t}$	1,539	0.0277	0.0250	6,244	0.0292	0.0261	−1.607	2.7629*
$Growth_{i,t}$	1,539	0.1229	0.1008	6,244	0.1594	0.1074	−4.3021***	1.744
$CF_{i,t}$	1,539	0.0578	0.0606	6,244	0.0418	0.0423	9.3626***	109.9127***
$Tang_{i,t}$	1,539	0.4562	0.4879	6,244	0.4436	0.4395	2.3645**	23.1865***
$Board_{i,t}$	1,539	2.2597	2.1972	6,244	2.2094	2.1972	8.0467***	133.7923***
$Independent_{i,t}$	1,539	0.3892	0.3636	6,244	0.3783	0.3636	5.9327***	24.2437***
$Dual_{i,t}$	1,539	0.9019	1.0000	6,244	0.8006	1.0000	9.3260***	.
$BondSize_{i,t}$	1,539	2.8059	2.7081	6,244	2.1521	2.1401	27.0253***	506.4293***
$BondTerm_{i,t}$	1,539	0.8335	0.9774	6,244	0.6963	0.8857	5.4767***	22.1031***
$BondSecured_{i,t}$	1,539	0.2619	0.0000	6,244	0.3061	0.0000	−3.3996***	11.5434***
$BondPut_{i,t}$	1,539	0.3093	0.0000	6,244	0.4859	0.0000	−12.5968***	155.5473***
$BondCredit_{i,t}$	1,539	4.5517	5.0000	6,244	3.7857	4.0000	27.6167***	762.7968***

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

insurance coverage. The difference is statistically significant at the 1% level, implying that insured firms have lower credit spreads than uninsured firms. In addition, significant differences exist among the control variables between the two groups.

5.2. Correlation matrix

Table 2 presents the correlation matrix across all variables, with the Pearson correlation shown in the bottom left and the Spearman correlation shown in the upper right. The results show that $Doins_{i,t}$ is significantly and negatively associated with $CS_{i,t}$. The correlation coefficients between the control variables are less than 0.8. We calculate the variance inflation factor (VIF) to further test the multicollinearity issue. The largest VIF is 3.35, well below the threshold value of 10. Thus, multicollinearity is unlikely to be a serious issue in our study.

5.3. Multivariate analysis

Table 3 presents the results of the baseline regression. Column (1) only includes the variable of interest and controls for year and industry fixed effects. In column (2), firm characteristics are added to the model. In column (3), we further control for the effects of bond features. The coefficients of $Doins_{i,t}$ in all columns are negatively associated with $CS_{i,t}$ and significant at the 1% level, thereby supporting H1a. The coefficient of $Doins_{i,t}$ in column (3) is −0.2977, illustrating a 29.77 basis point decrease in credit spreads for insured firms compared with uninsured firms. Given that the average bond credit spread is 2.22%, purchasing D&O insurance helps reduce the credit spread by 13.41%. In summary, purchasing D&O insurance benefits insured firms with strong external monitoring, by improving information transparency, reducing default risk and lowering credit spreads.

The coefficients for the control variables are generally consistent with prior studies (Gao et al., 2020; Tong et al., 2021). Firms with more assets, lower leverage, better profitability, lower growth, a higher value of mortgage assets, larger board size and greater board independence, separation of the roles of chairman and CEO, a larger bond issuance amount, longer bond maturity, higher bond credit ratings and no security clauses or put options embedded in their bonds are associated with tighter credit spreads.

Table 2
Correlation coefficient matrix.

Variable	$CS_{i,t}$	$Doins_{i,t}$	$Size_{i,t}$	$Lev_{i,t}$	$ROA_{i,t}$	$Growth_{i,t}$	$CF_{i,t}$	$Tang_{i,t}$	$Board_{i,t}$	$Independent_{i,t}$	$Dual_{i,t}$	$BondSize_{i,t}$	$BondTerm_{i,t}$	$BondSecured_{i,t}$	$BondPut_{i,t}$	$BondCredit_{i,t}$
$CS_{i,t}$	1	**−0.2490*****	−0.3228***	0.1117***	−0.2127***	−0.0059	−0.1882***	−0.0302***	−0.1268***	−0.0647***	−0.1368***	−0.3043***	−0.0867***	0.0344***	0.1764***	−0.4698***
$Doins_{i,t}$	**−0.2326*****	1	0.3482***	0.0675***	−0.0116	−0.0306***	0.1233***	0.0356***	0.0938***	0.0810***	0.1051***	0.2889***	0.0662***	−0.0385***	−0.1414***	0.3211***
$Size_{i,t}$	−0.2888***	0.3560***	1	0.4629***	−0.0219*	0.0897***	0.0673***	0.2386***	0.1975***	0.1408***	0.0329***	0.7026***	0.0702***	−0.1458***	−0.2388***	0.5772***
$Lev_{i,t}$	0.1313***	0.0730***	0.4157***	1	−0.4323***	0.0897***	−0.2655***	0.2939***	0.0183	0.0682***	−0.0293***	0.2351***	−0.0088	−0.0575***	−0.0079	0.0252**
$ROA_{i,t}$	−0.2257***	−0.0182	0.0043	−0.4213***	1	0.2363***	0.2994***	−0.1441***	0.0627***	−0.0635***	0.0322***	−0.0016	0.0355***	−0.0787***	−0.0406***	0.0986***
$Growth_{i,t}$	0.0217*	−0.0487***	0.0385***	0.0678***	0.1967***	1	0.0009	0.0135	−0.0055	−0.0001	−0.0536***	−0.0038	0.0093	−0.0449***	0.0523***	−0.0417***
$CF_{i,t}$	−0.1639***	0.1055***	0.0922***	−0.2521***	0.3127***	−0.0010	1	0.1323***	0.1836***	−0.0385***	0.0719***	0.1213***	0.0232**	0.0254**	−0.1309***	0.1630***
$Tang_{i,t}$	−0.0285**	0.0268**	0.2163***	0.2856***	−0.1107***	0.0047	0.1062***	1	0.1357***	−0.0757***	0.0654***	0.2260***	0.0801***	0.0447***	−0.0514***	0.0599***
$Board_{i,t}$	−0.1392***	0.0908***	0.2106***	0.0271**	0.0711***	−0.0212*	0.1721***	0.1401***	1	−0.4110***	0.1441***	0.1629***	0.0893***	−0.0187*	−0.1441***	0.1701***
$Independent_{i,t}$	−0.0808***	0.0671***	0.1843***	0.1053***	−0.0778***	−0.0105	−0.0552***	−0.0676***	−0.4449***	1	−0.1053***	0.1028***	0.0097	0.0266**	−0.0857***	0.1094***
$Dual_{i,t}$	−0.1511***	0.1051***	0.0341***	−0.0323***	0.0212*	−0.0549***	0.0725***	0.0623***	0.1506***	−0.1204***	1	0.0541***	0.0689***	0.0630***	−0.1053***	0.1312***
$BondSize_{i,t}$	−0.2902***	0.2929***	0.7018***	0.1996***	0.0230**	−0.0349***	0.1357***	0.2116***	0.1858***	0.1223***	0.0611***	1	0.1699***	0.0036	−0.1413***	0.5085***
$BondTerm_{i,t}$	−0.1333***	0.0620***	0.0793***	0.0055	0.0461***	0.0092	0.0075	0.0830***	0.0909***	0.0109	0.0540***	0.1555***	1	0.1445***	0.0711***	0.2381***
$BondSecured_{i,t}$	0.0278**	−0.0385***	−0.1319***	−0.0570***	−0.0654***	−0.0107	0.0179	0.0521***	−0.0085	0.0303***	0.0630***	0.0019	0.1191***	1	0.0437***	0.1805***
$BondPut_{i,t}$	0.1954***	−0.1414***	−0.2430***	−0.0095	−0.0485***	0.0618***	−0.1285***	−0.0511***	−0.1546***	−0.0856***	−0.1053***	−0.1542***	0.0500***	0.0437***	1	−0.2493***
$BondCredit_{i,t}$	−0.4413***	0.2988***	0.5281***	0.0080	0.0817***	−0.0804***	0.1468***	0.0547***	0.1787***	0.1272***	0.1241***	0.4737***	0.2323***	0.1645***	−0.2411***	1

Note: Lower triangular cells report Pearson's correlation coefficients, upper triangular cells are Spearman's rank correlation coefficients. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 3
The impact of D&O insurance on bond credit spreads.

Variable	(1)	(2)	(3)
$Doins_{i,t}$	−0.6774***	−0.3772***	−0.2977***
	(−20.65)	(−11.16)	(−9.15)
$Size_{i,t}$		−0.2905***	−0.0732***
		(−23.26)	(−4.22)
$Lev_{i,t}$		1.8434***	1.2918***
		(13.22)	(9.49)
$ROA_{i,t}$		−6.4890***	−6.0767***
		(−11.42)	(−11.01)
$Growth_{i,t}$		0.2154***	0.1005*
		(3.94)	(1.91)
$CF_{i,t}$		0.4598	0.2308
		(1.59)	(0.84)
$Tang_{i,t}$		−0.1374*	−0.1671**
		(−1.67)	(−2.10)
$Board_{i,t}$		−0.3187***	−0.2380***
		(−4.39)	(−3.43)
$Independent_{i,t}$		−1.9361***	−1.4421***
		(−7.47)	(−5.61)
$Dual_{i,t}$		−0.3534***	−0.2835***
		(−8.69)	(−7.21)
$BondSize_{i,t}$			−0.0849***
			(−3.68)
$BondTerm_{i,t}$			−0.0420**
			(−2.24)
$BondSecured_{i,t}$			0.2225***
			(7.18)
$BondPut_{i,t}$			0.1137***
			(3.88)
$BondCredit_{i,t}$			−0.4401***
			(−21.58)
Constant	3.2349***	11.2788***	7.7764***
	(14.76)	(31.93)	(19.45)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Observations	7,783	7,783	7,783
Adjusted R^2	0.1793	0.3064	0.3688

Note: The t-statistics are reported in brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

6. Robustness tests

In this section, we conduct several robustness tests to confirm the reliability of our results, including the instrumental variable (IV) approach, the Heckman two-stage procedure, PSM, entropy balance (EB), a placebo test, the use of alternative explained (explanatory) variables and alternative models.

6.1. Endogeneity issues

The results of our baseline regression confirm that the purchase of D&O insurance can effectively decrease bond credit spreads. However, such results may not be robust due to endogeneity issues. For instance, insurance companies are more likely to choose clients with low default risk. We therefore use three methods to address endogeneity concerns.

Table 4
IV regression analysis of the impact of D&O insurance on bond credit spreads.

Variable	First-stage regression $Doins_{i,t}$	Second-stage regressions $CS_{i,t}$		
		2SLS	GMM	LIML
$IndustryMean_{i,t}$	0.1423***			
	(14.52)			
$OverseaBack_{i,t}$	0.3474***			
	(4.20)			
$Doins_{i,t}$		−0.7926***	−0.7901***	−0.7929***
		(−4.25)	(−4.24)	(−4.25)
$Size_{i,t}$	0.0707***	−0.0337	−0.0336	−0.0337
	(12.82)	(−1.49)	(−1.48)	(−1.49)
$Lev_{i,t}$	0.1109***	1.3217***	1.3228***	1.3217***
	(3.09)	(9.55)	(9.56)	(9.55)
$ROA_{i,t}$	−0.4802***	−6.3859***	−6.3852***	−6.3861***
	(−3.31)	(−11.19)	(−11.19)	(−11.19)
$Growth_{i,t}$	−0.0314**	0.0883*	0.0882*	0.0883*
	(−2.32)	(1.65)	(1.65)	(1.65)
$CF_{i,t}$	0.1980***	0.3444	0.3424	0.3444
	(2.66)	(1.22)	(1.21)	(1.22)
$Tang_{i,t}$	−0.1626***	−0.2566***	−0.2566***	−0.2567***
	(−6.16)	(−2.92)	(−2.92)	(−2.92)
$Board_{i,t}$	−0.0714***	−0.2690***	−0.2686***	−0.2690***
	(−3.19)	(−3.79)	(−3.79)	(−3.79)
$Independent_{i,t}$	0.1057	−1.3964***	−1.3984***	−1.3964***
	(1.49)	(−5.38)	(−5.39)	(−5.38)
$Dual_{i,t}$	0.0822***	−0.2446***	−0.2444***	−0.2446***
	(8.93)	(−5.89)	(−5.88)	(−5.89)
$BondSize_{i,t}$	0.0150**	−0.0753***	−0.0755***	−0.0753***
	(2.08)	(−3.18)	(−3.19)	(−3.18)
$BondTerm_{i,t}$	0.0122**	−0.0346*	−0.0348*	−0.0346*
	(2.32)	(−1.82)	(−1.83)	(−1.82)
$BondSecured_{i,t}$	−0.0028	0.2176***	0.2179***	0.2176***
	(−0.29)	(6.85)	(6.86)	(6.85)
$BondPut_{i,t}$	−0.0245***	0.1009***	0.1012***	0.1009***
	(−2.72)	(3.38)	(3.39)	(3.38)
$BondCredit_{i,t}$	0.0224***	−0.4248***	−0.4250***	−0.4247***
	(4.16)	(−19.86)	(−19.87)	(−19.86)
Constant	−1.6724***	6.7377***	6.7394***	6.7371***
	(−12.41)	(12.56)	(12.57)	(12.56)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	7,758	7,758	7,758	7,758
Pseudo R^2/Adjusted R^2	0.2263	0.3510	0.3512	0.3510
F	118.78			
Sargan		0.1966	0.1966	0.1574
(P-value)		(0.6575)	(0.6575)	(0.6916)

Note: The t-statistics are reported in brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

6.1.1. IV approach

Our baseline results show that the purchase of D&O insurance helps tighten bond credit spreads. However, it could be argued that firms with higher credit risk are more inclined to purchase D&O insurance to attract more investors and lower the cost of debt. We implement the IV approach to mitigate endogeneity issues caused by reverse causality. Following the literature (Lin et al., 2011), we construct $IndustryMean_{i,t}$ (the mean of industry D&O insurance coverage for firms in the same year excluding the focal firm) as the first IV for a firm's purchase of D&O insurance for two reasons. First, to attract talented managers, enterprises may imitate competitors' purchase of D&O insurance. Second, firms in the same industry share similarities in economic cycle, operational risk and litigation risk from shareholders. Therefore, industry D&O insurance coverage may affect an individual firm's intention to purchase D&O insurance but not directly influence its default risk. We use the existence of independent directors with overseas work experience ($OverseaBack_{i,t}$) as the second IV. Given the prevalence of D&O insurance in overseas capital markets, independent directors with overseas work experience may better recognize potential risk while carrying out their duties, so they may decide to purchase D&O insurance to cover their potential litigation liability (Giannetti et al., 2015). Such work experience does not directly affect firms' default risk, thus meeting the requirements of relevance and exogeneity for IVs.

Three IV techniques are used, including two-stage least squares (2LSL), the generalized method of moments (GMM) and limited information maximum likelihood (LIML). The first-stage regression results in Table 4 show that both $IndustryMean_{i,t}$ and $OverseaBack_{i,t}$ are positively associated with the purchase of D&O insurance at the 1% significance level. With respect to IV validity, the weak instrument F-test of 118.78 is much larger than 10 and meets the relevance requirements. Additionally, the nonsignificant Sargan value of the overidentification test illustrates that our IVs are not correlated with the error terms, indicating that they will not affect credit spreads by means other than D&O insurance.

The coefficients of $Doins_{i,t}$ in the second-stage regression are statistically negative and significant at the 1% level among the three IV regression models. This further supports H1a that D&O insurance negatively affects credit spreads after addressing endogeneity issues.[8]

6.1.2. The Heckman two-stage model

Our study uses a sample consisting of enterprises' bonds and medium-term notes. However, there could be obvious differences between firms that have issued bonds and those that have not yet done so. For example, research finds that large firms prefer bond financing and are associated with large issuance amounts (Johnson, 1997; Hooks, 2003). Therefore, it could be argued that the decrease in bond credit spreads may not be the result of purchasing D&O insurance but is caused by other features (omitted variables) of a firm, leading to self-selection bias. We implement the Heckman two-stage procedure to mitigate omitted variable bias.

Following Wang and Gao (2017), in the first-stage regression, we regress $BondDum_{i,t}$ with $Size_{i,t}$, $Lev_{i,t}$, $ROA_{i,t}$, $Growth_{i,t}$, $CF_{i,t}$, $Risk_{i,t}$ (three-year volatility of $ROA_{i,t}$), $AltZ_{i,t}$ (Z score developed by Altman, 1968),[9] $State_{i,t}$ (ownership structure), $Top1_{i,t}$ (shareholding ratio of the controlling shareholder), $Independent_{i,t}$ (board independence), $Big4_{i,t}$ (a dummy variable that equals 1 if a firm is audited by a Big Four auditor), $Equity_{i,t}$ (natural logarithm of net assets), $DistributionProfit_{i,t}$ (three-year average of undistributed profits over total assets), $ExBond_{i,t}$ (natural logarithm of bonds payable), $ShortTerm_{i,t}$ (percentage of short-term loans in total assets) and $LongTerm_{i,t}$ (proportion of long-term loans in total assets).

The inverse Mills' ratio (IMR) generated from the first-stage probit model is then included in the second stage to control for self-selection bias. The other specification of the second-stage model remains the same as in Model (1) in Section 4.2. Table 5 presents the results of the Heckman two-stage procedure. In the second-stage regression, the coefficient of $Doins_{i,t}$ is statistically negative and significant at the 1% level, and the coefficient of $IMR_{i,t}$ is statistically positive and significant at the 1% level, illustrating that D&O insurance coverage still negatively affects bond credit spreads after controlling for self-selection bias.[10]

[8] Due to the concern that the IV *OverseaBack* may affect credit spreads via other channels, we construct a new IV to address endogeneity issues. The first case of D&O insurance compensation was in 2011, during which AIG compensated GAC Changfeng in the sum of 0.8 million Chinese yuan after civil lawsuits concerning GAC Changfeng's financial misstatements. We use this external shock as the IV of D&O insurance ($Doins_{i,t}$). The case provides a more direct and better understanding of D&O insurance in risk mitigation, while credit spreads are not affected by this case, making it a reasonable IV. Given that the insurance claim occurred in 2011, we follow Hu et al. (2019) and construct an indicator variable (*IV-2011*) that equals 1 if the year is 2012 and after and 0 otherwise. We then adopt 2SLS, GMM and LIML procedures and find that the results are qualitatively and quantitatively similar.

[9] Following Altman (1968), we use our sample firms to estimate the coefficient of each variable and then calculate the Z score using the equation: $AltZ = 1.2 \times$ (Working Capital / Total Assets) + 1.4 × (Retained Earnings / Total Assets) + 3.3 × (EBIT / Total Assets) + 0.6 × (Total Value of Common Stocks Outstanding / Total Liabilities) + 1 × Total Asset Turnover.

[10] To further address endogeneity concerns caused by omitted variables, we follow Cinelli et al. (2020) and conduct a sensitivity analysis, in which we examine how strong an omitted variable should be to overturn our baseline results. Using $Size_{i,t}$ for comparison purposes, the baseline results remain statistically negative after adding an omitted variable that has three times the explanatory power of $Size_{i,t}$.

Table 5
Heckman two-stage analysis of the impact of D&O insurance on bond credit spreads.

First-stage regression: $BondDum_{i,t}$		Second-stage regression: $CS_{i,t}$	
$Size_{i,t}$	−0.5111***	$Doins_{i,t}$	−0.3034***
	(−4.77)		(−9.23)
$Lev_{i,t}$	3.0036***	$Size_{i,t}$	−0.0469**
	(8.92)		(−2.15)
$ROA_{i,t}$	0.1878	$Lev_{i,t}$	1.4394***
	(0.50)		(9.87)
$Growth_{i,t}$	−0.1022***	$ROA_{i,t}$	−4.6105***
	(−3.43)		(−8.69)
$CF_{i,t}$	−1.0307***	$Growth_{i,t}$	0.0967**
	(−4.53)		(2.00)
$Risk_{i,t}$	−0.5784**	$CF_{i,t}$	0.3542
	(−2.33)		(1.26)
$AltZ_{i,t}$	−0.1658***	$Tang_{i,t}$	−0.0255
	(−5.93)		(−0.31)
$State_{i,t}$	−0.1104***	$Board_{i,t}$	−0.3525***
	(−3.35)		(−5.05)
$Top1_{i,t}$	−0.0056***	$Independent_{i,t}$	−1.4051***
	(−5.41)		(−5.11)
$Independent_{i,t}$	−0.3237	$Dual_{i,t}$	0.3285***
	(−1.25)		(7.27)
$Big4_{i,t}$	−0.0859	$BondSize_{i,t}$	−0.0739***
	(−1.53)		(−3.09)
$Equity_{i,t}$	0.9237***	$BondTerm_{i,t}$	−0.0406**
	(8.43)		(−2.01)
$DistributionProfit_{i,t}$	1.1567***	$BondSecured_{i,t}$	0.2334***
	(5.47)		(7.26)
$ExBond_{i,t}$	0.1054***	$BondPut_{i,t}$	0.0824***
	(67.07)		(2.68)
$ShortTerm_{i,t}$	−1.1888***	$BondCredit_{i,t}$	−0.4624***
	(−6.85)		(−20.94)
$LongTerm_{i,t}$	−1.5689***	$IMR_{i,t}$	0.1646***
	(−7.37)		(5.44)
Constant	−11.3016***	*Constant*	6.7902***
	(−26.84)		(14.03)
Year fixed effects	Yes	Year fixed effects	Yes
Industry fixed effects	Yes	Industry fixed effects	Yes
Observations	22,962	Observations	6,963
Pseudo R^2	0.6826	Adjusted R^2	0.3813

Note: The t-statistics are reported in brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

6.1.3. PSM and EB procedures

D&O coverage among Chinese firms is much lower than that in developed capital markets. An insurance company may intend to select potential clients with low default risk. Thus, insured firms may have better corporate governance and lower default risk than uninsured firms. In other words, the negative effects between $CS_{i,t}$ and $Doins_{i,t}$ may not be attributed to D&O insurance monitoring but be caused by the "screening effects" of insurance companies. This will cause endogeneity concerns as the difference exists not only in the decision to purchase D&O insurance but also in other features, observable or not. To alleviate this issue, we implement the PSM procedure and the EB procedure to match the treatment group and control group according to the factors that may cause confounding effects, after which we can use a matched sample to further test the robustness of our results.

For PSM, we first construct a logit model for the factors influencing the purchase of D&O insurance. According to Yuan et al. (2016), we use a series of variables including $Size_{i,t}$, $Lev_{i,t}$, $ROA_{i,t}$, $Lnage_{i,t}$ (firm age), $Independent_{i,t}$, $LnIC_{i,t}$ (quality of internal controls), $State_{i,t}$ and $CrossList_{i,t}$, as matching variables to calculate the propensity scores for the sample firms. We then apply nearest neighbor matching without replacement to match three uninsured firms to each insured firm (1:3 matching), to address the "screening effects." After testing the covariate balance of the matched sample, we re-estimate Model (1) with the matched sample.

As proposed by Hainmueller (2012), the EB procedure has an advantage in processing multidimensional data and can accurately match a treatment group with control groups through multidimensional adjustments to first-order moments, second-order cross moments and third-order moments of all covariates.

Panel A of Appendix II reports the results of the logit model for the PSM procedure. Consistent with prior studies (Yuan et al., 2016; Lai and Tai, 2019), the coefficients of $Size_{i,t}$, $Lnage_{i,t}$, $State_{i,t}$ and $CrossList_{i,t}$ are all significantly positive, indicating that large firms, older firms, SOEs and cross-listed firms are more likely to purchase D&O insurance. The negative impact of $ROA_{i,t}$ is also consistent with the literature (Jia et al., 2019). Panel B shows a large decrease in bias between the treatment group and the control group. There are no significant differences in the means of all covariates, thus meeting the "balanced condition assumption." Panel C of Appendix II reports the results of the EB test, illustrating a decrease in the differences between all

Table 6
The impact of D&O insurance on bond credit spreads with a matched sample.

Variable	PSM	EB
	$CS_{i,t}$	$CS_{i,t}$
$Doins_{i,t}$	−0.1542***	−0.0676**
	(−3.13)	(−2.00)
$Size_{i,t}$	−0.0248	−0.0294
	(−0.78)	(−1.23)
$Lev_{i,t}$	0.8257***	0.9080***
	(2.84)	(4.47)
$ROA_{i,t}$	−3.5147***	−4.0277***
	(−2.96)	(−4.47)
$Growth_{i,t}$	0.1150	0.0965
	(1.05)	(1.15)
$CF_{i,t}$	0.5209	1.1041**
	(0.92)	(2.49)
$Tang_{i,t}$	−0.2085	−0.1503
	(−1.47)	(−1.40)
$Board_{i,t}$	−0.4350***	−0.3798***
	(−3.59)	(−4.29)
$Independent_{i,t}$	−1.9707***	−2.0227***
	(−4.69)	(−7.00)
$Dual_{i,t}$	−0.1775**	−0.1928***
	(−2.10)	(−3.73)
$BondSize_{i,t}$	−0.0634	−0.0407
	(−1.59)	(−1.41)
$BondTerm_{i,t}$	−0.0339	0.0033
	(−0.95)	(0.13)
$BondSecured_{i,t}$	0.2548***	0.2575***
	(4.56)	(6.37)
$BondPut_{i,t}$	0.0188	−0.0234
	(0.35)	(−0.61)
$BondCredit_{i,t}$	−0.4320***	−0.4572***
	(−10.36)	(−14.76)
Constant	7.2218***	7.1929***
	(8.36)	(14.25)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	1,973	7,626
Adjusted R^2	0.3137	0.3084

Note: The t-statistics are reported in brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

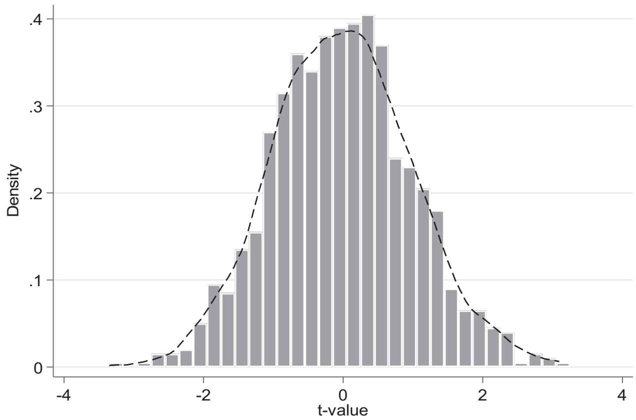

Fig. 2. Placebo test of the impact of D&O insurance on bond credit spreads.

variables between the treatment group and the control group. We then re-estimate Model (1) and report the results in Table 6. The coefficients of $Doins_{i,t}$ are statistically negative and significant at the 1% and 5% levels following the PSM and EB procedures, respectively.

6.2. Placebo test

Considering that the statistical significance of our baseline results may be driven by some random factors, we follow Li et al. (2016) and conduct a placebo test to eliminate this concern. We estimate Model (1) with the purchase of D&O insurance randomly assigned to the sample firms. The baseline results will not hold if we still identify a negative relationship between D&O insurance and credit spreads. We repeat the placebo test 1,000 times and draw the virtual distribution of the t-value of $Doins_{i,t}$ in Fig. 2. The symmetric curve around the origin demonstrates the non-existence of a virtual correlation between D&O insurance and bond credit spreads, thus validating our main results.

6.3. Other robustness tests

Table 7 provides the results of additional robustness tests, including the following:

1) Use of alternative explanatory variables. We use $Doins2_{i,t}$ (the history of D&O coverage) and $Doins3_{i,t}$ (a dummy variable that equals 1 if firms disclose D&O insurance contract details) as alternative explanatory variables to estimate Model (1) and report a negative relationship significant at the 1% level in columns (1) and (2) of Table 7.
2) Use of alternative explained variables. We replace $CS_{i,t}$ with $CS2_{i,t}$ (the difference between bond YTM and the 5-year fixed deposit rate), $CS3_{i,t}$ (the difference between bond YTM and the 1-year fixed deposit rate) and $CS4_{i,t}$ (the credit spread of the bond with the largest issuance amount if a firm issues more than one bond) as a robustness test. The coefficients in columns (3) to (5) of Table 7 remain significantly negative at the 1% level.
3) Given the impact of the global financial crisis (GFC), we exclude observations for 2008 and 2009 to re-estimate Model (1) and reach a similar conclusion to that shown in column (6).
4) Fixed effects model. We use a fixed effects model to control for time-invariant firm characteristics. The results in column (7) of Table 7 show that D&O insurance is still negatively associated with bond credit spreads.
5) The interaction of industry and year fixed effects. It is possible that industry effects and time effects may interact, i.e., industry effects only occur in specific years. We add the interaction term of industry and year fixed effects to re-estimate Model (1) and obtain similar results to those shown in column (8) of Table 7.

Table 7
Other robustness tests of the impact of D&O insurance on bond credit spreads.

Variable	Panel A: Alternative D&O insurance measure		Panel B: Alternative bond credit spread measure			Panel C: Excluding the GFC	Panel D: Fixed effects model	Panel E: Controlling Year × Industry
	$CS_{i,t}$	$CS_{i,t}$	$CS2_{i,t}$	$CS3_{i,t}$	$CS4_{i,t}$	$CS_{i,t}$	$CS_{i,t}$	$CS_{i,t}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Doins2_{i,t}$	−0.0342***							
	(−9.47)							
$Doins3_{i,t}$		−0.1987***						
		(−4.49)						
$Doins_{i,t}$			−0.4411***	−0.4384***	−0.1868***	−0.3026***	−0.2421***	−0.2936***
			(−7.41)	(−7.43)	(−3.74)	(−9.11)	(−5.27)	(−8.86)
$Size_{i,t}$	−0.0772***	−0.0841***	−0.0643**	−0.0664**	−0.0840***	−0.0699***	−0.1023***	−0.0772***
	(−4.48)	(−4.81)	(−1.97)	(−2.04)	(−3.02)	(−3.95)	(−4.02)	(−4.38)
$Lev_{i,t}$	1.3558***	1.2336***	1.9455***	1.9357***	0.9394***	1.2962***	1.6330***	1.2974***
	(9.91)	(9.05)	(6.83)	(6.85)	(5.54)	(9.30)	(9.38)	(9.31)
$ROA_{i,t}$	−5.9646***	−6.0255***	−8.7483***	−8.7977***	−7.1967***	−6.2636***	−3.5239***	−5.8999***
	(−10.84)	(−10.89)	(−7.07)	(−7.14)	(−10.70)	(−11.12)	(−6.49)	(−10.30)
$Growth_{i,t}$	0.0954*	0.1097**	−0.0294	−0.0253	0.1737***	0.1010*	0.0667	0.1184**
	(1.81)	(2.09)	(−0.28)	(−0.24)	(2.63)	(1.90)	(1.64)	(2.13)
$CF_{i,t}$	0.2169	0.2032	0.9160*	0.8896*	0.1863	0.2127	0.4149*	0.0970
	(0.79)	(0.73)	(1.81)	(1.78)	(0.56)	(0.76)	(1.74)	(0.34)
$Tang_{i,t}$	−0.1671**	−0.1360*	−0.5270***	−0.5199***	−0.0491	−0.1721**	−0.0287	−0.1601**
	(−2.10)	(−1.71)	(−3.52)	(−3.49)	(−0.48)	(−2.13)	(−0.27)	(−2.00)
$Board_{i,t}$	−0.2486***	−0.2253***	−0.3733***	−0.3779***	−0.1737*	−0.2426***	−0.2714***	−0.2209***
	(−3.58)	(−3.25)	(−2.87)	(−2.91)	(−1.91)	(−3.46)	(−3.05)	(−3.16)
$Independent_{i,t}$	−1.3805***	−1.5247***	−1.8903***	−1.8876***	−0.8957**	−1.4955***	−1.4888***	−1.2716***
	(−5.36)	(−5.90)	(−3.81)	(−3.84)	(−2.56)	(−5.77)	(−5.18)	(−4.90)
$Dual_{i,t}$	−0.2840***	−0.3047***	−0.3137***	−0.3152***	−0.2149***	−0.2839***	−0.1644***	−0.2990***
	(−7.22)	(−7.72)	(−4.12)	(−4.16)	(−4.27)	(−7.20)	(−3.91)	(−7.51)
$BondSize_{i,t}$	−0.0882***	−0.0905***	−0.0241	−0.0242	−0.0846**	−0.0899***	−0.0950***	−0.0756***
	(−3.82)	(−3.91)	(−0.54)	(−0.55)	(−2.32)	(−3.83)	(−2.58)	(−3.25)
$BondTerm_{i,t}$	−0.0395**	−0.0457**	−0.0516	−0.0515	−0.0255	−0.0406**	−0.0008	−0.0374**
	(−2.11)	(−2.42)	(−1.15)	(−1.14)	(−1.03)	(−2.15)	(−0.04)	(−1.97)
$BondSecured_{i,t}$	0.2250***	0.2282***	0.3171***	0.3212***	0.2671***	0.2282***	0.2404***	0.2072***
	(7.26)	(7.38)	(5.24)	(5.34)	(6.40)	(7.23)	(4.56)	(6.51)
$BondPut_{i,t}$	0.1126***	0.1190***	0.1532***	0.1537***	−0.0286	0.1110***	0.2067***	0.1112***
	(3.84)	(4.04)	(2.70)	(2.72)	(−0.75)	(3.75)	(4.41)	(3.77)
$BondCredit_{i,t}$	−0.4424***	−0.4483***	−0.5613***	−0.5599***	−0.5043***	−0.4375***	−0.4815***	−0.4469***
	(−21.67)	(−21.88)	(−14.27)	(−14.34)	(−18.22)	(−21.26)	(−15.89)	(−21.44)
Constant	7.8234***	8.0974***	5.8025***	7.3630***	8.0432***	6.1455***	8.2324***	8.0701***
	(19.61)	(20.19)	(7.83)	(10.12)	(13.38)	(15.87)	(15.77)	(15.89)

(*continued on next page*)

Table 2 (*continued*)

Variable	Panel A: Alternative D&O insurance measure		Panel B: Alternative bond credit spread measure			Panel C: Excluding the GFC	Panel D: Fixed effects model	Panel E: Controlling Year × Industry
	$CS_{i,t}$	$CS_{i,t}$	$CS2_{i,t}$	$CS3_{i,t}$	$CS4_{i,t}$	$CS_{i,t}$	$CS_{i,t}$	$CS_{i,t}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Firm fixed effects	No	No	No	No	No	No	Yes	No
Year × Industry fixed effects	No	No	No	No	No	No	No	Yes
Observations	7,783	7,783	7,783	7,783	4,480	7,618	7,783	7,783
Adjusted R^2	0.3691	0.3643	0.2185	0.2220	0.3684	0.3678	0.3467	0.3776

Note: The t-statistics are reported in brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 8
Channel analysis regression results.

Variable	Panel A: Internal governance		Panel B: External supervision		Panel C: Information asymmetry		Panel D: Default risk	
	$LnIC_{i,t}$	$Score_{i,t}$	$Big4_{i,t}$	$Intown_{i,t}$	$Atran_{i,t}$	$Restate_{i,t}$	$EDP_{i,t}$	$AltZ_{i,t}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Doins_{i,t}$	−3.8717***	−0.4737***	−0.4444***	−0.7237***	−0.4848***	−0.2515***	−0.2434***	−0.4865***
	(−2.99)	(−11.15)	(−8.69)	(−5.79)	(−8.93)	(−7.31)	(−7.26)	(−7.22)
$Doins_{i,t} \times \Delta$	0.5490***	0.3908***	0.3703***	0.0063***	0.0209***	−0.2588***	−0.6564***	0.1391***
	(2.79)	(7.88)	(5.55)	(3.94)	(4.60)	(−3.14)	(−4.23)	(3.37)
Δ	−0.7064***	−0.3546***	−0.2160***	−0.0077***	−0.0046*	0.2406***	0.2973***	−0.0725**
	(−5.17)	(−11.80)	(−5.05)	(−8.51)	(−1.71)	(6.06)	(3.07)	(−2.31)
$Size_{i,t}$	−0.0453**	−0.0617***	−0.0668***	−0.0321*	−0.0780***	−0.0718***	−0.0762***	−0.0730***
	(−2.51)	(−3.53)	(−3.79)	(−1.81)	(−4.49)	(−4.15)	(−4.41)	(−4.20)
$Lev_{i,t}$	1.1569***	1.3386***	1.2972***	1.2714***	1.3180***	1.2729***	1.2227***	1.1396***
	(8.55)	(9.77)	(9.52)	(9.38)	(9.64)	(9.36)	(8.78)	(6.83)
$ROA_{i,t}$	−4.8011***	−6.0041***	−5.9557***	−5.6891***	−6.0692***	−5.9511***	−5.9616***	−5.6171***
	(−8.08)	(−10.85)	(−10.78)	(−10.25)	(−10.98)	(−10.77)	(−10.82)	(−9.50)
$Growth_{i,t}$	0.1428***	0.0762	0.0991*	0.1059**	0.1034**	0.0908*	0.1148**	0.1046**
	(2.68)	(1.46)	(1.89)	(2.03)	(1.96)	(1.72)	(2.19)	(1.99)
$CF_{i,t}$	0.3044	0.3842	0.3124	0.3629	0.1722	0.2727	0.1818	0.2235
	(1.08)	(1.41)	(1.13)	(1.32)	(0.62)	(0.99)	(0.66)	(0.81)
$Tang_{i,t}$	−0.1332*	−0.1051	−0.2049**	−0.1810**	−0.1462*	−0.1787**	−0.1685**	−0.1633**
	(−1.69)	(−1.32)	(−2.56)	(−2.29)	(−1.81)	(−2.25)	(−2.12)	(−2.06)
$Board_{i,t}$	−0.2383***	−0.2459***	−0.2296***	−0.2146***	−0.2336***	−0.2449***	−0.2298***	−0.2476***
	(−3.47)	(−3.56)	(−3.33)	(−3.11)	(−3.38)	(−3.53)	(−3.33)	(−3.58)
$Independent_{i,t}$	−1.3810***	−0.2211	−1.3904***	−1.3620***	−1.4404***	−1.4539***	−1.4172***	−1.4313***
	(−5.46)	(−0.80)	(−5.41)	(−5.29)	(−5.61)	(−5.66)	(−5.52)	(−5.58)
$Dual_{i,t}$	−0.2969***	−0.1503***	−0.2771***	−0.2487***	−0.2726***	−0.2765***	−0.2727***	−0.2797***
	(−7.54)	(−3.62)	(−7.08)	(−6.29)	(−6.93)	(−7.09)	(−6.94)	(−7.12)
$BondSize_{i,t}$	−0.0898***	−0.0818***	−0.0868***	−0.0726***	−0.0865***	−0.0858***	−0.0826***	−0.0858***
	(−3.89)	(−3.57)	(−3.77)	(−3.14)	(−3.73)	(−3.72)	(−3.57)	(−3.71)
$BondTerm_{i,t}$	−0.0299	−0.0426**	−0.0437**	−0.0416**	−0.0421**	−0.0395**	−0.0383**	−0.0409**
	(−1.61)	(−2.28)	(−2.33)	(−2.24)	(−2.24)	(−2.11)	(−2.05)	(−2.18)
$BondSecured_{i,t}$	0.2099***	0.2332***	0.2094***	0.2402***	0.2151***	0.2155***	0.2202***	0.2204***
	(6.82)	(7.53)	(6.73)	(7.74)	(6.93)	(6.97)	(7.09)	(7.10)
$BondPut_{i,t}$	0.1021***	0.0905***	0.1149***	0.1232***	0.1146***	0.1088***	0.1096***	0.1195***
	(3.48)	(3.13)	(3.93)	(4.23)	(3.90)	(3.72)	(3.74)	(4.08)
$BondCredit_{i,t}$	−0.4402***	−0.4131***	−0.4267***	−0.4288***	−0.4347***	−0.4331***	−0.4388***	−0.4399***
	(−21.44)	(−20.39)	(−20.64)	(−21.15)	(−21.28)	(−21.25)	(−21.54)	(−21.58)
Constant	11.7673***	6.7861***	7.5954***	6.9955***	7.8606***	7.7090***	7.8291***	7.9989***
	(13.49)	(16.50)	(18.80)	(17.19)	(19.62)	(19.29)	(19.64)	(19.37)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,783	7,783	7,783	7,783	7,783	7,783	7,783	7,783
Adjusted R^2	0.3687	0.3799	0.3712	0.3755	0.3698	0.3722	0.3708	0.3695

Note: The t-statistics are reported in brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

7. Channel analysis

In this section, we explore four channels through which D&O insurance reduces bond credit spreads. It is organized as follows. First, to test the internal governance mechanism, we follow prior studies (Bai et al., 2004; Yuan et al., 2016) and use $LnIC_{i,t}$ and $Score_{i,t}$ (a comprehensive index of corporate governance) as two proxies.[11] Second, to investigate the external monitoring mechanism, we proxy external monitoring with

[11] We first conduct principle component analysis (PCA) by using a series of variables including $Top1_{i,t}$, the shareholding ratio of the second- to the tenth-largest shareholders ($Top2\_10_{i,t}$), $Dual_{i,t}$, $Independent_{i,t}$, executive shareholding ratio ($Exeshare_{i,t}$), $State_{i,t}$, $CrossList_{i,t}$ and the existence of a parent company ($Parent_{i,t}$). We then use the selected PCA factors to calculate $Score_{i,t}$.

Table 9
Regression results with the four economic channels.

$Doins_{i,t}$	Internal governance: $LnIC_{i,t}$		External supervision: $Big4_{i,t}$		Information asymmetry: $Atran_{i,t}$		Default risk: $EDP_{i,t}$		Controls	Year fixed effects	Industry fixed effects	Observations	Adjusted R^2
	$Doins_{i,t} \times \Delta$	Δ	$Doins_{i,t} \times \Delta$	Δ	$Doins_{i,t} \times \Delta$	Δ	$Doins_{i,t} \times \Delta$	Δ					
−3.5610***	0.4646**	−0.6645***	0.3073***	−0.2202***	0.0202***	−0.0068**	−0.5626***	0.2660***	Yes	Yes	Yes	7,783	0.3738
(−2.64)	(2.27)	(−4.81)	(4.64)	(−5.17)	(4.52)	(−2.53)	(−3.64)	(2.72)					

Note: The t-statistics are reported in brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 10
The impact of D&O insurance on bond credit spreads: Cross-sectional analysis.

Variable	(1)	(2)	(3)
$Doins_{i,t}$	−0.4953***	−0.4327***	−0.3741***
	(−6.00)	(−3.76)	(−9.01)
$Doins_{i,t} \times State_{i,t}$	0.3404***		
	(3.95)		
$State_{i,t}$	−0.8218***		
	(−24.17)		
$Doins_{i,t} \times Marketization_{i,t}$		0.2039*	
		(1.72)	
$Marketization_{i,t}$		−0.2494***	
		(−6.89)	
$Doins_{i,t} \times Reputation_{i,t}$			0.1978***
			(3.39)
$Reputation_{i,t}$			0.0148
			(0.43)
$Size_{i,t}$	−0.0980***	−0.0716***	−0.0725***
	(−5.79)	(−4.12)	(−4.16)
$Lev_{i,t}$	1.3630***	1.1724***	1.2902***
	(10.15)	(8.53)	(9.47)
$ROA_{i,t}$	−6.5279***	−6.0705***	−6.0262***
	(−11.86)	(−11.06)	(−10.89)
$Growth_{i,t}$	0.0696	0.1031**	0.0999*
	(1.36)	(1.97)	(1.90)
$CF_{i,t}$	0.1844	0.2238	0.2139
	(0.71)	(0.82)	(0.77)
$Tang_{i,t}$	0.1419*	−0.2167***	−0.1524*
	(1.80)	(−2.72)	(−1.91)
$Board_{i,t}$	−0.0428	−0.2540***	−0.2307***
	(−0.63)	(−3.67)	(−3.33)
$Independent_{i,t}$	−0.6744***	−1.3914***	−1.3787***
	(−2.72)	(−5.43)	(−5.35)
$Dual_{i,t}$	−0.1412***	−0.2985***	−0.2852***
	(−3.75)	(−7.62)	(−7.25)
$BondSize_{i,t}$	−0.0595***	−0.0802***	−0.0882***
	(−2.68)	(−3.50)	(−3.81)
$BondTerm_{i,t}$	−0.0349*	−0.0426**	−0.0387**
	(−1.89)	(−2.27)	(−2.07)
$BondSecured_{i,t}$	0.2364***	0.2291***	0.2345***
	(7.88)	(7.41)	(7.47)
$BondPut_{i,t}$	0.0172	0.1108***	0.1309***
	(0.62)	(3.81)	(4.24)
$BondCredit_{i,t}$	−0.3644***	−0.4389***	−0.4412***
	(−18.33)	(−21.56)	(−21.68)
$Constant_{i,t}$	7.4132***	8.0233***	7.6949***
	(18.62)	(20.09)	(19.17)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Observations	7,783	7,783	7,783
Adjusted R^2	0.4185	0.3732	0.3696

Note: The t-statistics are reported in brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

$Big4_{i,t}$ and $Intown_{i,t}$ (shareholding of institutional investors). Third, for information asymmetry, following Bhattacharya et al. (2003) and Park and Wu (2009), we use $Atran_{i,t}$ (information transparency measured by the average of the deciles assigned to earnings aggressiveness and earnings smoothing) and $Restate_{i,t}$ (a dummy variable that equals 1 if financial restatements occur) as proxies. Last, for the default risk channel, we follow Gao et al. (2020) and construct two proxies, $EDP_{i,t}$ (naive default probability by Bharath and Shumway, 2008) and $AltZ_{i,t}$. Detailed definitions of the variables are shown in Appendix I.

We investigate how D&O insurance reduces bond credit spreads by regressing Model (2), in which the interaction term of the explanatory variable and the channel variable is added. Δ proxies various channels, including internal governance ($LnIC_{i,t}$ and $Score_{i,t}$), external monitoring ($Big4_{i,t}$ and $Intown_{i,t}$), information asymmetry ($Atran_{i,t}$ and $Restate_{i,t}$) and default risk ($EDP_{i,t}$ and $AltZ_{i,t}$). The specification of the other variables is the same as in Model (1).

$$CS_{i,t} = \alpha_0 + \alpha_1 Doins_{i,t} + \alpha_2 Doins_{i,t} \times \Delta + \alpha_3 \Delta + \sum_{q=4}^{m} \alpha_q (ControlVariable_{i,t}) + \delta_j + \tau_t + \varepsilon_{i,t} \quad (2)$$

Table 8 presents the results for all channels. As shown in Panels A to D, the negative correlation is more significant when there is weak internal governance, insufficient external monitoring, more asymmetric information and higher default risk.

We then simultaneously consider the impacts of the four channels and re-run the regression of Model (2). It should be noted that we only add one proxy for each channel to mitigate multicollinearity. As shown in Table 9, the coefficients of all of the interaction terms are significant at the 1% level, illustrating that D&O insurance can affect bond credit spreads through the four channels. Furthermore, after controlling for the characteristics of the channels and bonds, the coefficient of $Doins_{i,t}$ remains negative and significant at the 1% level, indicating the direct effect of D&O insurance on reducing bond credit spreads.

8. Further analysis

8.1. Cross-sectional analysis

Our results show that D&O insurance can reduce credit spreads via multiple channels. In Section 8.1, we conduct cross-sectional analysis to examine how heterogeneous factors, including the nature of ownership, the level of marketization and the reputation of the rating agency, affect the negative relationship between D&O insurance and bond credit spreads. Heterogeneous factors cannot easily be changed or be out of a firm's control, yet they cause heterogeneity in some aspects of default risk, governance environments and level of information asymmetry.

8.1.1. The nature of ownership

The nature of ownership should be taken into consideration when exploring China's economic problems in the era of economic transition. Specifically, the nature of ownership leads to different perceptions of issuers' default risk. When SOEs face a repayment crisis, the local government could use tax relief, capital raising or coordination with banks to prevent a material default. Bond investors have "rigid repayment" expectations and perceive low risk for bonds issued by SOEs, which weakens the negative effect of D&O insurance on credit spreads (Tong et al., 2021). Given the lack of implicit guarantees for non-SOEs, their default risk is more closely associated with their operational performance and governance mechanism, meaning that D&O insurance should be more influential in reducing credit spreads. Therefore, we use $State_{i,t}$ as a proxy. The results of column (1) in Table 10 show that the coefficient of $Doins_{i,t} \times State_{i,t}$ remains positive and significant at the 1% level, illustrating that the impact of D&O insurance on decreasing credit spreads is more pronounced in non-SOEs than in SOEs.

8.1.2. Level of marketization

The differences in geographical location, resource endowment and national policy between Chinese provinces result in an obvious imbalance in the progress of marketization, reflected in the heterogenous governance environments faced by issuers. A high level of marketization provides more rounded government supervision and market restrictions, forcing firms to develop better internal governance to constrain managerial opportunism. This in turn reduces the ex-ante cost of information searching and investors' ex-post costs of supervision, leading to lower risk premiums. D&O insurance may play a limited role in reducing bond credit spreads if the issuers are located in areas with a high level of marketization. Following the literature (Wang

Table 11
Alternative explanation: The eyeball effect.

Variable	(1)
$Doins_{i,t}$	−0.3174***
	(−6.63)
$Doins_{i,t} \times Public_{i,t}$	0.0399
	(0.68)
$Public_{i,t}$	0.0440
	(1.31)
$Size_{i,t}$	−0.0838***
	(−4.53)
$Lev_{i,t}$	1.3000***
	(9.54)
$ROA_{i,t}$	−6.0991***
	(−11.03)
$Growth_{i,t}$	0.1024*
	(1.94)
$CF_{i,t}$	0.2304
	(0.84)
$Tang_{i,t}$	−0.1675**
	(−2.10)
$Board_{i,t}$	−0.2354***
	(−3.40)
$Independent_{i,t}$	−1.4455***
	(−5.63)
$Dual_{i,t}$	−0.2817***
	(−7.16)
$BondSize_{i,t}$	−0.0836***
	(−3.61)
$BondTerm_{i,t}$	−0.0414**
	(−2.21)
$BondSecured_{i,t}$	0.2258***
	(7.26)
$BondPut_{i,t}$	0.1135***
	(3.87)
$BondCredit_{i,t}$	−0.4405***
	(−21.54)
Constant	8.0166***
	(18.95)
Year fixed effects	Yes
Industry fixed effects	Yes
Observations	7,783
Adjusted R^2	0.3689

Note: The t-statistics are reported in brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

et al., 2008; Yuan et al., 2016), we use the marketization index developed by Fan et al. (2016) to measure the level of regional marketization ($Marketization_{i,t}$). As shown in column (2) of Table 10, the coefficient of $Doins_{i,t} \times Marketization_{i,t}$ remains positive and significant at the 10% level, indicating that the impact of D&O insurance on decreasing credit spreads is more pronounced in regions with a low level of marketization. This also supports the claim that D&O insurance affects credit spreads through governance channels.

8.1.3. The reputation of rating agencies

Rating agencies play an important role in the bond market by providing information about bond issuers' credit risk. Rating agencies that provide effective and accurate ratings can develop a long-term reputation, thereby enhancing investor confidence and alleviating information asymmetry. This may weaken the effect of D&O insurance on credit spreads via the information asymmetry channel. Therefore, we use $Reputation_{i,}$

$_t$ (a dummy variable that equals 1 if the issuers employ China Credit International or United Credit for credit rating and 0 otherwise) as a proxy and examine whether variation in the reputation of rating agencies leads to differences in the impact of D&O insurance on credit spreads. The results of column (3) in Table 10 show that the coefficient of $Doins_{i,t} \times Reputation_{i,t}$ remains positive and significant at the 1% level, illustrating that D&O insurance is associated with tighter bond credit spreads if a firm employs a rating agency with a poorer reputation, supporting the claim that D&O insurance can affect bond credit spreads via the information asymmetry channel.

8.2. An alternative explanation: The eyeball effect

The limited coverage of D&O insurance among Chinese listed firms may cause an eyeball effect whereby firms that purchase D&O insurance may become capital market superstars and receive more external attention. This prevents insured firms from hiding negative news and improves their information transparency, which in turn reduces the cost of bond financing. Considering the possibility of an alternative explanation, we investigate whether the effect of D&O insurance on bond credit spreads varies with external attention. The proxy is public attention ($Public_{i,t}$), measured as the average value of the annual web search index for each listed firm.[12] The results in Table 11 are similar to our main results, showing that D&O insurance tightens bond credit spreads at the 1% significance level. However, the coefficient of $Doins_{i,t} \times Public_{i,t}$ is not significant, illustrating that external attention does not affect the role of D&O insurance in reducing credit spreads, and therefore we reject the eyeball effect as an alternative explanation.

9. Conclusion

Using a unique dataset that combines the purchase of D&O insurance by Chinese listed firms with bond credit spreads, we empirically examine whether D&O insurance affects bond credit spreads. We find that D&O insurance is associated with tighter credit spreads. This association is robust to a series of robustness tests, including the IV approach, the Heckman two-stage model, PSM, a placebo test and alternative explanatory (explained) variables and alternative fixed effects models. The results of our channel analysis imply that D&O insurance reduces credit spreads via the channels of internal governance, external monitoring, information asymmetry and default risk. Further analysis illustrates that the effect of D&O insurance on credit spreads is more pronounced if a firm is a non-SOE, is located in a low-marketization area or if it employs rating agencies with a bad reputation. We also confirm that this negative relationship is not driven by the eyeball effect.

Contrary to the conclusion that D&O insurance negatively affects corporate governance in developed capital markets, we identify some positive governance effects of D&O insurance on reducing bond credit spreads through improved internal governance and stronger external monitoring, given China's institutional environment. This finding further enriches the literature on the determinants of bond credit spreads as well as the economic consequences of D&O insurance.

Our findings also have policy implications. First, listed firms can purchase D&O insurance at their discretion, so they can improve their internal governance, mitigate agency issues, protect bond investors and ultimately reduce their credit spreads. Second, the D&O insurance products available to the Chinese market typically feature terms that are a direct translation of foreign terms and lack clearly defined boundaries of responsibility. To restrain managerial opportunism, insurance companies need to design more appropriate contractual terms that take into account the institutional and cultural background in China. Third, bond investors should incorporate D&O insurance coverage into the framework governing their investment decisions and systematically evaluate bond risk from the perspective of corporate governance, external monitoring and the quality of information disclosure to avoid a loss on their investment. Last, given the positive governance impact of D&O insurance, the China Securities Regulatory Committee may consider mandating disclosure of D&O insurance purchases by listed firms.

[12] This Baidu index is based on the massive search volume of Internet users on Baidu. It first defines the keywords and counts the frequency of searching via Baidu for each keyword. Then, the average weighted search frequency can be calculated. Detailed information can be found at: https://index.baidu.com/v2/index.html#/.

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Variable definitions.

Variable name	Variable definition
Explained variable	
$CS_{i,t}$	The difference in yield to maturity (YTM) between a corporate bond and the Treasury bond with the closest maturity.
Explanatory variable	
$Doins_{i,t}$	A dummy variable that equals 1 if a firm purchases D&O insurance in a given year and 0 otherwise.
Control variables	
$Size_{i,t}$	Firm size, measured as the natural logarithm of total assets.
$Lev_{i,t}$	Firm's financial leverage ratio, calculated as total debt divided by total assets.
$ROA_{i,t}$	Firm's return on assets, calculated as net income divided by total assets.
$Growth_{i,t}$	Sales revenue in year t minus sales revenue in year t–1 divided by sales revenue in year t–1.
$CF_{i,t}$	Measured as cash flow divided by total assets.
$Tang_{i,t}$	Measured as tangible assets divided by total assets.
$Board_{i,t}$	Measured as the natural logarithm of the total number of board directors.
$Independent_{i,t}$	Number of independent directors divided by the total number of board directors.
$Dual_{i,t}$	An indicator variable that equals 1 if the CEO is not the Chairman of the firm and 0 otherwise.
$BondSize_{i,t}$	Measured as the natural logarithm of the bond issuance amount.
$BondTerm_{i,t}$	Measured as the natural logarithm of a bond's maturity.
$BondSecured_{i,t}$	An indicator variable that equals 1 if a bond is secured with collateral and 0 otherwise.
$BondPut_{i,t}$	An indicator variable that equals 1 if a new bond issue has a put option and 0 otherwise.
$BondCredit_{i,t}$	Defined as an ordered variable, with 5 for AAA ratings; 4 for AA+; 3 for AA; 2 for AA-; and 1 for A +.
Other variables	
$State_{i,t}$	An indicator variable that equals 1 if the firm is an SOE, and 0 otherwise.
$Exeshare_{i,t}$	The proportion of shares held by top executives.
$Top1_{i,t}$	The percentage of shares owned by the largest shareholder.
$CrossList_{i,t}$	An indicator variable that equals 1 if the firm is cross-listed, and 0 otherwise.
$Violation_{i,t}$	An indicator variable that equals 1 if the firm has a violation record, and 0 otherwise.
$Lnage_{i,t}$	The natural logarithm of the sum of the number of years that have elapsed since the firm was established plus 1.
$LnIC_{i,t}$	The natural logarithm of 1 plus the Chinese internal control quality index.
$Top2\_10_{i,t}$	The percentage of shares owned by the second to tenth largest shareholders.
$Parent_{i,t}$	An indicator variable that equals 1 if the firm has a parent company and 0 otherwise.

$Big4_{i,t}$	An indicator variable that equals 1 if the firm's auditor is one of the Big Four and 0 otherwise.
$Intown_{i,t}$	The percentage of shares owned by institutional investors.
$Atran_{i,t}$	The mean value of the decile assignment method of earnings stimulus and earnings smoothness.
$Restate_{i,t}$	An indicator variable that equals 1 if the firm announces a financial restatement and 0 otherwise.
$EDP_{i,t}$	According to Bharath and Shumway (2008).
$AltZ_{i,t}$	1.2×(Working Capital/Total Assets) + 1.4×(Retained Earnings/Total Assets) + 3.3×(Earnings Before Interest and Taxes/Total Assets) + 0.6×(Market Value of Equity/Book Value of Long-Term Debt) + (Net Sales/Total Assets).
$Marketization_{i,t}$	Measured as the regional marketization index (Fan et al., 2016).
$Reputation_{i,t}$	An indicator variable that equals 1 if the issuing firm hires a brand name rating agency (i.e., China Chengxin International Credit Rating Co., Ltd.,China Lianhe Credit Rating Co. Ltd.) and 0 otherwise.
$Public_{i,t}$	The natural logarithm of the sum of the number of web searches plus 1.

Appendix B. Additional tables of PSM and EB matching procedures.

Panel A: First-stage regression of PSM

Variable	$Doins_{i,t}$
$Size_{i,t}$	0.3130***
	(10.65)
$Lev_{i,t}$	−0.0601
	(−0.20)
$ROA_{i,t}$	−2.7005*
	(−1.80)
$Lnage_{i,t}$	1.0524***
	(10.28)
$Independent_{i,t}$	−0.2433
	(−0.47)
$LnIC_{i,t}$	0.0446
	(0.20)
$State_{i,t}$	1.1452***
	(11.21)
$CrossList_{i,t}$	2.1014***
	(26.40)
Constant	−13.8752***
	(−9.07)
Year fixed effects	Yes
Industry fixed effects	Yes
Observations	7,626
Pseudo R^2	0.2783

Note: The t-statistics are reported in brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Panel B: Matching efficiency of PSM

Variable	Unmatched	Mean		%reduct		*t*-test	
	Matched	Treatment	Control	%bias	|bias|	t-value	p > |t|
$Size_{i,t}$	U	25.4890	24.1080	94.9000		33.3400	0.0000
	M	25.2890	25.2320	4.0000	95.8000	1.0800	0.2800
$Lev_{i,t}$	U	0.6327	0.6019	21.1000		7.0300	0.0000
	M	0.6352	0.6341	0.8000	96.3000	0.2200	0.8240
$ROA_{i,t}$	U	0.0279	0.0302	−7.7000		−2.5200	0.0120
	M	0.0280	0.0271	3.2000	58.2000	0.8200	0.4100
$Lnage_{i,t}$	U	2.9143	2.8690	12.5000		4.3600	0.0000
	M	2.8937	2.8764	4.8000	61.7000	1.2900	0.1960
$Independent_{i,t}$	U	0.3894	0.3784	16.9000		6.0100	0.0000
	M	0.3886	0.3856	4.5000	73.4000	1.2100	0.2270
$LnIC_{i,t}$	U	6.5633	6.5165	26.5000		9.8300	0.0000
	M	6.5583	6.5583	0.0000	99.9000	−0.0100	0.9930
$State_{i,t}$	U	0.9117	0.6147	74.5000		22.9000	0.0000
	M	0.9053	0.9040	0.3000	99.6000	0.1100	0.9110
$CrossList_{i,t}$	U	0.6285	0.1084	128.0000		51.6100	0.0000
	M	0.6014	0.6171	−3.9000	97.0000	−0.8600	0.3900

Panel C: Matching efficiency of EB matching

Variable	Treatment			Control before matching			Control after matching		
	Mean	Variance	Skewness	Mean	Variance	Skewness	Mean	Variance	Skewness
$Size_{i,t}$	25.4885	2.1468	0.0091	24.0998	2.0728	0.5985	25.4885	2.6160	0.2216
$Lev_{i,t}$	0.6327	0.0174	−0.4119	0.6042	0.0251	−0.2861	0.6327	0.0200	−0.3675
$ROA_{i,t}$	0.0279	0.0007	0.0235	0.0292	0.0012	−0.3336	0.0279	0.0009	−0.4422
$Lnage_{i,t}$	2.9143	0.1327	−0.5984	2.8696	0.1337	−1.0838	2.9143	0.1207	−0.9114
$Independent_{i,t}$	0.3894	0.0046	1.3818	0.3783	0.0040	1.7882	0.3894	0.0049	1.5862
$LnIC_{i,t}$	6.5633	0.0372	−5.7932	6.5164	0.0254	−2.1041	6.5633	0.0320	−1.4742
$State_{i,t}$	0.9117	0.0806	−2.9022	0.6134	0.2372	−0.4657	0.9117	0.0805	−2.9017
$CrossList_{i,t}$	0.6285	0.2336	−0.5319	0.1073	0.0958	2.5376	0.6285	0.2335	−0.5319

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Does the social security fund help non-financial enterprises to transform from the virtual to the real?

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ABSTRACT

At its 19th National Congress, the Communist Party of China vowed to "strengthen the financial sector's ability to serve the real economy." However, many studies provide evidence of the opposite trend, a problematic "transition from the real to the virtual," among Chinese enterprises. Meanwhile, the investment efficiency of China's Social Security Fund (SSF), a public fund, attracts much attention. In this context, we use A-share listed companies in China from 2009 to 2018 to study the relationship between holding by the SSF and enterprise financialization. We find that SSF holding significantly inhibits financialization and that this effect is non-linear. Mechanism analysis indicates that SSF holding suppresses enterprises' financialization mainly by improving their governance. Moreover, SSF holding more strongly inhibits small-scale (vs. large-scale), state-owned (vs. non-state-owned), and non-eastern (vs. eastern) enterprises in China. Furthermore, SSF holding can alleviate corporate value impairment caused by financialization. The conclusions enrich theoretical research and provide empirical evidence that may help regulatory authorities to guide investment by enterprises and prevent financial risks.

1. Introduction

To promote sound economic development, the report of the 19th National Congress of the Communist Party of China (CPC) emphasized the need to strengthen the financial sector's ability to serve the real econ-

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omy and enhance supervision to prevent an economic "transition from the real to the virtual." The Second Session of the 13th National People's Congress also proposed that the financial sector's support for non-financial enterprises (hereafter "enterprises") should be government-guided. These policies illustrate the main and auxiliary roles of the real sector (e.g., manufacturing industry) and the virtual sector (e.g., financial industry), respectively, in China's economic system. The 2008 financial crisis drew extensive governmental and academic attention to the relationship between finance and the real economy. In response to this crisis, the Social Security Fund (SSF) promptly changed its investment policy to stress "prudent investment, safety first, controlling risks and increasing returns" (https://www.ssf.gov.cn/portal/index.htm), thus adopting a more cautious attitude toward financial investment as early as 2008. However, as enterprises' return on investment continued to decline (Zhang and Zhang, 2016), many entered the financial field, seeking new profit through cross-industry arbitrage (Duchin et al., 2017). This ultimately led to the trend of "enterprise financialization," in which enterprises increasingly allocate or invest in an increasingly high percentage of financial assets (Wang et al., 2017). In terms of absolute quantity, the financial assets held by China's non-financial enterprises have increased yearly since 2009 (Zhang and Zhang, 2016; Hu et al., 2017; Xu and Guo, 2021). Following the financial crisis in 2008, the proportion of financial assets held by China's non-financial enterprises reached a high level as profit accumulation based on financial channels gradually became the dominant mode of corporate profitability (Zhang and Zhang, 2016). However, as the impact of the crisis subsided, the proportion of financial assets held by non-financial listed companies persistently failed to return to its previous low level; instead, it has increased significantly since 2012 (Fig. 1). Such "off-track" business behavior makes a large amount of capital "idle" after flowing into the virtual sector, which brings a high return on investment but also risks causing violent fluctuations in the capital market and a "squeezing effect" of non-financial investment (Zheng et al., 2019). Moreover, a recurrent claim in the literature is that in developed and some developing economies, the financialization of enterprises can be detrimental to their development (Orhangazi, 2008; Demir, 2009; Davis, 2016). Indeed, financialization is currently a focus of attention in both academic and practical circles (Du et al., 2017).

The investment behaviors of enterprises can be affected by many factors, so firm-level investment decisions are not necessarily the main driver. However, the trend of enterprise financialization is worth noting. After all, enterprises in non-financial industries are representatives of the real sector, so if this sector generally pursues financial income and even allows financial investment to dominate its operations, this phenomenon is worthy of concern (Zhang and Zheng, 2018). As shown in Fig. 2, as the degree of their financialization increases, the value of enterprises generally shows a downward trend. To curb enterprises' excessive financialization and prevent and control financial risks, it is crucial to establish how the latter process can be prevented. The optimal approach is to explore the factors inhibiting financialization. However, to the best of our knowledge, scholars do not discuss this issue extensively (Demir, 2009; Xie et al., 2014; Peng et al., 2018; Du et al., 2019; Tang and Zhang, 2019). Thus, further research is necessary. Additionally, the operation of enterprises in China, compared with other countries, is more likely to be affected by the actions of the government. Based on this assumption, we conjecture that China's SSF, a public fund, also plays the role of a financial policy tool con-

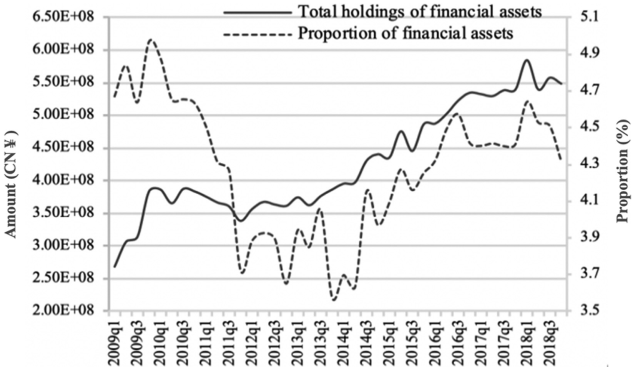

Fig. 1. Changes in the holding of financial assets of non-financial enterprises in China (2009–2018).

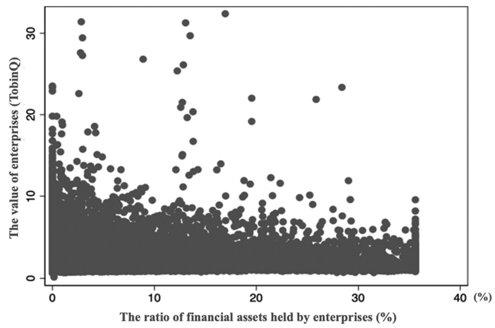

Fig. 2. Relationship between enterprises' value and proportion of financial assets.
Data source: The China Stock Market & Accounting Research (CSMAR) database.

necting national macroeconomic policies with the micro-behaviors of enterprises and a strategic institutional investor, is well positioned to guide enterprises' investment. Therefore, its shareholding in listed companies is expected to have a significant impact on the allocation of investment assets. An in-depth study on this issue will help solve the problems related to the financialization of enterprises.

In recent years, with the scale of investment increasing, the SSF has become one of the most important institutional investors in China's capital market. By the end of 2018, the total investment assets of the SSF had increased from 20 billion in 2000 to 2,235.378 billion yuan. In essence, with the primary objectives of improving people's livelihoods, promoting fairness and maintaining stability, the SSF is the material foundation supporting the national social security system. Therefore, unlike other institutional investors in the market, such as mutual funds and QFIIs, the SSF focuses on sharing the benefits of national economic growth and facilitating the sound development of the macroeconomy.[1] As a public fund incorporated into the government's budget management, its investment behaviors, to a certain degree, represent national investment behavior and the direction of industrial development. For example, under the guidance of the policy of "transition from the virtual to the real," (Du et al., 2017; Peng et al., 2018) the SSF began to subscribe to industrial investment funds as early as 2016. By directly supporting the development of the real economy, the SSF plays a leading role in the transition from the virtual to the real. Similarly, if the SSF can actively fulfill its governmental fund function, SSF holding is likely to have an inhibitory effect on the financial investment by enterprises it holds.

The main aim of our study is to determine whether and how SSF holding affects the financialization of Chinese enterprises. As a powerful executor of national investment policies, the SSF is required to actively respond to the policy requirements of the CPC Central Committee and the State Council and embody the spirit of "transition from the virtual to the real" by guiding the financial investment decisions of its holding enterprises. This leads us to explore whether the SSF really plays a role in restricting financialization in the actual investment process. To answer this question, we select A-share non-financial listed Chinese companies in 2009–2018 as our research sample. Our study finds that SSF holding has a significant negative impact on financialization, and this finding remains valid after addressing the potential problem of endogeneity. In addition, the inhibitory effect is stronger for enterprises with a higher degree of financialization. Further analysis shows that the role of SSF holding in inhibiting financialization is achieved through active participation in corporate governance. This role varies in tests of different groups based on size, property rights, and location. Furthermore, SSF holding weakens the negative association between financialization and enterprise value.

Our study contributes to the literature in several important ways. First, there are few studies on SSF holding, most of which investigate its influence on earnings management and dividend policies (Jin et al., 2016; Li et al., 2018). And, no scholars pay attention to the relationship between SSF holding and enterprises' financial investment, our study helps to fill this gap. Second, we focus on the role of a government fund, the SSF, in the financialization of enterprises, whereas the previous literature in this area focuses directly on macro policies

[1] For more information, please visit https://www.southmoney.com/caijing/caijingyaowen/201504/306783.html.

(Peng et al., 2018), factors internal to enterprises, or the effect of institutional investors as a whole. Meanwhile, we study not only the direct effect of SSF holding on the financialization of enterprises but also the non-linear nature and mechanism of this effect, as well as providing extensive evidence, such as insights into the effects of SSF holding on financialization under different circumstances, to supplement financialization research. Third, we find that SSF holding significantly inhibits financialization, which is a discussion on the factors influencing the financialization of enterprises from the perspective of SSF holding. Our conclusions suggest ways to prevent and mitigate the problems associated with enterprise financialization and a micro-level approach to supporting the realization of sound economic development, with important policy implications for China and other countries.

The remainder of this paper proceeds as follows. The next section presents the theoretical analysis and research hypothesis. The third section describes the research design. The fourth section presents our regression results and tests our hypothesis. The fifth section reports tests for further analysis. The final section concludes the study with a summary and a discussion of policy implications.

2. Theory and hypothesis

It is generally recognized that enterprises improve their core competitiveness by concentrating resources in business activities, so fixed assets and intangible assets are always their key reserves (Zhang and Zhu, 2007). However, with the continuing trend of global economic financialization, growing awareness of financial investment and the increasing diversity of financial investment channels, financial investment has gradually become an essential form of investment for (non-financial) enterprises. The choice of allocation between physical and financial assets has become a problem that many enterprises need to confront (Hu et al., 2017; Duchin et al., 2017).

Theoretically, the financial investment behaviors of enterprises are influenced by shareholder value (Froud et al., 2000). Zhang and Zheng (2018) point out that an increase in financial transactions and a reduction in productive investment, i.e., financialization, constitute a process by which corporate governance maximizes value for short-term shareholders. Wang et al. (2016) similarly hold that this kind of cross-industry arbitrage is a short-term behavior. In other words, if institutional investors tend to pursue the maximization of short-term profits, they will promote financialization and strongly influence enterprises' investment behaviors by participating in their corporate governance (Stockhammer, 2004; Xie et al., 2014). Some studies show that, sometimes, institutional investors care more about short-term than long-term earnings (Laverty, 1996; Callen and Fang, 2013). However, unlike other institutional investors in the stock market, the SSF is a typical public fund with "national team" characteristics (Leckie and Pan, 2007; Tang and Wu, 2020). This places the SSF at the boundary between the government and the market in the investment process and gives it an essential transmission role in the path from macro-economic policies to micro-enterprise behaviors, i.e., providing industry guidance. Therefore, in addition to pursuing investment income, the SSF is responsible for fulfilling public trusteeship and undertaking political tasks such as enacting national strategies (Li et al., 2016). Thus, the SSF can be classified as a dedicated institutional investor, as it focuses on long-term rather than short-term objectives (Bushee, 1998, 2001). Guided by the principle of "long-term, valuable and responsible investment," (https://www.ssf.gov.cn/portal/index.htm), the SSF is likely to behave as a prudent shareholder in the allocation of investment assets. Thus, responding to the state's call to "let finance serve the real economy,"[2] the SSF should be cautious about the financial investment decisions made by enterprises and eschew the short-sighted behaviors, i.e., allocating more assets for financial investment mentioned above.

In addition, due to its special status as an industry guidance fund, the SSF is likely to exert an inhibitory effect on the financial investment of enterprises. Institutional shareholder activism is generally a natural consequence of the existence of a restrictive external control market (Karpoff, 2011), and institutional investors have a positive influence on corporate governance (Bertrand and Mullainathan, 2001). Compared with general individual investors, institutional investors are better able and more motivated to supervise management.

[2] China's 2017 National Financial Work Conference proposed that finance should take serving the real economy as its starting and ending point, after which the spirit of letting finance serve the real economy has been constantly mentioned in important economic conferences and other essential documents such as government work reports.

From the perspective of ability, they have greater financial strength and scale advantages and more professional knowledge, and are better able to discover information (Utama and Cready, 1997). Holding the shares of many enterprises enables them to accumulate practical experience that can be transferred to corporate governance (Li and Li, 2008). From the perspective of motivation, institutional investors tend to hold a large proportion of shares, meaning that their gains from supervision often exceed the costs, thus overcoming the "free rider" problem (Grossman and Hart, 1980; Shleifer and Vishny, 1986). In addition, as the identity of institutional investors is relatively independent and they tend to focus on long-term investment value, such investors are particularly motivated to supervise managers (Bushee, 2001; Pan et al., 2011). Furthermore, regarding issues related to national strategic compliance, the SSF—as a strategic institutional investor with public fund attributes—is unlikely to "stand by" during crises (Leckie and Pan, 2007).

The components and investment mechanisms of the SSF are predominantly state-owned, and it is bound to serve the goals pursued by the government. Compared with other institutional investors, the SSF pays more attention to the value of invested enterprises and tends to make more long-term investments; hence, it more actively participates in corporate governance. Studies indicate that the SSF is more likely than other institutional investors to show shareholder activism due to the political influence it faces, its greater independence, and the lower risk of retaliation (Karpoff, 2011). It is also more likely to guide other major shareholders to "vote with their hands" due to its attributes as an industry guidance fund, supervising and even intervening in management through specific governance mechanisms and ultimately improving the corporate governance of the enterprises it holds. In addition, as a government fund, the SSF can "vote with its feet" by selling its stock holdings and express opinions on corporate governance by affecting enterprises' stock prices directly (Westphal and Bednar, 2008; Hope, 2013). Many studies show that the improvement of corporate governance can inhibit the financialization of enterprises to a certain extent and restrict managers' investment in financial assets (Crotty, 2003; Stockhammer, 2004; Yan and Chen, 2018). In theory, good corporate governance indeed reduces the short-sightedness of management and prevents managers from over-allocating capital to financial assets with shorter profit cycles for the sake of short-term performance. As an independent institutional investor, the SSF can play an active role through supervision and other possible means in curbing excessive investment by its holding enterprises, whereas poorly managed enterprises tend to over-invest and increase their financial asset allocation (Harford et al., 2008). Thus, it can be conjectured that SSF holding improves corporate governance and consequently inhibits financialization. Therefore, we propose the following testable hypothesis.

The higher the shareholding ratio of the SSF, the lower the degree of financialization of the corresponding enterprises.

3. Research design

3.1. Data and sample

New Chinese accounting standards were implemented in 2007. It not only supplements the new standard but also revises the general principles of the original accounting. From the perspective of data availability, 2007 should therefore be the first year of our sample data. However, the quality of data in 2007 and 2008 is relatively low (Wang et al., 2016), and the capital market was hit by the financial crisis in 2008. Therefore, we select A-share listed companies in 2009–2018 as the sample (a total of 40 quarters of sample data), and then filter and process the initial sample according to the following criteria: (1) excluding financial companies; (2) excluding companies listed in the current year; (3) excluding ST and *ST companies; (4) excluding observations with missing values; and (5) winsorizing the continuous variables at the 1% level to reduce the impact of outliers on the results. Data on SSF holding, SSF managers and other related variables are from the Wind database, and financial data are from the CSMAR database. The final dataset has an unbalanced panel structure with 69,451 firm-year observations.

3.2. Model and variables

To test the impact of SSF holding on the financialization of enterprises, we construct the following multiple regression model:

$$FINR_{i,t} = \beta_0 + \beta_1 SSFR_{i,t} + \beta CVs + YEAR\ FE + FIRM\ FE + \varepsilon_{i,t} \tag{1}$$

where i and t denote the enterprise and time, respectively. The dependent variable *FINR* indicates the degree of financialization of each enterprise. Following Du et al. (2017), we measure this indicator by the ratio of financial assets to total assets. Our definition of financial assets differs from the provisions of traditional financial accounting standards in corporate accounting (e.g., Accounting Standards for Enterprises No. 22 - Recognition and Measurement of Financial Instruments) in two ways. First, financial assets here do not include monetary funds. As the main purpose of holding money is to pay for daily production and operations, it does not bring capital appreciation to enterprises. Second, financial assets in this study do include investment in real estate. Due to the current rapid development of China's real estate industry, the purpose of holding an investment in real estate for many enterprises has gradually become that of profit-seeking, which brings such investment in the definition of financial assets in this study. The main independent variable, *SSFR*, represents the shareholding ratio of the SSF.

As suggested by previous research (Hu et al., 2017; Li et al., 2018; Peng et al., 2018), we control for control variables (CVs) related to corporation conditions and market environment. First, enterprises' financialization is closely linked to firm features such as financial characteristics and governance structures. Thus, we incorporate the following two types of variables. (1) Financial characteristics of enterprises: *SIZE* (the natural logarithm of total assets); *LEV* (the ratio of total liabilities to total assets); *GROW* (the growth rate of operating income); *ROA* (the ratio of total profit to total assets); and *CFO* (the ratio of cash flow from operating activities to total assets). (2) Corporate governance characteristics: *BOARD* (the number of board members); *INDSIZE* (the ratio of the number of independent directors to the total number of directors); *TOP1* (the ratio of the number of shares held by the largest shareholder to the total number of shares); *DUAL* (whether the chairman and general manager are the same person, one for yes and zero for no); *IO* (the shareholding ratio of all other institutional investors to that of the SSF); and *SOE* (one for state-owned enterprises and zero for non-state-owned enterprises). As other factors external to enterprises in the capital market are also likely to play a role in enterprises' financialization, we further control for two other types of variables, as follows. (3) Regional characteristics: *EAST* (one for enterprises in eastern China and zero otherwise). (4) Macroeconomic characteristics: *GDP* (GDP quarterly growth rate); *M2GROW* (M2 quarterly growth rate); and *LOANR* (bank loan interest rate). Additionally, we incorporate time fixed effects (*YEAR FE*) and firm individual fixed effects (*FIRM FE*). Detailed definitions of these variables are shown in Appendix A.

4. Empirical results and analysis

4.1. Descriptive statistics

The mean value of the financialization of enterprises (*FINR*) during the sample period is 3.014%, the standard deviation is 6.181 and the gap between the maximum and minimum value is large, suggesting that the variation in financialization among enterprises in China is relatively significant. The mean shareholding ratio of the SSF (*SSFR*) is 0.5%, its minimum and maximum are 0 and 6.6% respectively and its P75, i.e., the 75% quantile, is still 0, which all demonstrate that the SSF does not yet widely possess holdings in listed companies. The mean size of the companies (*SIZE*) is 22.086, which is roughly consistent with previous studies (e.g., Hu et al., 2017; Chen et al., 2020; Hope et al., 2020). The values of *SOE* and *EAST* show that our sample is dominated by non-state-owned enterprises and enterprises in eastern China. The values of other variables are within reasonable ranges, indicating that these variables do not have abnormal effects on the results of this study (Table 1).

Table 1
Descriptive statistics.

Variable	N	Mean	Std. Dev.	Min	Max	P25	P50	P75
*FIN*R (%)	69,451	3.014	6.181	0.000	35.591	0.000	0.448	2.812
SSFR	69,451	0.005	0.012	0.000	0.066	0.000	0.000	0.000
SIZE	69,451	22.086	1.274	19.959	26.062	21.144	21.883	22.807
LEV	69,451	0.411	0.206	0.042	0.844	0.241	0.406	0.572
ROA	69,451	0.035	0.038	–0.040	0.178	0.009	0.025	0.051
GROW	69,451	0.389	0.787	–0.887	2.677	–0.110	0.483	0.860
CFO	69,451	0.016	0.059	–0.150	0.188	–0.017	0.013	0.048
BOARD	69,451	8.763	1.746	5.000	15.000	8.000	9.000	9.000
INDSIZE	69,451	0.373	0.053	0.333	0.571	0.333	0.333	0.429
TOP1	69,451	35.275	14.847	9.000	74.450	23.470	33.480	45.330
DUAL	69,451	0.748	0.434	0.000	1.000	0.000	1.000	1.000
IO	69,451	0.032	0.040	0.000	0.186	0.000	0.016	0.049
SOE	69,451	0.396	0.489	0.000	1.000	0.000	0.000	1.000
EAST	69,451	0.693	0.461	0.000	1.000	0.000	1.000	1.000
GDP (%)	69,451	7.667	1.357	6.400	12.200	6.700	7.100	7.900
M2GROW (%)	69,451	3.236	1.777	0.930	10.560	1.790	3.240	3.870
LOANR (%)	69,451	5.226	0.811	4.350	6.560	4.350	5.310	6.000

4.2. Empirical results

4.2.1. The overall impact of SSF holding on financialization

The test results for the impact of SSF holding on financialization are shown in Table 2. The CVs are progressively added in columns (1), (2), and (3); only the individual fixed effects are controlled in column (4); and both the time and individual fixed effects are controlled in column (5). The coefficients of *SSFR* are all statistically significant and negative at the 1% level, suggesting that SSF holding reduces the degree of financialization of enterprises. This finding reflects the SSF's compliance with the national policy of "transition from the virtual to the real." The SSF has evidently implemented the concept of long-term value investment and thus has an inhibitory effect on the deviation of enterprises from their main business. This result still holds when the other CVs are controlled for.

4.2.2. Difference analysis: A non-linear impact

The previous tests show that SSF holding can reduce the degree of financialization of enterprises. Next, we test whether the inhibitory effect differs for enterprises with different degrees of financialization. We divide our sample into high financialization groups (H*i*) and low financialization groups (L*i*) on the basis of *FINR*, where *i* are the *i*-th quantiles of *FINR*. For example, enterprises in group H3 are those above the tertile of *FIN*R, and enterprises in group L3 are those below the tertile of *FINR*. Table 3 tabulates the results of this group test.

It can be seen from Table 3 that the coefficients of groups H*i* are all significantly negative, whereas those of groups L*i* are all insignificant, which indicates that SSF holding has a stronger inhibitory effect on enterprises with a higher degree of financialization. Thus, the impact of SSF holding on financialization is non-linear. We conjecture that it only acts to regulate enterprises with an excessive degree of financialization. As can be seen from the descriptive statistics, the average degree of financialization of China's enterprises is currently 2.905%, which is notably high.

4.3. Robustness tests

4.3.1. Endogeneity: Lagging variable analysis

The above tests confirm that SSF holding can inhibit the financialization of enterprises. However, it is also likely that enterprises with a low degree of financialization are more likely to be held by the SSF, implying potential endogeneity problems caused by reverse causality. Hence, to make our findings more persuasive, referring to Du et al. (2019) we retest the above question while lagging variables for one period, including

Table 2
The impact of SSF holding on the financialization of enterprises.

Variable	(1) *FINR*	(2) *FINR*	(3) *FINR*	(4) *FINR*	(5) *FINR*
SSFR	−4.873***	−4.508***	−4.956***	−4.949***	−4.383***
	(−3.77)	(−3.49)	(−3.84)	(−3.84)	(−3.40)
SIZE		−0.399***		−0.183***	−0.422***
		(−9.27)		(−4.57)	(−9.78)
LEV		−2.378***		−2.750***	−2.458***
		(−14.47)		(−16.90)	(−14.96)
ROA		0.950*		−1.262**	−0.629
		(1.82)		(−2.40)	(−1.16)
GROW		0.040**		−0.118***	−0.058***
		(2.33)		(−6.42)	(−2.98)
CFO		−0.237		−1.472***	−0.713**
		(−0.80)		(−5.01)	(−2.39)
BOARD		0.044**		0.026	0.046**
		(2.41)		(1.44)	(2.54)
INDSIZE		0.945**		0.889*	0.941**
		(1.98)		(1.86)	(1.97)
TOP1		−0.014***		−0.018***	−0.013***
		(−4.97)		(−6.45)	(−4.81)
DUAL		−0.084		−0.092*	−0.086
		(−1.57)		(−1.72)	(−1.61)
IO		−1.599***		−0.845**	−1.228***
		(−3.98)		(−2.12)	(−3.05)
SOE		0.319**		0.277**	0.313**
		(2.32)		(2.01)	(2.28)
EAST			0.414	0.184	0.066
			(1.09)	(0.48)	(0.17)
GDP			−0.051**	−0.165***	−0.091***
			(−2.31)	(−13.02)	(−3.98)
M2GROW			−0.073***	−0.166***	−0.121***
			(−7.43)	(−18.12)	(−10.14)
LOANR			−0.278***	−0.985***	−0.323***
			(−3.70)	(−46.01)	(−4.29)
Constant	1.987***	11.237***	4.141***	15.286***	15.150***
	(36.52)	(11.89)	(7.92)	(14.60)	(13.57)
YEAR FE	YES	YES	YES	NO	YES
FIRM FE	YES	YES	YES	YES	YES
Obs	69,451	69,451	69,451	69,451	69,451
R-squared	0.073	0.080	0.074	0.077	0.082
N	2,721	2,721	2,721	2,721	2,721
F	526.41	276.44	382.92	348.57	238.31

Note: t-statistics are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Unless otherwise indicated, the same applies to subsequent tables.

Table 3
The impact of SSF holding on the financialization of enterprises with different degrees of financialization.

Variable	(1) H2 *FINR*	(2) L2 *FINR*	(3) H3 *FINR*	(4) L3 *FINR*	(5) H4 *FINR*	(6) L4 *FINR*	(7) H5 *FINR*	(8) L5 *FINR*
SSFR	−11.045***	0.104	−9.130***	0.355	−11.462***	−0.043	−7.953*	−0.458
	(−4.69)	(1.34)	(−2.95)	(−1.47)	(−2.85)	(−0.15)	(−1.67)	(−1.11)
SIZE	−0.938***	0.032***	−0.938***	0.024***	−1.363***	0.025**	−1.418***	0.051***
	(−11.68)	(11.01)	(−8.26)	(−2.71)	(−9.30)	(−2.30)	(−8.04)	(−3.57)
LEV	−5.138***	−0.071***	−5.000***	−0.251***	−5.060***	−0.171***	−5.842***	−0.119**
	(−17.17)	(−6.59)	(−12.80)	(−7.49)	(−10.42)	(−4.32)	(−10.31)	(−2.17)
ROA	−4.058***	−0.030	−5.867***	−0.200**	−6.506***	−0.185*	−6.225***	−0.05
	(−4.40)	(−0.88)	(−5.02)	(−2.08)	(−4.56)	(−1.69)	(−3.83)	(−0.29)
GROW	−0.081**	−0.005***	−0.121***	−0.003	−0.179***	−0.003	−0.151**	0.001
	(−2.48)	(−4.33)	(−2.87)	(−1.03)	(−3.44)	(−0.82)	(−2.45)	(−0.23)
CFO	−0.273	0.029	0.441	0.150***	1.209	0.161***	−0.276	0.200***
	(−0.55)	(1.55)	(−0.68)	(−2.97)	(−1.52)	(−2.98)	(−0.30)	(−2.88)
BOARD	0.076**	−0.005***	−0.076*	0.002	−0.100*	0.016***	−0.086	0.005
	(2.41)	(−3.64)	(−1.77)	(−0.46)	(−1.81)	(−3.07)	(−1.33)	(−0.76)
INDSIZE	1.798**	−0.132***	−2.278**	−0.473***	−1.038	−0.103	−1.984	−0.289
	(2.16)	(−4.18)	(−2.06)	(−4.29)	(−0.73)	(−0.79)	(−1.18)	(−1.51)
TOP1	−0.007	−0.001***	0.006	−0.003***	0.003	−0.005***	−0.002	−0.003***
	(−1.34)	(−6.97)	(−0.83)	(−5.89)	(−0.38)	(−6.68)	(−0.22)	(−3.03)
DUAL	0.202**	−0.018***	0.265**	−0.024**	0.473***	0.002	0.694***	−0.026
	(2.11)	(−5.32)	(−2.16)	(−2.23)	(−3.13)	(−0.17)	(−3.98)	(−1.40)
IO	−1.517**	0.004	−0.286	0.019	−0.956	−0.204**	−0.776	−0.441***
	(−2.19)	(0.14)	(−0.31)	(−0.24)	(−0.85)	(−2.21)	(−0.59)	(−3.58)
SOE	0.652***	−0.024**	0.724***	−0.062**	1.005***	−0.092***	1.229***	−0.101**
	(2.82)	(−2.48)	(−2.64)	(−2.06)	(−2.98)	(−2.78)	(−3.1)	(−2.19)
EAST	−0.545	−0.053**	0.108	0.606***	0.215	0.354***	1.292	0.450***
	(−0.81)	(−2.26)	(−0.14)	(−5.24)	(−0.24)	(−3.66)	(−1.14)	(−4.29)
GDP	−0.119***	−0.009***	−0.128***	−0.016***	−0.135**	−0.013**	−0.115*	−0.004
	(−3.09)	(−6.73)	(−2.63)	(−3.09)	(−2.24)	(−2.46)	(−1.67)	(−0.54)
M2GROW	−0.190***	−0.007***	−0.220***	−0.015***	−0.259***	−0.014***	−0.236***	−0.003
	(−9.54)	(−9.58)	(−8.66)	(−6.26)	(−8.27)	(−4.78)	(−6.48)	(−0.91)
LOANR	−0.468***	−0.049***	−0.656***	−0.057***	−0.788***	−0.074***	−0.463**	−0.028
	(−3.74)	(−10.79)	(−4.11)	(−4.62)	(−4.00)	(−4.18)	(−2.05)	(−1.39)
Constant	30.970***	−0.058	36.062***	−0.169	47.522***	−0.183	47.596***	−0.965***
	(15.20)	(−0.78)	(−12.83)	(−0.73)	(−13.1)	(−0.68)	(−10.94)	(−2.71)
YEAR FE	YES	YES	YES	YES	YES	YES	YES	YES
FRIM FE	YES	YES	YES	YES	YES	YES	YES	YES
Obs	35,782	33,652	24,060	13,421	17,702	7,172	14,286	2,998
R-squared	0.096	0.289	0.102	0.172	0.109	0.196	0.115	0.215
N	2,044	2,241	1,684	1,510	1,418	1,097	1,258	362
F	143.18	509.97	101.79	98.60	79.35	59.10	67.75	28.65
Mean	5.7031	0.1077	7.9640	0.1245	9.4664	0.0913	10.8728	0.1187

Note: *Mean* represents the mean value of the financialization level of enterprises expressed as a percentage.

our independent variable and CVs. The results in column (1) of Table 4 show that the coefficient of *SSFR* remains significantly negative at the 1% level, which confirms the robustness of our above conclusions.

4.3.2. Endogeneity: Instrumental variable analysis

We further use the instrumental variable (IV) approach to eliminate any endogeneity caused by reverse causality. We select the total amount of equity and the total number of shareholders as our IVs for testing. There is no evidence in the literature that these IVs directly affect financialization, but they may affect the shareholding ratio of the SSF. The test results are reported in columns (2) and (3) of Table 4. First, the *F* statistic of the first test stage is larger than the empirical value of 10, indicating that these selected IVs are

Table 4
Robustness test: Lagging variables, independent variable (IV) analysis and PSM test.

Variable	(1) Lagging variables *FINR*	(2) IV – first stage *SSFR* (%)	(3) IV – second stage *FINR*	(4) PSM test *FINR*
SSFR	−4.926***		−1.136***	−3.347**
	(−3.83)		(0.00)	(−2.20)
LNTE		0.133***		
		(0.00)		
LNTH		−0.424***		
		(0.00)		
SIZE	−0.377***	0.261***	−0.210	−0.315***
	(−8.56)	(0.00)	(−0.27)	(−4.49)
LEV	−2.393***	−0.326**	−2.892***	−1.380***
	(−14.39)	(0.01)	(0.00)	(−5.14)
ROA	−1.125**	1.193***	0.992	0.392
	(−2.07)	(0.00)	−0.45	(0.48)
GROW	0.018	0.001	−0.070***	−0.037
	(0.93)	(0.79)	(0.00)	(−1.22)
CFO	−0.038	−0.021	−0.805	−0.605
	(−0.13)	(0.86)	(0.15)	(−1.27)
BOARD	0.035*	0.001	0.058	0.039
	(1.93)	(0.91)	(0.37)	(1.38)
INDSIZE	0.788	−0.057	0.912	2.064***
	(1.64)	(0.86)	(0.51)	(2.72)
TOP1	−0.015***	−0.005**	−0.013	−0.013***
	(−5.30)	(0.04)	(0.26)	(−3.01)
DUAL	−0.036	0.043	−0.057	−0.110
	(−0.67)	(0.20)	(0.71)	(−1.26)
IO	−1.643***	−0.469*	−0.422	−2.259***
	(−4.07)	(0.06)	(0.67)	(−3.84)
SOE	0.179	−0.052	0.205	−0.113
	(1.28)	(0.62)	(0.76)	(−0.49)
EAST	−0.141	0.178*	0.180	0.486
	(−0.37)	(0.07)	(0.79)	(0.65)
GDP	−0.046**	−0.004	−0.092***	−0.029
	(−2.03)	(0.50)	(0.00)	(−0.73)
M2GROW	−0.080***	0.009***	−0.111***	−0.107***
	(−6.79)	(0.00)	(0.00)	(−5.66)
LOANR	−0.277***	−0.071***	−0.342***	−0.378***
	(−3.76)	(0.00)	(0.00)	(−3.31)
Constant	13.572***	−3.061***	10.968***	11.571***
	(12.01)	(0.00)	(0.00)	(6.32)
YEAR FE	YES	YES	YES	YES
FIRM FE	YES	YES	YES	YES
Obs	67,910	69,426	69,426	26,340
N	2,720	2,720	2,720	2,512
R-squared	0.082	0.096	–	0.083
F	233.04	12.20	–	85.99
Sargan–Hansen statistic	–	–	2.126	–
			(0.145)	

Note: In columns (2) and (3), p-values are in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

strongly correlated with the endogenous independent variable and the problem of weak IVs can be excluded. Second, the result of the Sargan–Hansen statistic test is insignificant, so the null hypothesis that all variables are exogenous cannot be rejected, indicating that the IVs we choose are effective. Finally, the regression results of the second stage show that the coefficient of *SSFR* remains significantly negative, consistent with the results of the benchmark model, which verifies that SSF holding does have an inhibitory effect on financialization.

4.3.3. Endogeneity: Propensity score matching test

To deal with the issue of sample selection bias, we adopt the propensity score matching (PSM) method as a robustness test. First, we perform logit regression with the indicative variable SSF holding (*SSFD*) as the dependent variable and 13 characteristic variables: *SIZE*, *AGE*, *BOARD*, *INDSIZE*, *IO*, *SOE*, *ROA*, *LEV*, *GROW* and *CFO* as previously defined, and the newly defined variable *BIG4* (representing auditor type, equaling one if the enterprise's auditors are from PwC, DTT, KPMG or EY, and zero otherwise), *TobinQ* (Tobin's Q ratio, measured by the market value of the enterprise divided by the replacement cost of its assets) and *TURN* (turnover on assets, measured by sales revenue divided by total assets). Next, we use the probability values to perform nearest neighbor matching.[3] The results in column (4) of Table 4 show that the coefficients of *SSFR* remain significantly negative, further supporting our hypothesis.

4.4. Alternative financialization measures

4.4.1. Measuring financialization from a revenue perspective

Here, referring to Zhang and Zhang (2016), we measure the financialization of enterprises in terms of income, as follows: Financial profit (*FIN1*) = (investment income + fair value change gains and losses + net exchange gains – investment income of associated or joint ventures) / operating profit.

4.4.2. Adopting an absolute scale of financialization

Hu et al. (2017) argue that although "relative scale" (the ratio of financial assets to total assets) is a common measure of financial assets, this ratio may be distorted by factors other than the holding decisions of financial assets, such as decreases in total assets. Thus, we rerun the above tests using the absolute scale of financial assets (*FIN2*). The definition of financial assets is the same as before, and the natural logarithm is taken when regressing.

4.4.3. Measuring financialization through cross-industry arbitrage behavior

According to Wang et al. (2017), any enterprise that receives income from the financial industry or the real estate industry shows financialization behavior. Hence, we use cross-industry arbitrage behavior (*FIN3*) as a proxy variable for financialization, which equals one if an enterprise has one or both of the above kinds of income and zero otherwise. The results in columns (1), (2) and (3) of Table 5 indicate that the coefficients of *SSFR* are all statistically significant and negative at the 1% level, implying that our findings are not sensitive to the proxy of financialization.

4.5. Alternative regression method

Although the degree of financialization for all firms is restricted to positive values, some enterprises' financialization is close to zero. Therefore, the sample can be subjected to a censored regression model, the Tobit model. We use Tobit regression to perform a retest. The results are presented in column (4) of Table 5. It can be seen that the coefficient of *SSFR* remains significantly negative, which further suggests that SSF holding exerts an inhibitory effect on financialization.

4.6. The impact of the four trillion yuan stimulus plan

At the end of 2008, the Chinese government announced a four trillion yuan stimulus plan. As enterprises with SSF holdings are likely to have close connections with the government, this stimulus plan may have helped them to obtain external financial support. As such, those enterprises would have focused more on their main business operations and reduced financial investments accordingly. This would have weakened the role of the SSF.[4] As the time frame of the stimulus plan was from late 2008 to the end of 2010, i.e., covering all of

[3] The results of tests of the assumptions of the PSM method are reported in Appendix B.

[4] We thank one of the anonymous reviewers for this suggestion.

Table 5
Robustness test: Alternative financialization measures and regression method.

Variable	(1) *FIN1*	(2) *FIN2*	(3) *FIN3*	(4) *FINR*
SSFR	−0.391***	−2.139***	−5.222***	−24.038***
	(−2.89)	(−3.90)	(−6.17)	(−13.02)
SIZE	0.004	0.624***	0.607***	0.390***
	(0.99)	(34.10)	(55.55)	(15.62)
LEV	−0.038**	−0.233***	0.145**	−3.783***
	(−2.17)	(−3.28)	(2.15)	(−25.11)
ROA	0.426***	−0.497**	0.165	−1.221*
	(7.51)	(−2.22)	(0.51)	(−1.68)
GROW	−0.001	−0.026***	0.013	−0.155***
	(−0.35)	(−3.35)	(0.92)	(−4.76)
CFO	−0.140***	0.091	0.162	−0.544
	(−4.46)	(0.75)	(0.85)	(−1.27)
BOARD	−0.007***	0.002	−0.018***	−0.127***
	(−3.71)	(0.22)	(−2.71)	(−8.15)
INDSIZE	−0.010	0.217	1.502***	−0.491
	(−0.20)	(1.11)	(7.46)	(−1.04)
TOP1	−0.001***	−0.005***	−0.004***	−0.019***
	(−3.95)	(−4.19)	(−5.63)	(−12.30)
DUAL	0.022	0.173***	0.169***	0.173***
	(0.95)	(3.25)	(6.93)	(3.25)
IO	−0.117***	−0.804***	−0.689***	−2.601***
	(−2.76)	(−4.79)	(−2.75)	(−4.52)
SOE	0.001	0.112**	−0.355***	1.229***
	(0.04)	(2.02)	(−14.89)	(22.59)
EAST	0.226	1.017***	0.361***	1.017***
	(1.44)	(20.59)	(16.17)	(20.59)
GDP	−0.005*	−0.050***	−0.040**	−0.112***
	(−1.92)	(−5.17)	(−2.38)	(−2.87)
M2GROW	−0.007***	−0.058***	−0.061***	−0.140***
	(−5.68)	(−11.51)	(−6.94)	(−7.05)
LOANR	−0.167***	−0.307**	−0.082	−0.307**
	(−5.49)	(−2.39)	(−1.43)	(−2.39)
Constant	0.204*	4.909***	−13.223***	−0.747
	(1.74)	(10.41)	(−31.56)	(−0.78)
YEAR FE	YES	YES	YES	YES
FIRM FE	YES	YES	YES	YES
Obs	69,451	48,340	69,451	69,451
R-squared	0.008	0.280	–	–
N	2,721	2,422	–	–
F	20.47	715.04	–	–
LR chi^2	–	–	7389.93	10337.85
Log likelihood	–	–	−33539.83	−219879.62
Prob > chi^2	–	–	0.0000	0.0000
Pseudo R-squared	–	–	0.0992	0.0230

Note: In column (4), which reports Tobit regression results, z-statistics are presented in parentheses. In the other columns, t-statistics are in parentheses.

2009 and 2010, its effect can be eliminated or largely attenuated by excluding sample firms from these two years. Additionally, considering that the impact of the stimulus plan may have continued beyond then, we conduct tests that also exclude the sample firms from the first to the third year after the implementation of the plan, i.e., from 2009 to 2011, 2012 and 2013, in turn, to confirm that the SSF still plays a role in curbing corporate financialization even after the stimulus. The test results are reported in Table 6. The coefficients of *SSFR* remain negative and statistically significant, confirming again that our previous findings are not spurious.

Table 6
Robustness test: Considering the impact of the four trillion yuan stimulus plan.

Variable	(1) Excluding sample firms from 2009 to 2010 *FINR*	(2) Excluding sample firms from 2009 to 2011 *FINR*	(3) Excluding sample firms from 2009 to 2012 *FINR*	(4) Excluding sample firms from 2009 to 2013 *FINR*
SSFR	−3.243**	−2.897**	−2.490*	−2.324***
	(−2.46)	(−2.10)	(−1.75)	(−3.35)
SIZE	−0.559***	−0.569***	−0.191***	−0.666***
	(−12.08)	(−11.57)	(−6.56)	(−11.18)
LEV	−1.401***	−1.416***	−0.364***	−1.245***
	(−8.03)	(−7.55)	(−3.24)	(−5.51)
ROA	−1.312**	−1.279**	−0.006	−0.912
	(−2.30)	(−2.11)	(−0.01)	(−1.34)
GROW	−0.063***	−0.077***	−0.051***	−0.086***
	(−3.23)	(−3.79)	(−4.02)	(−3.73)
CFO	−0.333	−0.423	−0.255	0.007
	(−1.06)	(−1.26)	(−1.21)	(0.02)
BOARD	0.008	0.002	−0.014	−0.061**
	(0.42)	(0.10)	(−0.95)	(−2.24)
INDSIZE	0.114	0.108	1.222***	−0.899
	(0.22)	(0.20)	(2.78)	(−1.32)
TOP1	−0.011***	−0.007**	−0.008***	0.006
	(−3.79)	(−2.28)	(−3.88)	(1.48)
DUAL	−0.068	−0.091	−0.062*	−0.201***
	(−1.23)	(−1.57)	(−1.85)	(−2.89)
IO	−1.410***	−1.693***	−1.937***	−1.864***
	(−3.28)	(−3.67)	(−5.66)	(−3.39)
SOE	0.214	0.031	0.015	0.153
	(1.34)	(0.18)	(0.14)	(0.65)
EAST	0.283	0.660	0.454	0.425
	(0.63)	(1.30)	(1.44)	(0.62)
GDP	−0.238***	−0.074	−0.131	0.081
	(−3.65)	(−0.65)	(−1.49)	(0.36)
M2GROW	−0.127***	−0.159***	−0.105***	−0.217***
	(−9.88)	(−9.96)	(−10.62)	(−9.52)
LOANR	−0.382***	−0.347***	−0.317***	−0.408***
	(−4.85)	(−4.00)	(−6.44)	(−4.52)
Constant	19.846***	17.746***	8.487***	20.230***
	(14.09)	(11.68)	(8.46)	(9.33)
YEAR FE	YES	YES	YES	YES
FIRM FE	YES	YES	YES	YES
Obs	60,942	55,147	48,207	40,699
R-squared	0.090	0.090	0.124	0.060
N	2,717	2,717	2,715	2,715
F	249.46	234.26	305.41	121.41

5. Further analysis

5.1. Mechanism analysis

Due to their high shareholding ratio and rich experience in investment management, institutional investors are highly motivated and well equipped to constrain and supervise managers, reduce agency problems and improve operational efficiency, thus maximizing the long-term performance and market value of enterprises. This should be particularly true of the SSF, a key representative of the Chinese state's long-term strategic investors. However, although studies in western countries mostly agree that institutional investors are skilled at improving corporate governance (Hartzell and Starks, 2003; Ajinkya et al., 2005; Boehmer and Kelley, 2009; An and Zhang, 2013; Callen and Fang, 2013), some research on China's capital market questions this view (Pan et al., 2011). Nevertheless, for the sake of conservatism, we select proxy indicators of corporate governance to test the pathway proposed in the theoretical analysis, i.e., that the SSF reduces financialization by improving corporate governance.

We construct three models to test the pathway. The model in Eq. (2) tests the impact of SSF holding on financialization. If the coefficient v_1 is significant, then Eq. (3) can be used to test the effect of the independent variable (*SSFR*) on the mediator variable (*MV*); if the coefficient γ_1 is significant, the independent variable (*SSFR*) and the MV should both be included in Eq. (4) for analysis. If the coefficient μ_2 is significant and μ_1 is not, there is a complete mediating effect of SSF holding on financialization; if the coefficients μ_2 and μ_1 are both significant, there is a partial mediating effect; if the coefficient μ_2 is not significant, the mediating effect does not exist.

$$FINR_{it} = v_0 + v_1 SSFR_{it} + vCVs_{it} + YEARFE + FIRMFE + \varepsilon_{i,t} \tag{2}$$

$$MV_{it} = \gamma_0 + \gamma_1 SSFR_{it} + \gamma CVs_{it} + YEARFE + FIRMFE + \varepsilon_{i,t} \tag{3}$$

$$FINR_{it} = \mu_0 + \mu_1 SSFR_{it} + \mu_2 MV_{it} + \mu CVs_{it} + YEARFE + FIRMFE + \varepsilon_{i,t} \tag{4}$$

Li and Li (2008, P9) suggest that "institutional investors are involved in the governance of listed companies, which improve their corporate governance, and as a result, the agency costs of companies can be reduced." This implies that it is possible to judge whether the SSF exerts corporate governance effects by examining the impact of SSF holding on internal agency issues in enterprises. Therefore, referring to prior studies (Ang et al., 2000; Chen and Jiang, 2000; Du and Liu, 2002), we select direct proxy variables of corporate governance, namely the ratio of administrative expenses (*AEXP*) and asset turnover (*TURN*), and an indirect proxy variable of corporate governance, namely the main business profit rate (*MBPR*), as MVs for testing. The specific form of Eq. (3) for these three MVs is shown in Eq. (5), and the definition of each control variable is the same as that in Eq. (1).

$$\begin{aligned} AEXP_{it}/TURN_{it}/MBPR_{it} = {} & \alpha_0 + \alpha_1 SSFR_{i,t} + \alpha_2 SIZE_{i,t} + \alpha_3 LEV_{i,t} + \alpha_4 INDSIZE_{i,t} + \alpha_5 TOP1_{i,t} \\ & + \alpha_6 DUAL_{i,t} + \alpha_7 SOE_{i,t} + YEARFE + FIRMFE + \varepsilon_{it} \end{aligned} \tag{5}$$

In column (1) of Table 7, the coefficient of *SSFR* is −4.383, which is significant at the 1% level, and the coefficient of *SSFR* in column (2) is significant and negative at the 1% level, indicating that SSF holding reduces the rate of administrative expenses. The coefficients of *SSFR* and *TURN* in column (3) are significantly negative and positive, respectively, at the 1% level, indicating that corporate governance as measured by *AEXP* exerts a partial mediating effect between SSF holding and the financialization of enterprises. In column (1) of Table 8, the coefficient of *SSFR* is −4.377, which is significant at the 1% level, and in column (2) the coefficient of *SSFR* is significantly positive at the 1% level, indicating that SSF holding increases the asset turnover ratio. The coefficients of *SSFR* and *TURN* in column (3) are significantly negative at 1% and 10% levels respectively, indicating that corporate governance measured by asset turnover ratio also exerts a partial mediating effect between SSF holding and financialization. Moreover, when *MPR* is used as the MV, as can be seen from Table 9, the conclusion is similar. From these results, we can see that SSF holding reduces financialization by improving corporate governance. These tests all support the pathway of "SSF holding → corporate governance → financialization of enterprises."

Table 7
Analysis based on administrative expenses.

Variable	(1) *FINR*	(2) *AEXP*	(3) *FINR*
SSFR	−4.383***	−0.048***	−4.321***
	(−3.40)	(−3.20)	(−3.35)
AEXP			3.519***
			(10.24)
Constant	15.150***	0.423***	13.852***
	(13.57)	(39.37)	(12.34)
CVs	YES	YES	YES
YEAR FE	YES	YES	YES
FIRM FE	YES	YES	YES
Obs	69,450	69,450	69,450
R-squared	0.082	0.044	0.083
N	2,721	2,721	2,721
F	238.31	190.66	233.53

Table 8
Analysis based on asset turnover ratio.

Variable	(1) *FINR*	(2) *TURN*	(3) *FINR*
SSFR	−4.377***	0.265***	−4.393***
	(−3.39)	(3.06)	(−2.99)
TURN			−0.153*
			(−1.86)
Constant	15.067***	−0.547***	15.366***
	(13.49)	(−8.78)	(13.62)
CVs	YES	YES	YES
YEAR FE	YES	YES	YES
FIRM FE	YES	YES	YES
Obs	69,447	69,447	69,447
R-squared	0.082	0.025	0.082
N	2,721	2,721	2,721
F	238.43	106.83	229.40

Table 9
Analysis based on main business profit rate.

Variable	(1) *FINR*	(2) *MBPR*	(3) *FINR*
SSFR	−4.396***	−0.018***	−4.237***
	(−3.41)	(−3.25)	(−3.28)
MBPR			−0.747***
			(−3.25)
Constant	15.160***	−0.019	15.171***
	(13.58)	(−1.17)	(13.59)
CVs	YES	YES	YES
YEAR FE	YES	YES	YES
FIRM FE	YES	YES	YES
Obs	69,435	69,435	69,435
R-squared	0.082	0.035	0.082
N	2,721	2,721	2,721
F	238.30	151.61	229.60

5.2. Differences test: Scale, property right and location

In addition to the degree of financialization as mentioned above, other factors may also influence the inhibitory effect of SSF holding on financialization. To further explore this, referring to studies such as Xie et al. (2014), we select three commonly used variables for group tests, as follows.

5.2.1. The impact of scale

Enterprises of diverse scales should differ in their degree of financialization, which can be confirmed by the coefficient of *SIZE* in the previous regressions. In theory, large-scale enterprises are better able to obtain loans and capital and engage in financial business than small-scale enterprises are. This implies that there may be differences in the impact of SSF holding on the financialization of enterprises of different scales. To test this, we conduct a group test with enterprises of different scales. Specifically, we calculate the average scale based on the total assets of enterprises, and assign those with a larger-than-average value to the large-scale group and vice versa. The results in columns (1) and (2) of Table 10 show that the inhibitory effect of the SSF is no longer significant for large-scale enterprises but still significant for small-scale enterprises, i.e., SSF holding has a greater influence on the financialization of small-scale than large-scale enterprises, which may be attributable to the relatively simple structure of small-scale enterprises, making them more easily influenced by SSF holding.

5.2.2. The impact of property rights

It is generally believed that due to the special status of the Chinese state and its agent role, its supervision and control of state-owned enterprises shows some features of official administration (Chen et al., 2020; Hope et al., 2020). This often leads to excessive intervention, which, coupled with the more serious issue of internal control of state-owned enterprises, restricts the governance effectiveness of institutional investors in state-owned enterprises (Wei and Varela, 2003). However, as far as the financialization of enterprises is concerned, since promoting the "transition from the virtual to the real" has become an official policy, state-owned enterprises, as extensions of the government (Xin et al., 2019), have the responsibility and obligation to practice the policies of the SSF. Furthermore, state-owned (vs. non-state-owned) enterprise managers are more risk-averse and face more stringent financial constraints from the government. Therefore, we speculate that SSF holding plays a greater role in reducing the financialization of state-owned than non-state-owned enterprises. The results reported in columns (3) and (4) of Table 10, i.e., the coefficient of *SSFR* is only statistically significant when *SOE* equals one, support our conjecture.

5.2.3. The impact of location

The degree of financialization of Chinese enterprises is highest in eastern China. One explanation is that enterprises in these areas may be better developed, with more abundant funds and financial assets. Another explanation is that the overall economy in eastern China is better developed, which increases the number of enterprises and the demand for funds, and thereby the opportunities and profit margin for financial speculation (Hu et al., 2017). On the one hand, as the economy of eastern regions is much healthier than that of non-eastern regions, the SSF may be less involved in eastern firms' investment decisions. On the other hand, according to the theory of diminishing marginal effects (Horowitz et al., 2007), if financialization is more severe in eastern regions, the regulatory role of the SSF should be more significant in these regions. We discuss this issue here. The results in columns (5) and (6) of Table 10 show that although SSF holding significantly inhibits financialization in both eastern and non-eastern regions, it is less effective in the former than in the latter and the significance levels of the respective coefficients are different (significant at the 5% level vs. the 1% level, respectively). The SSF's management of financial investment is weaker for enterprises in eastern regions than for enterprises in non-eastern regions, with their relatively backward economy.

5.3. The mitigation effect of SSF holding on the impairment of financialization

The previous tests confirm that SSF holding can reduce the financialization of enterprises. However, considering the ongoing controversies regarding the role of financialization, the aforementioned results do not

Table 10
Group tests of SSF holding's effect on enterprises' financialization.

Variable	(1) Large-scale *FINR*	(2) Small-scale *FINR*	(3) State-owned *FINR*	(4) Non-state-owned *FINR*	(5) Eastern *FINR*	(6) Non-eastern *FINR*
SSFR	−2.735	−3.682**	−5.370**	−2.167	−3.631**	−6.252***
	(−1.11)	(−2.47)	(−2.45)	(−1.38)	(−2.20)	(−3.31)
SIZE	0.656***	−0.758***	−0.442***	−0.607***	−0.583***	−0.140**
	(−6.09)	(−13.45)	(−6.22)	(−10.95)	(−10.15)	(−2.36)
LEV	−2.580***	−2.463***	−4.796***	−1.546***	−2.545***	−2.399***
	(−6.64)	(−13.17)	(−17.36)	(−7.53)	(−11.94)	(−10.15)
ROA	−0.116	−0.222	−1.566*	−0.048	−0.603	−0.805
	(−0.11)	(−0.36)	(−1.74)	(−0.07)	(−0.86)	(−1.03)
GROW	−0.082**	−0.055**	−0.060*	−0.053**	−0.075***	−0.015
	(−2.32)	(−2.49)	(−1.96)	(−2.18)	(−2.98)	(−0.57)
CFO	−0.42	−0.825**	−0.934**	−0.768**	−0.994***	0.045
	(−0.71)	(−2.46)	(−2.02)	(−2.01)	(−2.61)	(0.10)
BOARD	0	0.112***	−0.024	0.118***	−0.015	0.145***
	(−0.01)	(−4.88)	(−0.93)	(4.44)	(−0.60)	(6.03)
INDSIZE	1.827**	1.164**	0.974	1.501**	1.080*	0.500
	(−2.30)	(−2.01)	(1.43)	(2.25)	(1.69)	(0.78)
TOP1	0.003	−0.019***	0.000	−0.007*	−0.001	−0.033***
	(−0.57)	(−5.78)	(0.00)	(−1.90)	(−0.23)	(−8.56)
DUAL	0.107	0.041	0.238**	−0.273***	−0.126*	0.121
	(−0.89)	(−0.68)	(2.43)	(−4.30)	(−1.87)	(1.50)
IO	0.089	−1.187**	−1.178*	−1.193**	−0.887*	−2.262***
	(−0.12)	(−2.52)	(−1.90)	(−2.29)	(−1.65)	(−4.16)
SOE	−0.200	0.142			0.859***	−0.334**
	(−0.68)	(−0.89)			(4.02)	(−2.20)
EAST	0.398	−0.179	1.002	−0.218		
	(−0.45)	(−0.41)	(0.97)	(−0.54)		
GDP	−0.055	−0.102***	−0.057*	−0.122***	−0.101***	−0.068**
	(−1.36)	(−3.89)	(−1.90)	(−3.52)	(−3.31)	(−2.21)
M2GROW	−0.089***	−0.126***	−0.104***	−0.137***	−0.136***	−0.089***
	(−4.19)	(−9.23)	(−5.86)	(−8.69)	(−8.72)	(−5.36)
LOANR	−0.354***	−0.318***	−0.223*	−0.371***	−0.441***	−0.069
	(−2.65)	(−3.70)	(−1.95)	(−3.81)	(−4.51)	(−0.64)
Constant	−9.601***	21.489***	16.582***	17.397***	19.620***	6.625***
	(−3.56)	(−15.32)	(8.87)	(12.16)	(13.82)	(4.51)
YEAR FE	YES	YES	YES	YES	YES	YES
FIRM FE	YES	YES	YES	YES	YES	YES
Obs	14,290	55,161	27,523	41,928	48,120	21,331
R-squared	0.102	0.081	0.066	0.107	0.086	0.087
N	689	2,477	852	1,961	1,976	758
F	61.96	185.12	78.07	200.19	180.49	81.87
Mean comparison tests	0.000***		0.000***		0.0164**	

Note: In the final line, "Mean comparison tests," p-values are reported.

necessarily indicate that the effect of the SSF is always beneficial. For example, Xu and Guo (2021) find that "the impact of financialization on firm performance is not simply a crowding-out or pulling effect but rather depends on the type of financial assets held by the firms." Hence, we further explore the moderating effect of SSF holding on the relationship between financialization and enterprise value. Enterprise value is measured by *TobinQ*, the ratio of the market value of each enterprise to the replacement cost of its assets, which is a commonly used indicator of enterprise value in the stock market (e.g., Liu et al., 2012; Wang et al., 2017). The control variables are *SIZE*, *LEV*, *DUAL*, *SOE,* and *AGE*, defined as in Eq. (1). The results are presented in Table 11. We can see that the coefficients of *FINR* and *FINR*SSFR* are significantly negative and positive, respectively, suggesting that financialization does reduce enterprise value and SSF holding does weaken this negative association, i.e., SSF holding plays a beneficial role.

Table 11
The moderating effect of SSF holding on the enterprise value impairment effect of financialization.

Variable	(1) *TobinQ*	(2) *TobinQ*	(3) *TobinQ*
FINR	−0.003***	−0.006***	−0.004***
	(−2.96)	(−5.08)	(−3.47)
*FINR*SSFR*		0.699***	0.252***
		(10.52)	(3.48)
SSFR			6.225***
			(15.33)
Constant	19.202***	19.298***	19.490***
	(73.76)	(74.15)	(74.94)
YEAR FE	YES	YES	YES
FIRM FE	YES	YES	YES
Obs	67,417	67,417	67,417
R-squared	0.265	0.267	0.269
N	2,721	2,721	2,721
F	1557.85	1469.87	1402.23

6. Conclusions and implications

China's General Secretary Xi Jinping once proposed that "running a business and pursuing a career is not just a matter of making money, it is also a duty to do business in a real and unbiased manner."[5] However, as in other countries, financialization has become increasingly common among enterprises in China in recent years. Exploring the factors influencing enterprise financialization is a promising way to address the root causes of this problem. As a representative organ of the "national team," the SSF is expected to actively implement national policies and thereby influence the characteristics of its holding enterprises through its special status as an industry guidance fund. Therefore, the issue of whether SSF holding in enterprises boosts their "transition from the virtual to the real" requires exploration. We take China's A-share non-financial listed companies from 2009 to 2018 as a research sample and systematically discuss how SSF holding affects the level of financialization of the enterprise. Our study finds that as the shareholding ratio of the SSF increases, the degree of financialization significantly decreases. For enterprises with higher degrees of financialization, this inhibitory effect is more significant, i.e., the effect is non-linear. These findings confirm the public fund's adherence to the state's policy of "transition from the virtual to the real." Further analysis indicates that SSF holding realizes its inhibitory effect by improving corporate governance. Moreover, the SSF has a stronger inhibitory effect on small-scale (vs. large-scale), state-owned (vs. non-state-owned) and non-eastern (vs. eastern) enterprises. In addition, the SSF can alleviate the impairment of enterprise value corporate financialization.

Several policy recommendations follow from our study. First, while insisting that the market plays a decisive role in resource allocation, regulatory authorities should appropriately control the financialization of enterprises, optimize the supply to the financial system, pay attention to the actual implementation of their policies and encourage enterprises to return to their main business through external mandatory supervision. Second, although an appropriate level of financial investment may be an effective approach to solving problems such as financing constraints, enterprises should fully acknowledge the importance of their main business operations to their long-term development, uphold a commitment to strong practical actions in support of their main business and avoid allowing financial investment to take the lead under the guidance of the spirit of remaining true to the original aspiration and keeping the mission firmly in mind.

[5] Xi made this remark on 10 March 2019, during a speech at the deliberation of the Fujian delegation at the Second Session of the 13th National People's Congress. Indeed, Xi has always attached great importance to the issue of "transition from the virtual to the real." According to a report by Xinhua.net on 18 September 2019, Xi had explicitly mentioned this issue more than 10 times in local inspections since the end of 2017. Clearly, the CPC Central Committee and State Council attach great importance to the financialization of non-financial enterprises.

Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that may have influenced the work reported in this paper.

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Appendix A. Definition and measures of main variables

Panel A: Independent variable and dependent variable		
FINR	Financialization degree of enterprise	Sum of transaction monetary assets, derivative financial assets, loans and advances, financial assets available for sale, held to maturity investments and investment real estate divided by total assets (%).
SSFR	SSF shareholding ratio	Number of shares held by SSF divided by the total number of shares in circulation.

Panel B: Control variables		
SIZE	Company size	Natural logarithm of total assets.
LEV	Financial leverage	Total liabilities divided by total assets.
ROA	Return on assets	Net profit divided by total assets.
GROW	Growth opportunity	Growth rate of operating income.
CFO	Operating cash flow	Cash flow from operations divided by total assets.
BOARD	Board size	Number of board members.
INDSIZE	Ratio of independent directors	Total number of independent directors divided by the total number of board members.
TOP1	The shareholding ratio of the largest shareholder	Number of shares held by the largest shareholder divided by the total number of shares.
DUAL	Two-in-one situation	One if the chairman and general manager are the same person, and zero otherwise.
IO	Institutional shareholding ratio	Shareholding ratio of institutional investors except the SSF. Specifically, other institutional investors include funds, qualified foreign investors, brokers, insurance, trusts, finance companies, banks and non-financial listed companies.
SOE	Property rights	One for state-owned enterprises, and zero otherwise.
EAST	Eastern region	One if the company is located in Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong or Hainan, and zero otherwise.
GDP	GDP growth rate	Quarterly growth rate of GDP (%).
M2GROW	M2 growth rate	Quarterly growth rate of currency supply (%).
LOANR	Bank lending rate	One-year bank loan interest rate (%).

Appendix B. Tests of the assumptions of the PSM method

(1) Test of the common support assumption
Fig. B1

(2) Test of the balance assumption

Fig. B2
Table B1

(3) Average treatment effect on the treated (ATT) result of the PSM test

Table B2

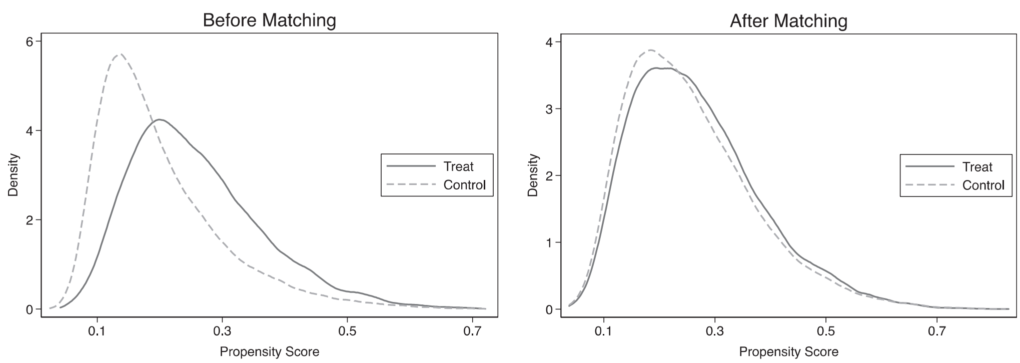

Fig. B1. PS value density distribution before and after matching.

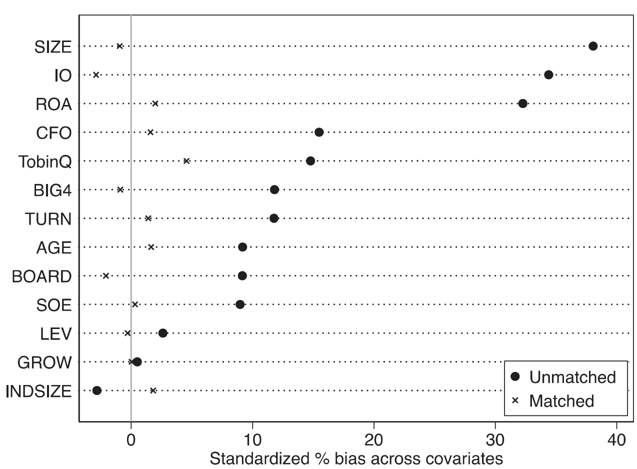

Fig. B2. Standardized % bias across covariates.

Table B1
Test of the balance assumption.

Variable	Unmatched	Mean		%bias	%reduct	t-test	
	Matched	Treated	Control		|bias|	t	p > |t|
SIZE	U	22.47500	21.98900	38.1		40.90	0.000
	M	22.47500	22.50000	−2.0	94.7	−1.62	0.106
AGE	U	1.92930	1.84580	9.2		9.54	0.000
	M	1.92930	1.91930	1.1	88.0	0.95	0.344
BOARD	U	8.90250	8.74320	9.2		9.71	0.000
	M	8.90250	8.94730	−2.6	71.9	−2.13	0.033
INDSIZE	U	0.37146	0.37295	−2.8		−3.00	0.003
	M	0.37146	0.37056	1.7	39.4	1.46	0.143
BIG4	U	0.09260	0.06119	11.8		13.30	0.000
	M	0.09260	0.08961	1.1	90.5	0.88	0.378
TobinQ	U	2.45570	2.21940	16.9		18.63	0.000
	M	2.45570	2.40930	3.3	80.4	2.56	0.011
IO	U	0.04259	0.02879	34.4		36.82	0.000
	M	0.04259	0.0438	−3.0	91.2	−2.34	0.019
SOE	U	0.43462	0.39047	9.0		9.59	0.000
	M	0.43462	0.43100	0.7	91.8	0.62	0.536
ROA	U	0.04529	0.03253	32.3		35.92	0.000
	M	0.04529	0.04319	5.3	83.5	4.23	0.000
TURN	U	0.42631	0.38821	11.8		12.70	0.000
	M	0.42631	0.42198	1.3	88.6	1.10	0.273
LEV	U	0.41545	0.41011	2.6		2.76	0.006
	M	0.41545	0.41905	−1.8	32.7	−1.48	0.138
CFO	U	0.02332	0.01399	15.5		16.71	0.000
	M	0.02332	0.02143	3.1	79.8	2.60	0.009
GROW	U	0.39017	0.38617	0.5		0.54	0.589
	M	0.39017	0.38720	0.4	25.7	0.33	0.740
Sample	pseudo-R^2	LR chi^2	p > chi^2	MeanBias	MedBias	B	R
Unmatched	0.069	4788.45	0.000	14.9	11.8	68.1*	0.90
Matched	0.001	44.52	0.000	2.1	1.8	7.9	0.95

Table B2
ATT result of the PSM test.

Variable	Sample	Treated	Controls	Difference	S.E.	t-stat.
FINR	Unmatched	2.61469349	3.102136	−0.487442507	0.057974751	−8.41
	ATT	2.61469349	3.039479	−0.424785266	0.079341442	−5.35

Note: t-statistics are in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1.

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Firm internationalization and cost of equity: Evidence from China

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ABSTRACT

This paper examines the relationship between firm internationalization and cost of equity. We find that firms with a higher degree of international operations have a significantly lower cost of equity, which is more pronounced for firms in provinces with a weak institutional environment or firms experiencing intense domestic competition. Our results are robust after adopting a firm fixed effect model, propensity score matching, difference-in-difference regressions and alternative measurements of key variables. Further, international operations help firms to break through their institutional constraints in the domestic market, which reduces the cost of equity and improves resource allocation efficiency in the capital market. Our paper enriches the literature on firm internationalization and the cost of equity from the perspective of emerging markets.

1. Introduction

Following China's reform and opening up, firm internationalization has been a key driver of China's excellent growth performance. According to the 2019 Statistical Bulletin of China's Outward Foreign Direct Investment, by the end of 2019, Chinese domestic investors had established 44,000 foreign direct investment (FDI) firms in 188 countries (regions).[1] Based on our data (Fig. 1), A-share listed firms are increasing their share of

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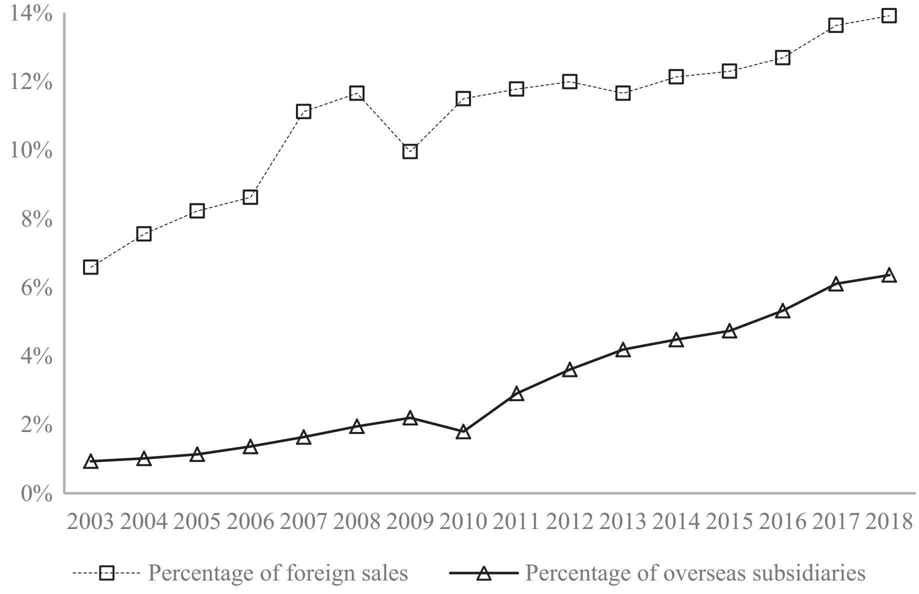

Fig. 1. A-share listed firms' international operations over time.

international operations as proxied by foreign sales and overseas subsidiaries. As Chinese firms' international operations intensify, how do capital market investors evaluate the value of Chinese firms? How does firm internationalization affect firms' resource allocation efficiency in the capital market? To answer these questions, in this paper we focus on the cost of equity and test whether firm internationalization impacts resource allocation efficiency in China's capital market.

China's stock market has grown exponentially since 1990. As a capital allocation channel, the stock market has played an increasingly significant role in reducing capital costs and improving firms' investment efficiency (Kim et al., 2015; Carpenter et al., 2021). Firm internationalization not only opens up the market and promotes the smooth circulation of capital but also improves resource allocation efficiency in the capital market, which is of great significance in enhancing the capital market's ability to finance firms. Therefore, this paper studies how firm internationalization affects resource allocation efficiency in the domestic stock market from the perspective of the cost of equity. The reason for focusing on the cost of equity is that a lower cost of equity reflects more efficient resource allocation in the stock market, which accelerates firm investment and economic growth (Henry, 2000; Carpenter et al., 2021). A lower cost of equity also promotes the circulation of capital and improves the efficiency of financial services in the real economy. In addition, the cost of equity is the expected rate of return required by investors. When the rate of return on firm investment projects is higher than the cost of capital, a firm has a positive net present value. Given the cost of debt financing, a lower cost of equity provides firms with more investment projects to choose from, which increases firm value and investor welfare (Christensen and Frimor, 2020). Therefore, if firms with international operations have a lower cost of equity, they can make full use of the capital resources in the domestic stock market and further enhance their technological ability and international competitiveness. In contrast, if internationalized firms have a higher cost of equity, they increase their exposure to financial risk and reduce their international competitiveness.

Studies of the effect of internationalization on the cost of equity are inconclusive. According to the risk diversification hypothesis, international operations can realize a risk diversification effect (Lewellen, 1971; Hann et al., 2013) and reduce the risk of investors' estimation of firms' future cash flow, which can further lower the cost of equity, increase firm value and improve capital allocation efficiency. Due to the segmentation of global financial markets, Mihov and Naranjo (2019) find that the more geographically diversified a firm's overseas subsidiaries, the more the firm can make full use of their financing resources in overseas financial markets, which lowers their cost of equity. Considering the risk contagion hypothesis, when internationalized firms diversify their direct investments and businesses around the world, they bear additional risks, such as exchange rate fluctuations, foreign market demand shocks and political instability, which may be transferred through their global trade networks. In this case, domestic investors may demand a higher risk premium (Amihud et al., 2015; Hoberg and Moon, 2019), which increases a firm's cost of equity.

Based on China's unique institutional background, which includes overall weak institutional environment and huge variations in the quality of institutional environments across different regions, we study whether firms' international operations influence their cost of equity. We select A-share listed nonfinancial firms from 2007 to 2018 as our sample. The international operations data for listed firms are collected manually, and *ex-ante* models are used to estimate the cost of equity. We find that firm internationalization significantly reduces the implied cost of equity. Furthermore, for firms that have headquarters in provinces with weak institutional environments or firms experiencing intense industry competition, the negative correlation between firm internationalization and cost of equity is strengthened. This result suggests that firms' international operations can alleviate regional institutional constraints and pressure from domestic competition, which reduces their cost of equity. Our results are robust after adopting a firm fixed effect model, propensity score matching (PSM), difference-in-difference (DID) regression based on the Sino-US trade dispute and alternative measurements of key variables. Our study shows that Chinese firms' international operations help them to break through domestic market constraints and provide a channel for domestic investors to diversify their investment risks, which reduces the cost of equity and improves resource allocation efficiency in the capital market.

This paper contributes to the literature in the following ways. First, the results provide micro empirical evidence from the transitional economy for the effect of firm internationalization on resource allocation efficiency in the capital market. Studies of developing economies, such as China, mainly explore inward FDI and its economic consequences on the capital market. For example, the Shanghai–Hong Kong Stock Connect program attracts foreign capital investment and improves the stock price efficiency of eligible A-share listed firms (Chen et al., 2022). Given the substantial growth of Chinese firms' international operations, many scholars examine the economic consequences of Chinese firms' outward FDI. Nevertheless, studies mainly focus on real dimensions, such as capacity use (Li et al., 2017) and employment (Li et al., 2016), but pay little attention to the impact of firms' international operations on the emerging capital market. This paper focuses on firms' cost of equity and examines the relationship between firm internationalization and resource allocation efficiency in the domestic stock market. Therefore, the results enrich the literature on internationalization and resource allocation efficiency.

Second, our study enriches the literature on the determinants of the firm cost of equity from the perspective of international operations, which mainly focuses on information disclosure (Healy and Palepu, 2001), firm governance (Chen et al., 2016), financial development (Kim et al., 2015) and stock market liberalization (Pang et al., 2020). Using data from multinational firms in developed countries, Mihov and Naranjo (2019) empirically examine the relationship between firms' international operations and cost of equity and find that firm internationalization can significantly reduce their cost of equity. Mihov and Naranjo (2019) reveal channels consistent with the incomplete international financial market theory, which suggests that multinational firms have an advantage in investment diversification and global financing because the global financial market is segmented and imperfect. In contrast to Mihov and Naranjo (2019), we examine the relationship between firm internationalization and cost of equity by focusing on firms in developing countries and considering the important role played by the domestic institutional environment. Compared with firms in developed countries, the business environment and international expansion of firms in emerging markets or economies in transition have distinct characteristics (Buckley et al., 2018; Luo and Tung, 2018). Firms face higher regional operational risks in China because of imperfect institutional development in developing countries; thus, international development avoids the negative impact of domestic institutional constraints on firms' development (Li and Xiao, 2017). As the largest developing country in the world, China has high institutional environment heterogeneity across different regions. Especially since China's reform and opening up, different Chinese provinces differ greatly in their level of market-oriented development, which provides an opportunity to examine the regional institutional constraint mechanism of the relationship between firm internationalization and cost of equity. In addition, against the institutional background of Chinese local officials' promotion tournament, local governments are keen to implement the economic policy of capacity expansion and form an investment-driven economic growth model (Carpenter et al., 2021). Consequently, Chinese firms experience an increasingly competitive environment and serious industry overcapacity. Firms' expansion into international markets alleviates the pressure of domestic industry competition. This paper finds that a serious domestic regional institutional environment and fierce industry competition enhance the effect of a firm's international operations in terms of reducing the cost of equity, which indicates that domestic regional institutional constraints and industry competition serve as important channels through which firms' internationalization in developing countries impacts the cost of equity capital. Thus, our paper provides an important supplement to Mihov and Naranjo's (2019) findings.

Finally, our findings have policy implications for the construction of a new development pattern in which domestic and international circulation reinforce each other. Chinese firms' internationalization is an important aspect of international circulation; therefore, making full use of domestic circulation to further enhance firms' international competitiveness to achieve a higher level of international circulation is one of the key issues in the construction of a new development pattern. From a capital market perspective, this paper examines how domestic investors evaluate firms' internationalization and finds that their active engagement in international operations helps to reduce the cost of equity. The results show that to a certain extent, resource allocation within China's capital market promotes the coordinated development of firms' international and domestic circulation.

The rest of this study is organized as follows. Section 2 reviews the related literature and develops the research hypotheses. Section 3 describes the research design. Section 4 reports the main empirical results. Section 5 conducts robustness checks. Finally, Section 6 concludes the paper.

2. Literature review and hypothesis development

2.1. Determinants and economic consequences of firm internationalization

In emerging economies, the institutional environment determines domestic firms' decisions to internationalize (Buckley et al., 2007; Luo and Tung, 2007). The literature considers three major perspectives. First, the institutional escapism perspective holds that domestic institutional constraints push firms in emerging markets to expand internationally (Witt and Lewin, 2007). In China, firms face domestic institutional constraints such as lack of regional marketization, local protectionism and regional market segmentation (Cao et al., 2015; Li and Xiao, 2017). High transaction costs may hinder firms' growth; therefore, firms in transitional economies may seek to reduce their institutional transaction costs through internationalization (Boisot and Meyer, 2008). Zhang et al. (2010) show that market segmentation caused by imperfect domestic institutions in China promotes firm exports. Li and Xiao (2017) report that both formal and informal institutional constraints push Chinese private firms to engage in outward FDI. Second, the springboard perspective argues that firms in emerging markets use international expansion as a springboard to not only escape from their domestic institutional constraints but also acquire strategic resources (Luo and Tung, 2007). This theory combines both institutional and resource viewpoints and can explain firms' motivations for international expansion in the capital market and resource seeking when these firms experience domestic institutional constraints (Luo and Tung, 2018). Third, firms' international expansion is also affected by government promotions. The governmental promotion perspective considers that governments in emerging markets provide policies, such as tax preferences, trade agreements and political guarantees, to stimulate domestic firms' expansion into the global market (Luo et al., 2010). Ramamurti and Hillemann (2018) argue that the Chinese government directly or indirectly supports domestic firms' international expansion strategy to offset their competitive disadvantages in global competition. Therefore, Chinese firms' international expansion shows their strategic decision-making behavior under multiple factors (Luo et al., 2010).

The literature on the economic consequences of firm internationalization mainly focuses on the micro and macro levels. At the micro level, scholars examine the impact of firm internationalization on innovation, sales growth, capability and financial performance. From the perspective of the reverse technology spillover effect of firm internationalization, Fu et al. (2018) find that by conducting outward direct investment in developed countries, firms from emerging countries can absorb advanced management systems and technologies, which increase their innovation performance. Wang and Lu (2019) find that the Belt and Road Initiative promotes outward FDI and improves the innovation capability of Chinese firms in affected areas. In addition, undertaking FDI can enhance firms' operational scale (Cozza et al., 2015) and resolve the problem of overcapacity

(Li et al., 2017). From the perspective of international operations and firm performance, Zhou and Su (2019) find that international operations under excess capacity can enhance the value of real options, which lowers the downside risk but increases the upside potential of firm performance. Furthermore, firms' international operations produce positive spillover effects at the macro level. Using provincial macro-level data, Bai and Liu (2018) find that outward FDI can improve the misallocation of capital and labor resources in China, which improves resource allocation efficiency. From the perspective of environmental governance, Ouyang et al (2020) find that outward FDI reduces domestic environmental pollution levels. Overall, studies of the economic effect of Chinese firm internationalization mainly focus on real dimensions and a macro regional economy, but few studies concentrate on the capital market.

2.2. Impact of firm internationalization on resource allocation efficiency

As an important financing channel, the capital market plays a significant role in promoting resource allocation optimization. The important premise of effective resource allocation is that resources can flow freely using price mechanisms. Restriction on the free flow of resources due to poor marketization is the main cause of reduced capital market efficiency. Fang (2006) finds that Chinese capital allocation efficiency improves with intensified marketization. From the perspective of capital suppliers, attracting FDI can make use of the advanced investment philosophy and capital strength to promote the free flow of capital and thus improve the efficiency of the capital market. For example, the implementation of Shanghai–Hong Kong Stock Connect has reduced domestic target firms' cost of equity (Pang et al., 2020) and increased listed firms' stock price information (Zhong and Lu, 2018). Under the condition of two-way international investment, the outward FDI of listed firms can also have an important impact on capital market efficiency from the perspective of capital demanders. Firm internationalization contributes to the cross-border flow of capital elements; therefore, capital elements can be allocated and capital returns maximized (Bai and Liu, 2018), which reduce the cost of firm equity capital and promote the efficiency of firms' investment and resource allocation in the capital market.

The important determinants of firms' cost of equity are business risks in the business environment (Modigliani and Miller, 1958; Dhaliwal et al., 2016). Firms' international operations can change capital market investors' perceptions of business risks, which then affect the cost of equity. Firm internationalization can alleviate firms' domestic institutional environment constraints such as domestic market segmentation, which makes it difficult for local firms to conduct cross-regional domestic operations (Song and Huang, 2014), such as cross-regional mergers and acquisitions (Fang, 2009), and establish nonlocal subsidiaries (Xia et al., 2011). Firms must concentrate their operations in domestic markets and may fail to achieve the goals of economies of scale and risk diversification if they only focus on the domestic market. However, by undertaking cross-border operations (i.e., internationalization), firms can escape or evade the adverse impact of domestic institutional constraints on their development and growth. These firms can enter overseas markets, expand their business scope and achieve economies of scale, thus diversifying their risks. Globally, the various economic development situations in different economies allow resource reallocation through multinational firms' geographically dispersed subsidiaries, based on different performance growth and strategic resources, among other factors. Under the favorable circumstances of the overseas market, firms with international operations can transfer their business activities from their home country to host countries. In contrast, while the market conditions in the home country are favorable, firms can transfer their business activities from overseas markets to the domestic market, which improves the flexibility of their business operations and potential for upward performance (Zhou and Su, 2019). Firm internationalization also can alleviate pressure from domestic industry competition. An increasingly fierce competitive environment and overcapacity in the domestic industry may cause a firm's sales scale to decrease and the downside risk of profits to increase. In an industry with fierce competition, firms that lack international experience can only focus on the limited space within the domestic market, while international firms can broaden their sales channels into the international market and adopt a strategy of differentiated competition. Li et al. (2017) find that outward FDI can alleviate the competitive pressure faced by firms domestically, which effectively resolves the excess capacity problem by improving firm capacity. From a cost perspective, firms can transfer their production and business activities to countries with lower costs (Zhou and Su, 2019). From the revenue side, international operations can enhance international awareness of firm brands, enabling the firm to gain more global resources, learn advanced market technologies and obtain management experience to improve production, operation efficiency and innovation capability.

In addition, Chinese domestic investors hold virtually all of China's stock market due to capital control, with few opportunities for international portfolio diversification. However, they can hold the stocks of multinational listed firms in the domestic stock market. Compared with purely domestic firms, a globally diversified listed firm allows its shareholders to have indirect access to foreign countries with restrictions on portfolio holdings; thereby, these shareholders can access international economic diversification. In the era of economic globalization, Bae et al. (2019) show that multinational corporations are exposed to economies with rapid economic growth; therefore, their shareholders can enjoy the development benefits of these economies.

In summary, by expanding into international markets, firms can avoid the institutional constraints of domestic markets and lower the risk of regional concentration. They can also acquire advanced experience and technologies from developed countries to reduce production costs and enhance profitability, which can alleviate the pressure of domestic industry competition. Finally, domestic investors can share the benefits of global economic development and diversify their investment risks by holding stocks in domestic international firms. Based on the above analysis, we propose the following hypothesis:

H1a: Firms with international operations have a lower cost of equity than other firms.

However, firms' international operations may also aggravate operation and information risks, which increase the cost of equity. Specifically, exchange rate fluctuations, foreign market demand shocks and political instability can increase the uncertainty of international operations (Amihud et al., 2015). Multinational firms might also face friction arising from geographic dispersion and cultural and language differences, which increases the challenges faced by international management and operations and harms firm performance (Shroff et al., 2014). Moreover, economic fluctuations in different countries may be interrelated, which weakens the goal of a firm to diversify its business risks through internationalization. The contagion of macroeconomic risks among countries may lead multinational firms to experience greater business fluctuations and losses (Hoberg and Moon, 2019). As the operations of multinational firms are more complex, domestic investors may face high levels of uncertainty and information asymmetry, which increase their information risk. Therefore, we propose the following competitive hypothesis:

H1b: Firms with more international operations have higher costs of equity than other firms.

3. Research design

3.1. Data sources and sample selection

We start with a sample of A-share listed firms from 2007 to 2018. The reason for choosing 2007 as the starting year of the sample period is that Chinese firms' international operations began to increase significantly after 2007 (see the internationalization trend chart for listed firms in Fig. 1), but the proportion of international income and subsidiaries was relatively low before 2007, which indicates that the international business of listed firms in China became increasingly common after 2007. In addition, China began to implement new accounting standards for listed firms in 2007, with profound changes to standards for segment reports and related party disclosures. Taking 2007 as the starting year of our study maintains the statistical quality of the data. We exclude listed firms in the financial industry. We also eliminate firm-years with a cost of equity less than 0 or greater than 1, and firm-years with missing or abnormal data for control variables. Our final sample consists of 21,615 firm-years for 2,724 listed firms. We manually collect and organize the data on the firm internationalization based on the China Stock Market and Accounting Research (CSMAR) outward FDI database. We also obtain financial and firm governance data from the CSMAR database.

3.2. Models and variables

3.2.1. Firm internationalization measure

In our main tests, we use foreign sales and subsidiaries to proxy for firm internationalization. Amihud et al. (2015) and Mihov and Naranjo (2019) measure firm internationalization using various dimensions. Following the literature, we adopt both sale- and subsidiary-based measures of firm internationalization: (i) the fraction of a firm's foreign to total sales, denoted by *FSALE*; (ii) a natural log transformation of the number of distinct foreign subsidiaries except for those located in offshore financial centers, such as the Cayman Islands, denoted by *FSUB*; (iii) a natural log transformation of the number of distinct foreign countries in which a firm discloses operations over a given fiscal year except for offshore financial centers, such as the Cayman Islands, denoted by *FCNT*; and (iv) the composite measure constructed using principal component analysis based on *FSALE*, *FSUB* and *FCNT*, denoted by *INTL*. We focus on *FSALE* and *INTL* in our main tests and use the remaining two measures for the robustness checks.

3.2.2. Implied cost of equity

Studies widely use both the *ex-ante* implied cost of equity and the *ex-post* realized stock return to measure the cost of capital. Compared with the *ex-post* measure, the *ex-ante* measure is more appropriate to capture the underlying cost of equity for listed firms in China (Kim et al., 2015). Following Kim et al. (2015) and Qin et al. (2020), we adopt four implied cost of equity measures derived by the estimation methods proposed by Easton (2004), Ohlson and Juettner-Nauroth (2005) and Gebhardt et al. (2001), denoted by *COE_PEG*, *COE_MPEG*, *COE_OJN* and *COE_GLS*. We summarize the detailed procedures for estimating these variables as follows.

For *COE_PEG* estimation, Easton (2004) proposes the PEG model based on the price-to-earnings and price-to-earnings growth ratios. The valuation model is:

$$COE\_PEG = \sqrt{(EPS_2 - EPS_1)/P_0} \tag{1}$$

where EPS_1 and EPS_2 are the forecast values of one- and two-year-ahead earnings per share, and P_0 is the stock price at the end of fiscal year t.

For *COE_MPEG* estimation, Easton (2004) also proposes the MPEG model, which considers the dividend compared with the PEG model. The specific formula is written as follows:

$$COE\_MPEG = \sqrt{(EPS_2 + COE\_MPEG \times DPS_1 - EPS_1)/P_0} \tag{2}$$

where DPS_1 is the future dividend per share and is set equal to future earnings per share multiplied by the expected dividend payout ratio. We measure the expected dividend payout ratio as the median payout ratio over the past three years, with the dividend payout ratio set to its industry median when missing (Kim et al., 2015).

For *COE_OJN* estimation, Ohlson and Juettner-Nauroth (2005) modify Gordon's dividend model, relax the assumption that dividends must be paid in full and theoretically deduce the OJN model. The calculation formula of the model is specified as follows:

$$COE\_OJN = A + \sqrt{A^2 + \frac{EPS_1}{P_0} \times \left[\frac{EPS_2 - EPS_1}{EPS_1} - (\gamma - 1)\right]} \tag{3}$$

where $A = \frac{1}{2}\left((\gamma - 1) + \frac{DPS_1}{P_0}\right)$, and $\gamma - 1$ is the asymptotic long-term growth rate measured as the one-year-ahead annualized *CPI* (Kim et al., 2015). The definitions of other variables are the same as those in the MPEG model.

For *COE_GLS* estimation, Gebhardt et al. (2001) propose a GLS model based on the residual income model, which holds that the current stock price of a firm is equal to the sum of the book value of net assets per share in the current period and the current value of residual income in future periods, where residual income is equal to the difference between the firm's accounting earnings and the expected income required by shareholders. Under a series of assumptions, the formula of the GLS model is:

$$P_0 = B_0 + \sum_{i=1}^{T-1} \frac{ROE_T - COE\_GLS}{(1 + COE\_GLS)^i} B_{i-1} + \frac{ROE_T - COE\_GLS}{COE\_GLS(1 + COE\_GLS)^{T-1}} B_{T-1} \quad (4)$$

where B_0 is the book value of equity at the current period, and ROE_i is the future return on equity (ROE) in the i year ahead. ROE_i is equal to forecasted earnings in the future i year divided by net assets in the future $i-1$ year. T is the number of future earnings forecast periods and is set to 12. We use forecasts predicted by earnings model to proxy for a firm's earnings for the next three years. Thereafter, we measure expectations for a firm's earnings by assuming that the future ROE declines linearly to an equilibrium ROE from the 4th to the T^{th} year. This equilibrium ROE is measured by the median ROE in each industry over the period of the listing year to the current year (Qin et al., 2020), and loss firms are excluded (Gebhardt et al., 2001; Claus and Thomas, 2001).

An earnings forecast is basic data used for estimating the *ex-ante* implied cost of equity. Note that due to limitations of analyst earnings forecast data in China, we use earnings forecasts predicted by the Hou et al. (2012) model, following Mao et al. (2012) and Qin et al. (2020). Specifically, we estimate the following pooled cross-section regressions using the previous 10 years of data:

$$E_{j,t+\tau} = \beta_0 + \beta_1 MV_{j,t} + \beta_2 TA_{j,t} + \beta_3 DIV_{j,t} + \beta_4 DD_{j,t} + \beta_5 E_{j,t} + \beta_6 NEGE_{j,t} + \beta_7 AC_{j,t} + \varepsilon_{j,t+\tau} \quad (5)$$

where $E_{j,t+\tau}$ denotes the earnings of firms j in year $t + \tau$ ($\tau = 1$ to 5), MV is the market capitalization, TA is the total assets, DIV is the dividend payment, DD is a dummy variable that equals 1 for dividend payers and 0 otherwise, $NEGE$ is a dummy variable that equals 1 for firms with negative earnings and 0 otherwise and AC is accruals, which is equal to the net profit minus net cash flow from operating activities. All explanatory variables are measured as of year t. To reduce the impact of extreme values, we winsorize all continuous variables in each year at the 1st and 99th percentiles. For each firm j in each year t in our sample, we forecast earnings for up to five years in the future by multiplying the independent variables as of year t with the coefficients from the pooled regression estimated using data over the previous 10 years.

According to Mao et al. (2012), of the four measures *COE_PEG*, *COE_MPEG*, *COE_OJN* and *COE_GLS*, *COE_PEG* and *COE_MPEG* are superior for evaluating China's capital market. Therefore, we use *COE_PEG* and *COE_MPEG* in our main empirical analysis. In our robustness checks, we also use *COE_OJN* and *COE_GLS*. In addition to the four individual implied costs of capital estimates, following Hou et al. (2012), we also construct a composite measure as the equal-weighted average of the four individual estimates, denoted by *COE_AVG*.[2]

3.2.3. Model specification

To examine the relationship between firm internationalization and the implied cost of equity at the firm-year level, we estimate the following panel regression model for our main analysis:

$$COE_{i,t} = \alpha_0 + \beta INTERNATIONAL_{i,t} + \gamma' X_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \quad (6)$$

where $COE_{i,t}$ is our measure of the implied cost of equity for firm i in year t. $INTERNATIONAL_{i,t}$ is a measure of firm internationalization. $X_{i,t}$ is a set of control variables. μ_i represents firm fixed effects, φ_t represents year fixed effects and $\varepsilon_{i,t}$ is the random error. We expect β to be negative if firm internationalization decreases the cost of equity.

Model (6) controls for other known determinants of the cost of equity used in related studies (Kim et al., 2015; Qin et al., 2020): namely, firms' financial characteristic variables, including firm size (*SIZE*), financial leverage (*LEV*), profitability (*ROA*) and sales growth rate (*GROWTH*); firm stock market characteristic variables, including book-to-market ratio (*BM*), stock liquidity (*TURNOVER*) and systematic risk (*BETA*); and firm governance characteristic variables, including board size (*BOARDSIZE*), CEO–chairperson duality (*DUAL*), stock ownership of the largest shareholder (*TOP1_HOLD*) and stock ownership of institutional investors (*INSTI_HOLD*). The Appendix describes the detailed definitions of all variables. To mitigate the

[2] Consistent with Hou et al. (2012), to maximize coverage, we only require a firm to have at least one non-missing individual implied cost of capital estimate to compute its equal-weight average. For example, if *COE_OJN* is missing in one year, then we use the remaining *COE_PEG*, *COE_MPEG* and *COE_GLS* to compute the average value.

impact of outliers, we winsorize all continuous variables at the 1st and 99th percentiles. The estimated standard errors in all regressions are corrected for heteroskedasticity and clustered at the firm level to correct for serial correlation within firm groupings.

4. Empirical results

4.1. Descriptive statistics

Table 1 presents the summary statistics for the main variables. The means (standard deviation) of the implied cost of equity capital measures *COE_PEG* and *COE_MPEG* are 0.094 (0.042) and 0.100 (0.044), respectively, which is consistent with Chinese capital market studies (Zhang et al., 2020). For the firm internationalization measures, the average percentage of sales from international operations (*FSALE*) is 11.6%. The maximum is close to 90%, while the minimum is 0%. For the subsidiary-based internationalization measures, the standard deviations of *FSUB* and *FCNT* are 0.579 and 0.498, respectively, which are about two times their means, indicating that the degree of internationalization varies considerably among the listed firms in Chinese capital market.

Table 2 reports the coefficients of Pearson pair-wise correlations among our key test variables. The correlation coefficients among the five cost of equity capital measures *COE_PEG*, *COE_MPEG*, *COE_OJN*, *COE_GLS* and *COE_AVG* range from 0.588 to 0.991 and are significantly positively correlated at the 1% level. These strong correlations suggest that the five measures capture the same underlying construct for the cost of equity capital. Similarly, the firm internationalization measures *FSALE*, *FSUB* and *FCNT* are also significantly positively correlated with each other at the 1% level. Importantly, the firm internationalization measure *FSALE* is significantly negatively correlated with all five cost of equity estimates at the 1% level, with coefficients ranging from −0.075 to −0.041. Although they are only suggestive of the underlying relationship, these negative correlations provide initial evidence that firm internationalization lowers the cost of equity capital in China. These results are similar when using *FSUB*, *FCNT* and *INTL* as measures of firm internationalization. In addition, the untabulated results show that the correlation coefficients among the control variables are small, indicating that the model is unlikely to have a serious multicollinearity problem.

Table 1
Summary statistics.

Variables	N	Mean	SD	Min	p25	p50	p75	Max
COE_PEG	18,326	0.094	0.042	0.017	0.064	0.089	0.118	0.217
COE_MPEG	18,324	0.100	0.044	0.022	0.068	0.095	0.126	0.227
COE_OJN	18,982	0.110	0.046	0.030	0.076	0.104	0.137	0.244
COE_GLS	21,339	0.051	0.026	0.006	0.033	0.048	0.066	0.130
COE_AVG	21,615	0.083	0.040	0.009	0.055	0.080	0.107	0.195
FSALE	21,615	0.116	0.201	0.000	0.000	0.004	0.145	0.892
FSUB	21,615	0.276	0.579	0.000	0.000	0.000	0.000	2.565
FCNT	21,615	0.243	0.498	0.000	0.000	0.000	0.000	2.197
INTL	21,615	−0.012	1.101	−0.702	−0.702	−0.649	0.368	5.197
SIZE	21,615	22.154	1.314	19.263	21.243	22.010	22.921	25.940
LEV	21,615	0.474	0.209	0.049	0.315	0.476	0.630	0.984
ROA	21,615	0.046	0.072	−0.224	0.013	0.038	0.074	0.351
GROWTH	21,615	0.198	0.541	−0.627	−0.024	0.110	0.273	3.963
BM	21,615	0.554	0.258	0.076	0.349	0.528	0.746	1.128
BETA	21,615	1.082	0.254	0.421	0.929	1.086	1.230	1.916
TURNOVER	21,615	0.026	0.021	0.002	0.011	0.020	0.035	0.179
AGE	21,615	2.786	0.336	1.792	2.565	2.833	3.045	3.497
BOARDSIZE	21,615	2.165	0.200	1.609	2.079	2.197	2.197	2.708
DUAL	21,615	0.205	0.403	0.000	0.000	0.000	0.000	1.000
TOP1_HOLD	21,615	0.357	0.153	0.087	0.235	0.338	0.466	0.750
INSTI_HOLD	21,615	0.487	0.225	0.004	0.333	0.507	0.658	0.908

Table 2
Pearson correlation matrix.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) *COE_PEG*	1.000							
(2) *COE_MPEG*	0.981***	1.000						
(3) *COE_OJN*	0.975***	0.987***	1.000					
(4) *COE_GLS*	0.588***	0.642***	0.588***	1.000				
(5) *COE_AVG*	0.976***	0.991***	0.971***	0.733***	1.000			
(6) *FSALE*	−0.052***	−0.043***	−0.041***	−0.075***	−0.053***	1.000		
(7) *FSUB*	−0.085***	−0.072***	−0.086***	0.053***	−0.025***	0.333***	1.000	
(8) *FCNT*	−0.086***	−0.072***	−0.086***	0.047***	−0.025***	0.336***	0.976***	1.000
(9) *INTL*	−0.088***	−0.073***	−0.083***	0.002	−0.043***	0.724***	0.887***	0.888***

Notes: This table reports the Pearson correlation matrix for the main testing variables. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

4.2. Firm internationalization and cost of equity

Table 3 presents the results of ordinary least squares regressions examining whether internationalization impacts a firm's cost of equity. Columns (1)–(4) use *COE_PEG* as the dependent variable. Including year and industry fixed effects, column (1) shows that the coefficient of firm internationalization measure *FSALE* is −0.006, which is significantly negative at the 1% level. Furthermore, to eliminate the potential impact of unobservable and time-invariant individual firm characteristics, we add firm fixed effects to column (2). In terms of economic significance, the coefficient estimate on *FSALE* in column (2) implies that a one standard deviation increase in *FSALE* decreases the cost of equity capital by 2.33% relative to the sample mean. Columns (3) and (4) use firm internationalization measure *INTL* as the independent variable. The results are similar to those in columns (1)–(2). Finally, the results in columns (5)–(8), using *COE_MPEG* as the dependent variable, are quantitatively and qualitatively similar to those in columns (1)–(4).

The results for control variables in Table 3 are consistent with the literature (Kim et al., 2015; Pang et al., 2020; Zhang et al., 2020): namely, firm size (*SIZE*), profitability (*ROA*), sales growth (*GROWTH*), stock liquidity (*TURNOVER*) and stock ownership of the institutional investors (*INSTI_HOLD*) are all significantly negatively associated with the cost of equity, while leverage ratio (*LEV*), book-to-market ratio (*BM*) and market (*BETA*) are positively associated with the cost of equity.

In summary, the results in Table 3 show that firm internationalization lowers the cost of equity after controlling for all other known determinants of the cost of equity. These results suggest that investors generally charge a lower risk premium to firms with more international operations. Therefore, *H1a* is supported.

4.3. Mechanism analysis

According to the literature, the important determinants of a firm's cost of equity are business risks stemming from the firm's business environment (Modigliani and Miller, 1958; Dhaliwal et al., 2016). We argue that Chinese firms' international operations avoid the constraints of the domestic institutional environment and lower the cost of equity capital by diversifying the operational risks stemming from domestic regions and industries. In this section, we evaluate the potential channels of this relationship from the perspectives of the domestic institutional environment and industry competition.

4.3.1. Domestic institutional environment

Firms' international operations alleviate institutional constraints in domestic markets. Against the institutional background of the Chinese local officials' promotion tournament, firms' cross-regional operations in domestic markets enable the transfer of regional tax revenues and employment, which is not conducive to the promotion of the local governments where the firms' headquarters are located. Therefore, the transaction costs and uncertainty of crossing domestic borders are high (Boisot and Meyer, 2008). Domestic firms located in areas with weak institutional environments usually experience severe government interventions. Meanwhile,

Table 3
Firm internationalization and implied cost of equity.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	*COE_PEG*				*COE_MPEG*			
FSALE	−0.006***	−0.011***			−0.005***	−0.009**		
	(−4.345)	(−2.870)			(−3.200)	(−2.411)		
INTL			−0.001***	−0.002***			−0.001***	−0.002***
			(−4.355)	(−3.283)			(−2.987)	(−2.831)
SIZE	−0.006***	−0.006***	−0.006***	−0.005***	−0.006***	−0.006***	−0.006***	−0.006***
	(−12.431)	(−6.227)	(−11.620)	(−5.689)	(−10.708)	(−6.443)	(−10.152)	(−5.967)
LEV	0.030***	0.026***	0.030***	0.026***	0.024***	0.022***	0.024***	0.022***
	(16.591)	(8.211)	(16.685)	(8.282)	(13.045)	(6.898)	(13.108)	(6.955)
ROA	−0.025***	−0.033***	−0.025***	−0.033***	−0.016***	−0.034***	−0.016***	−0.035***
	(−4.625)	(−5.326)	(−4.607)	(−5.390)	(−2.943)	(−5.413)	(−2.926)	(−5.461)
GROWTH	−0.005***	−0.004***	−0.005***	−0.004***	−0.007***	−0.005***	−0.007***	−0.005***
	(−9.449)	(−6.685)	(−9.459)	(−6.688)	(−11.729)	(−7.593)	(−11.733)	(−7.591)
BM	0.057***	0.047***	0.057***	0.047***	0.065***	0.057***	0.065***	0.056***
	(29.283)	(17.604)	(29.019)	(17.388)	(31.736)	(20.401)	(31.538)	(20.214)
BETA	0.011***	0.012***	0.011***	0.012***	0.010***	0.011***	0.010***	0.011***
	(9.795)	(9.980)	(9.719)	(9.986)	(8.604)	(9.312)	(8.532)	(9.316)
TURNOVER	−0.146***	−0.348***	−0.149***	−0.350***	−0.159***	−0.343***	−0.161***	−0.345***
	(−9.101)	(−16.432)	(−9.247)	(−16.541)	(−9.746)	(−16.454)	(−9.848)	(−16.558)
AGE	0.001	0.017**	0.001	0.017**	0.001	0.010	0.001	0.010
	(1.206)	(2.466)	(1.234)	(2.491)	(0.894)	(1.436)	(0.915)	(1.454)
BOARDSIZE	−0.001	−0.002	−0.001	−0.002	0.001	−0.003	0.001	−0.002
	(−0.602)	(−0.838)	(−0.713)	(−0.818)	(0.491)	(−0.854)	(0.416)	(−0.839)
DUAL	0.000	−0.001	−0.000	−0.001	0.000	−0.000	0.000	−0.001
	(0.003)	(−0.638)	(−0.038)	(−0.648)	(0.442)	(−0.482)	(0.403)	(−0.491)
TOP1_HOLD	−0.003	0.003	−0.003	0.003	0.001	0.005	0.000	0.004
	(−1.120)	(0.581)	(−1.169)	(0.508)	(0.206)	(0.860)	(0.174)	(0.798)
INSTI_HOLD	−0.007***	−0.028***	−0.007***	−0.028***	−0.006***	−0.029***	−0.006***	−0.029***
	(−3.746)	(−7.078)	(−3.881)	(−7.166)	(−3.483)	(−7.415)	(−3.576)	(−7.490)
CONSTANT	0.155***	0.136***	0.148***	0.126***	0.144***	0.163***	0.139***	0.154***
	(14.516)	(5.470)	(13.669)	(5.025)	(12.517)	(6.430)	(11.952)	(6.029)
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IND	Yes	No	Yes	No	Yes	No	Yes	No
FIRM	No	Yes	No	Yes	No	Yes	No	Yes
Observations	18,326	18,326	18,326	18,326	18,324	18,324	18,324	18,324
adj_R^2	0.502	0.574	0.502	0.574	0.512	0.587	0.512	0.588

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (*t*-statistics are in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

incomplete regional institutions usually suggest that product markets, factor markets and market intermediaries are not mature, which increases the firms' operational risks. Firms located in domestic areas with weak institutional environments are more likely to incur operational risks from the focused domestic markets and should benefit more from the risk diversification effects of internationalization. We expect that the effect of internationalization on reducing the cost of equity capital should be more pronounced for firms in domestic areas with poor institutional environments than for other firms.

Following the literature (Fang, 2009; Song and Huang, 2014; Li and Xiao, 2017), we choose the marketization index (MKI) for provinces in which firm headquarters are located as the proxy for regional institutional quality (Wang et al., 2019). We divide our sample based on whether a firm's regional marketization index is above or below the median. We report our results in Table 4. In columns (1) and (2), our baseline results are concentrated among firms with low regional marketization level. That is, the coefficient estimate of *FSALE* in column (2) is significantly negative at the 1% level but insignificant in column (1). The coefficient of *FSALE* in column (2) is 2.83 times that in column (1), and the difference between the two coefficients is statistically

Table 4
Effect of domestic institutional environment.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	COE_PEG				*COE_MPEG*			
	High MKI	Low MKI	High MKI	Low MKI	High MKI	Low MKI	High MKI	Low MKI
FSALE	−0.006	-0.017^{***}			−0.004	-0.016^{***}		
	(−1.232)	(−3.643)			(−0.742)	(−3.373)		
INTL			-0.002^{**}	-0.003^{***}			−0.001*	-0.002^{***}
			(−2.166)	(−3.417)			(−1.897)	(−3.031)
DIFF. Test		0.012**		0.063*		0.005***		0.079*
SIZE	-0.008^{***}	-0.006^{***}	-0.007^{***}	-0.005^{***}	-0.008^{***}	-0.005^{***}	-0.008^{***}	-0.005^{***}
	(−5.071)	(−5.020)	(−4.685)	(−4.560)	(−5.441)	(−4.644)	(−5.091)	(−4.250)
LEV	0.030^{***}	0.022^{***}	0.031^{***}	0.022^{***}	0.026^{***}	0.018^{***}	0.026^{***}	0.018^{***}
	(6.419)	(5.549)	(6.523)	(5.562)	(5.437)	(4.561)	(5.532)	(4.570)
ROA	-0.030^{***}	-0.035^{***}	-0.031^{***}	-0.036^{***}	-0.030^{***}	-0.039^{***}	-0.031^{***}	-0.039^{***}
	(−3.355)	(−4.790)	(−3.434)	(−4.827)	(−3.251)	(−4.977)	(−3.327)	(−4.994)
GROWTH	-0.003^{***}	-0.005^{***}	-0.003^{***}	-0.005^{***}	-0.004^{***}	-0.005^{***}	-0.004^{***}	-0.005^{***}
	(−3.226)	(−6.269)	(−3.226)	(−6.244)	(−4.173)	(−6.771)	(−4.157)	(−6.746)
BM	0.054^{***}	0.045^{***}	0.053^{***}	0.045^{***}	0.065^{***}	0.053^{***}	0.065^{***}	0.053^{***}
	(14.269)	(13.164)	(14.223)	(12.964)	(16.837)	(14.580)	(16.801)	(14.399)
BETA	0.012^{***}	0.012^{***}	0.012^{***}	0.012^{***}	0.011^{***}	0.011^{***}	0.011^{***}	0.011^{***}
	(7.047)	(7.975)	(7.004)	(8.079)	(6.254)	(7.591)	(6.222)	(7.682)
TURNOVER	-0.340^{***}	-0.355^{***}	-0.340^{***}	-0.358^{***}	-0.333^{***}	-0.352^{***}	-0.333^{***}	-0.354^{***}
	(−11.438)	(−13.133)	(−11.456)	(−13.196)	(−11.428)	(−13.102)	(−11.447)	(−13.148)
AGE	0.035^{***}	0.007	0.035^{***}	0.007	0.026^{***}	0.003	0.027^{***}	0.003
	(3.644)	(0.747)	(3.751)	(0.714)	(2.699)	(0.317)	(2.771)	(0.290)
BOARDSIZE	−0.004	−0.002	−0.004	−0.002	−0.002	−0.003	−0.002	−0.003
	(−0.832)	(−0.488)	(−0.820)	(−0.484)	(−0.542)	(−0.793)	(−0.548)	(−0.784)
DUAL	−0.001	−0.000	−0.001	−0.000	−0.001	0.000	−0.001	0.000
	(−0.751)	(−0.125)	(−0.796)	(−0.065)	(−0.690)	(0.052)	(−0.737)	(0.110)
TOP1_HOLD	−0.002	0.005	−0.002	0.005	0.002	0.005	0.002	0.004
	(−0.239)	(0.853)	(−0.297)	(0.740)	(0.267)	(0.687)	(0.207)	(0.586)
INSTI_HOLD	-0.028^{***}	-0.026^{***}	-0.029^{***}	-0.026^{***}	-0.029^{***}	-0.029^{***}	-0.029^{***}	-0.029^{***}
	(−5.016)	(−5.243)	(−5.080)	(−5.300)	(−4.977)	(−5.748)	(−5.025)	(−5.799)
CONSTANT	0.140^{***}	0.178^{***}	0.127^{***}	0.168^{***}	0.182^{***}	0.192^{***}	0.171^{***}	0.184^{***}
	(3.554)	(4.909)	(3.216)	(4.646)	(4.535)	(5.215)	(4.226)	(4.985)
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FIRM	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,003	9,708	8,003	9,708	8,003	9,706	8,003	9,706
adj_R^2	0.583	0.575	0.583	0.575	0.600	0.587	0.601	0.586

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (*t*-statistics are in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

significant at the 5% level. We report the results in columns (3) and (4) using *INTL* as the independent variable. Our conclusion still holds. Finally, we switch the dependent variable into *COE_MPEG* and rerun the regressions. Columns (5)–(8) show that the results are quantitatively and qualitatively similar. These results suggest that firms' international operations lower the risk of domestic institutional constraints, which reduces the cost of equity capital.

4.3.2. Domestic industry competition

International operations also help to alleviate industry competition in domestic markets. Seeking market opportunities is an important goal of Chinese firms that aim to conduct international operations (Buckley et al., 2007; Luo and Tung, 2007). Under the investment-led economic growth model, Chinese firms are facing increasingly fierce competition in the domestic industry environment. The domestic market space is limited for firms experiencing intense industry competition, which may lead these firms to overinvest and exceed their capacity. Firms can expand into overseas markets to make use of the differences between market demands in domestic and international markets, improving their capacity and lowering the profit downside risks (Zhou and Su, 2019). Therefore, we expect that the negative relation between firm internationalization and a firm's cost of equity to be more pronounced if the firm is experiencing more (versus less) intense industry competition in domestic markets.

We use the industry sales Herfindahl index (HHI) as a proxy for domestic industry competition. We divide our sample based on whether a firm's industry competition is above or below the median. A higher (lower) HHI suggests lower (higher) industry competition in the domestic country. We show the results in Table 5. In column (1), we report our results for firms with more intense industry competition. The coefficient of *FSALE* is −0.019, which is significantly negative at the 1% level. In contrast, in column (2), where the firms experience less intense industry competition, the coefficient of *FSALE* becomes insignificant. The coefficient of *FSALE* in column (1) is 3.8 times that in column (2), and the difference between them is significant at the 1%

Table 5
Effect of domestic industry competition.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	*COE_PEG*				*COE_MPEG*			
	Low HHI	High HHI	Low HHI	High HHI	Low HHI	High HHI	Low HHI	High HHI
FSALE	−0.019***	−0.005			−0.017***	−0.003		
	(−3.761)	(−0.965)			(−3.375)	(−0.624)		
INTL			−0.003***	−0.001*			−0.002**	−0.001
			(−2.939)	(−1.777)			(−2.379)	(−1.499)
DIFF. Test		0.002***		0.029**		0.001***		0.058*
SIZE	−0.009***	−0.004***	−0.009***	−0.003***	−0.010***	−0.004***	−0.009***	−0.004***
	(−6.506)	(−3.072)	(−5.964)	(−2.785)	(−6.531)	(−3.206)	(−6.059)	(−2.963)
LEV	0.023***	0.025***	0.024***	0.026***	0.019***	0.022***	0.020***	0.022***
	(5.687)	(5.639)	(5.721)	(5.720)	(4.472)	(4.859)	(4.499)	(4.932)
ROA	−0.032***	−0.040***	−0.033***	−0.041***	−0.037***	−0.041***	−0.038***	−0.041***
	(−3.968)	(−4.840)	(−4.065)	(−4.853)	(−4.285)	(−4.765)	(−4.345)	(−4.776)
GROWTH	−0.004***	−0.003***	−0.004***	−0.003***	−0.005***	−0.004***	−0.005***	−0.004***
	(−4.493)	(−4.911)	(−4.461)	(−4.879)	(−4.770)	(−5.641)	(−4.732)	(−5.605)
BM	0.060***	0.041***	0.060***	0.041***	0.068***	0.051***	0.067***	0.050***
	(15.072)	(11.892)	(14.845)	(11.755)	(16.539)	(14.028)	(16.283)	(13.930)
BETA	0.008***	0.013***	0.009***	0.013***	0.009***	0.012***	0.009***	0.012***
	(5.002)	(8.555)	(5.066)	(8.523)	(5.061)	(7.744)	(5.121)	(7.722)
TURNOVER	−0.306***	−0.334***	−0.307***	−0.337***	−0.309***	−0.328***	−0.309***	−0.329***
	(−10.295)	(−12.657)	(−10.288)	(−12.738)	(−10.336)	(−12.600)	(−10.334)	(−12.681)
AGE	0.032***	−0.002	0.032***	−0.002	0.026**	−0.010	0.026**	−0.010
	(2.897)	(−0.255)	(2.946)	(−0.263)	(2.273)	(−1.058)	(2.311)	(−1.063)
BOARDSIZE	−0.002	0.001	−0.002	0.001	−0.001	0.001	−0.000	0.001
	(−0.447)	(0.278)	(−0.379)	(0.248)	(−0.142)	(0.191)	(−0.075)	(0.161)
DUAL	−0.003**	0.001	−0.002*	0.001	−0.003**	0.002	−0.003*	0.002
	(−1.969)	(0.753)	(−1.794)	(0.689)	(−1.967)	(1.129)	(−1.815)	(1.073)
TOP1_HOLD	0.010	0.011	0.010	0.010	0.015*	0.010	0.015*	0.010
	(1.309)	(1.487)	(1.363)	(1.402)	(1.775)	(1.416)	(1.825)	(1.346)
INSTI_HOLD	−0.031***	−0.029***	−0.031***	−0.030***	−0.034***	−0.031***	−0.035***	−0.032***
	(−5.564)	(−5.938)	(−5.687)	(−5.992)	(−5.914)	(−6.186)	(−6.018)	(−6.238)
CONSTANT	0.184***	0.154***	0.167***	0.148***	0.208***	0.187***	0.194***	0.181***
	(4.622)	(4.142)	(4.192)	(3.947)	(5.146)	(4.889)	(4.774)	(4.715)
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FIRM	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,369	9,919	7,369	9,919	7,368	9,918	7,368	9,918
adj_R^2	0.600	0.581	0.600	0.581	0.608	0.598	0.608	0.598

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (*t*-statistics are in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 6
Variable differences before and after PSM.

		Mean		% Bias	Diff. test	
		Treated	Control		t-stat.	p>|t|
SIZE	Unmatched	22.306	22.251	4.3	2.91	0.004
	Matched	22.284	22.286	−0.2	−0.11	0.916
LEV	Unmatched	0.463	0.489	−12.7	−8.57	0.000
	Matched	0.483	0.480	1.3	0.78	0.437
ROA	Unmatched	0.047	0.047	−0.5	−0.31	0.757
	Matched	0.046	0.046	0.3	0.22	0.830
GROWTH	Unmatched	0.186	0.195	−1.7	−1.14	0.254
	Matched	0.188	0.186	0.4	0.27	0.786
BM	Unmatched	0.565	0.572	−2.9	−1.97	0.048
	Matched	0.575	0.573	1.0	0.59	0.554
BETA	Unmatched	1.112	1.067	17.5	11.84	0.000
	Matched	1.081	1.084	−1.1	−0.68	0.497
TURNOVER	Unmatched	0.026	0.024	6.3	4.27	0.000
	Matched	0.025	0.025	−1.1	−0.69	0.488
AGE	Unmatched	2.786	2.825	−11.8	−7.97	0.000
	Matched	2.816	2.810	1.7	1.05	0.294
BOARDSIZE	Unmatched	2.160	2.176	−8.1	−5.50	0.000
	Matched	2.176	2.173	1.6	0.97	0.332
DUAL	Unmatched	0.238	0.161	19.3	12.97	0.000
	Matched	0.168	0.176	−1.9	−1.25	0.213
TOP1_HOLD	Unmatched	0.353	0.367	−9.1	−6.17	0.000
	Matched	0.363	0.363	−0.1	−0.04	0.964
INSTI_HOLD	Unmatched	0.472	0.515	−18.9	−12.68	0.000
	Matched	0.511	0.505	2.6	1.70	0.088

level. This result implies that the negative relationship between firm internationalization and the cost of equity is stronger when the firm experiences more (versus less) intense industry competition in domestic markets. We report the results in columns (3) and (4) using *INTL* as the independent variable. Our conclusion still holds. Finally, we rerun the regressions in columns (1)–(4) using *COE_MPEG* as the dependent variable. We report the new results in columns (5)–(8) and find quantitatively and qualitatively similar results. The above results show that firm internationalization can alleviate the pressure of domestic industry competition, which reduces the cost of equity capital.

5. Robustness analysis

To ensure the robustness of our research conclusions, we adopt a series of robustness checks.[3]

5.1. Addressing potential endogeneity

We include firm fixed effects in all regression models; therefore, the endogeneity issue caused by omitting variables is weak. However, a potential endogeneity concern regarding our findings is that firms with international operations substantially differ from firms without international operations along some dimensions, which could be a driving force underlying the cost of equity (Mihov and Naranjo, 2019). To address this issue, we use PSM to construct matched samples. Specifically, we use a logit model to calculate the probability of undertaking international operations, with the dependent variable being a binary variable that indicates whether a firm has international operations in year *t*, and the independent variables being the control variables

[3] To save space in the robustness checks, we only report the results using *FSALE* as the independent variable. The results using *INTL* are remarkably similar.

in the model (6). Based on the propensity matching score calculated in the logit model, we match the sample using a one-to-one nearest neighbor matching method without replacement. The PSM results are shown in Table 6. We observe a considerable difference between the control variables in the treatment and control groups before PSM. After PSM, the differences between the control variables in the treatment and control groups are no longer significant. We rerun our regression using the PSM sample and report the results in Table 7. The coefficients of *FSALE* are significantly negative, supporting our baseline results.

Another potential endogeneity concern is the reverse causality issue. That is, the negative relationship between firm internationalization and cost of equity may be attributed to the greater likelihood of firms with a lower cost of equity to conduct international operations than other firms. We choose the Sino-US trade dispute as an exogenous setting to mitigate this reverse causality. Specifically, we use the election of former US President Donald Trump as an exogenous event to examine changes in the cost of equity capital of firms with a large proportion of international operations before and after the event. On 8 November 2016, US presidential candidate Donald Trump unexpectedly won the general election. During his campaign, Trump announced that he would impose punitive tariffs on countries that engage in "unfair dumping and subsidies" (alluding to China). In August 2017, the Office of the US Trade Representative officially launched an investigation into China ("Section 301 Investigations"). In April 2018, the US government formally announced a substantial

Table 7
Regression results using the PSM sample.

Variables	(1) *COE_PEG*	(2) *COE_MPEG*
FSALE	−0.011***	−0.010**
	(−2.661)	(−2.242)
SIZE	−0.005***	−0.006***
	(−5.129)	(−5.547)
LEV	0.023***	0.021***
	(6.712)	(5.968)
ROA	−0.030***	−0.029***
	(−4.512)	(−4.091)
GROWTH	−0.004***	−0.005***
	(−6.251)	(−7.440)
BM	0.048***	0.056***
	(16.409)	(18.451)
BETA	0.013***	0.011***
	(9.664)	(8.191)
TURNOVER	−0.368***	−0.344***
	(−15.283)	(−14.193)
AGE	0.010	0.008
	(1.378)	(1.081)
BOARDSIZE	−0.002	−0.003
	(−0.630)	(−0.828)
DUAL	0.000	0.000
	(0.060)	(0.138)
TOP1_HOLD	0.002	0.004
	(0.328)	(0.718)
INSTI_HOLD	−0.031***	−0.031***
	(−7.343)	(−7.120)
CONSTANT	0.142***	0.165***
	(5.302)	(5.953)
YEAR	Yes	Yes
FIRM	Yes	Yes
Observations	15,206	15,206
adj_R^2	0.577	0.585

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (*t*-statistics are in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

increase in tariffs on Chinese imports. Given the global economic and political influence of the US, the negative impact of Sino-US trade disputes may not be limited to trade between China and the US. Such disputes also impact China's trade with other countries, especially those with close ties with the US. The trade dispute between China and the US seriously hinders Chinese firms' internationalization. However, the Sino-US trade dispute is unlikely to be affected by firms' cost of equity capital. Therefore, the Sino-US trade dispute provides a reverse exogenous shock event to study the impact of Chinese firms' internationalization on the cost of equity capital. We expect to observe a significant increase in the cost of equity capital for firms with more international operations after the Sino-US trade dispute.

In Table 8, we report the regression results of the DID model based on the exogenous events of the Sino-US trade dispute. Specifically, we take 2016, the year Trump won the general election, as the event year, and take three years before and after the event (2013–2018) as the testing window. *POST* is a dummy variable equal to 1 for years after the event, and 0 otherwise. We divide the sample into tertiles according to the average percentage of sales from international operations during three years before the event. We regard the subsample in the highest tertiles of sales from international operations as the treated group ($TREAT = 1$), and the subsample in

Table 8
DID regression based on the Sino-US trade dispute.

Variables	(1) *FSALE*	(2) *COE_PEG*	(3) *COE_MPEG*
POST × TREAT	−0.029***	0.005***	0.005***
	(−3.899)	(3.835)	(3.724)
SIZE	0.004	−0.015***	−0.016***
	(0.379)	(−10.095)	(−10.176)
LEV	−0.025	0.026***	0.021***
	(−0.829)	(5.642)	(4.693)
ROA	−0.066	−0.026***	−0.031***
	(−1.642)	(−3.228)	(−3.691)
GROWTH	0.003	−0.004***	−0.004***
	(0.627)	(−4.565)	(−5.169)
BM	0.021	0.074***	0.083***
	(0.852)	(19.942)	(21.463)
BETA	0.004	0.008***	0.007***
	(0.528)	(5.997)	(5.299)
TURNOVER	−0.077	−0.149***	−0.143***
	(−0.372)	(−5.284)	(−4.982)
AGE	−0.035	−0.002	−0.015
	(−0.483)	(−0.112)	(−1.051)
BOARDSIZE	−0.056**	0.005	0.005
	(−2.529)	(1.198)	(1.248)
DUAL	−0.010	−0.000	−0.000
	(−1.496)	(−0.318)	(−0.220)
TOP1_HOLD	−0.023	0.014*	0.016**
	(−0.514)	(1.796)	(1.996)
INSTI_HOLD	−0.009	−0.019***	−0.021***
	(−0.256)	(−3.677)	(−3.975)
CONSTANT	0.278	0.389***	0.438***
	(0.862)	(7.502)	(8.717)
YEAR	Yes	Yes	Yes
FIRM	Yes	Yes	Yes
Observations	6,473	6,473	6,471
adj_R^2	0.881	0.678	0.704

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (*t*-statistics are in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

the lowest tertiles as the control group ($TREAT = 0$). To examine whether Trump's election has a substantial impact on the internationalization of Chinese firms, in column (1) we use the percentage of sales from international operations (*FSALE*) as the dependent variable in the DID model. The coefficient of the interaction term $POST \times TREAT$ is significantly negative at the 1% level, indicating that compared with domestically focused firms, internationalized firms have significantly fewer sales from overseas markets after the Sino-US trade dispute, and thus Trump's election exerts a negative impact on Chinese firms' internationalization. We rerun the DID regression using the cost of equity measures *COE_PEG* and *COE_MPEG* as the dependent variables in columns (2) and (3), respectively. The coefficients of the interaction term $POST \times TREAT$ are significantly positive at the 1% level, indicating that firm internationalization is seriously hindered by the gradual deterioration of the trade environment between China and the US. Compared with firms dominated by domestic operations, the cost of equity capital of firms with more international operations increases significantly after the Sino-US trade dispute, which inversely supports our baseline results.

Table 9
Alternative measures of firm internationalization.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	*COE_PEG*				*COE_MPEG*			
FSUB	−0.002***	−0.002**			−0.001**	−0.002**		
	(−3.261)	(−2.472)			(−2.131)	(−2.178)		
FCNT			−0.002***	−0.003**			−0.001*	−0.002*
			(−2.996)	(−2.288)			(−1.879)	(−1.946)
SIZE	−0.006***	−0.005***	−0.006***	−0.005***	−0.006***	−0.006***	−0.006***	−0.006***
	(−11.489)	(−5.736)	(−11.599)	(−5.795)	(−10.093)	(−6.000)	(−10.178)	(−6.062)
LEV	0.030***	0.026***	0.030***	0.026***	0.024***	0.022***	0.024***	0.022***
	(16.721)	(8.277)	(16.728)	(8.266)	(13.137)	(6.953)	(13.142)	(6.942)
ROA	−0.024***	−0.033***	−0.024***	−0.033***	−0.016***	−0.035***	−0.016***	−0.035***
	(−4.573)	(−5.339)	(−4.558)	(−5.333)	(−2.903)	(−5.422)	(−2.893)	(−5.414)
GROWTH	−0.005***	−0.004***	−0.005***	−0.004***	−0.007***	−0.005***	−0.007***	−0.005***
	(−9.471)	(−6.705)	(−9.486)	(−6.708)	(−11.739)	(−7.606)	(−11.749)	(−7.609)
BM	0.057***	0.047***	0.057***	0.047***	0.065***	0.056***	0.065***	0.056***
	(28.955)	(17.293)	(29.018)	(17.295)	(31.499)	(20.134)	(31.544)	(20.136)
BETA	0.011***	0.012***	0.011***	0.012***	0.010***	0.011***	0.010***	0.011***
	(9.631)	(9.985)	(9.624)	(10.002)	(8.470)	(9.316)	(8.464)	(9.331)
TURNOVER	−0.149***	−0.350***	−0.149***	−0.350***	−0.162***	−0.345***	−0.161***	−0.345***
	(−9.244)	(−16.514)	(−9.241)	(−16.505)	(−9.840)	(−16.537)	(−9.833)	(−16.525)
AGE	0.001	0.017**	0.001	0.018**	0.001	0.010	0.001	0.010
	(1.255)	(2.480)	(1.255)	(2.501)	(0.930)	(1.447)	(0.930)	(1.465)
BOARDSIZE	−0.001	−0.002	−0.001	−0.002	0.001	−0.002	0.001	−0.002
	(−0.688)	(−0.777)	(−0.678)	(−0.773)	(0.436)	(−0.806)	(0.447)	(−0.802)
DUAL	−0.000	−0.001	−0.000	−0.001	0.000	−0.000	0.000	−0.000
	(−0.169)	(−0.622)	(−0.161)	(−0.625)	(0.309)	(−0.470)	(0.312)	(−0.472)
TOP1_HOLD	−0.003	0.003	−0.003	0.003	0.001	0.004	0.001	0.005
	(−1.146)	(0.521)	(−1.141)	(0.534)	(0.190)	(0.808)	(0.196)	(0.820)
INSTI_HOLD	−0.007***	−0.028***	−0.007***	−0.028***	−0.006***	−0.029***	−0.006***	−0.029***
	(−3.869)	(−7.150)	(−3.864)	(−7.139)	(−3.569)	(−7.481)	(−3.560)	(−7.468)
CONSTANT	0.149***	0.128***	0.149***	0.128***	0.140***	0.155***	0.140***	0.156***
	(13.633)	(5.087)	(13.727)	(5.114)	(11.950)	(6.076)	(12.019)	(6.108)
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IND	Yes	No	Yes	No	Yes	No	Yes	No
FIRM	No	Yes	No	Yes	No	Yes	No	Yes
Observations	18,326	18,326	18,326	18,326	18,324	18,324	18,324	18,324
adj_R^2	0.501	0.574	0.501	0.574	0.512	0.587	0.512	0.587

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (*t*-statistics are in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

5.2. Alternative measures of key variables

First, considering the multidimensional nature of measures of firm internationalization, we adopt two alternative measures to proxy for firm internationalization. We examine the impact of international operations on the cost of equity capital using *FSUB* and *FCNT* as the independent variables, respectively. Table 9 shows that the coefficients of *FSUB* and *FCNT* are both significantly negative. Our findings are consistent after using alternative internationalization measures.

Second, we use the other implied cost of equity estimates, *COE_OJN*, *COE_GLS* and *COE_AVG*, as the dependent variables and rerun the main regression models. Table 10 shows that the coefficients of *FSALE* are significantly negative at the 1% or 5% level; therefore, our main conclusions are consistent.

Third, we adopt two alternative measures to proxy for the domestic institutional environment. Our theoretical analysis points out that firms in domestic regions with more government interventions will benefit more than other firms from firm internationalization. Following Song and Huang (2014), we use an index for the relationship between government and market and another index for reducing government intervention in firms (Wang et al., 2019) to proxy for the institutional environment. We then reexamine the impact of the domestic

Table 10
Alternative measures of the cost of equity.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	*COE_OJN*		*COE_GLS*		*COE_AVG*	
FSALE	−0.005***	−0.008**	−0.003***	−0.005**	−0.005***	−0.009***
	(−3.498)	(−2.408)	(−4.939)	(−2.547)	(−4.722)	(−3.205)
SIZE	−0.006***	−0.008***	0.000	0.001	−0.002***	−0.002***
	(−11.891)	(−8.821)	(0.523)	(1.008)	(−6.005)	(−2.799)
LEV	0.026***	0.024***	0.002	−0.001	0.023***	0.021***
	(14.024)	(8.233)	(1.125)	(−0.268)	(13.238)	(7.596)
ROA	−0.026***	−0.036***	0.026***	0.007*	−0.005	−0.020***
	(−4.858)	(−6.049)	(7.194)	(1.714)	(−1.082)	(−3.581)
GROWTH	−0.006***	−0.004***	−0.004***	−0.003***	−0.006***	−0.004***
	(−11.069)	(−6.827)	(−11.349)	(−9.941)	(−12.775)	(−8.794)
BM	0.060***	0.054***	0.057***	0.053***	0.053***	0.040***
	(29.375)	(20.336)	(51.049)	(34.268)	(32.931)	(17.091)
BETA	0.009***	0.011***	−0.001	0.002***	0.010***	0.011***
	(8.183)	(8.961)	(−1.543)	(2.941)	(10.193)	(10.402)
TURNOVER	−0.168***	−0.339***	−0.095***	−0.091***	−0.187***	−0.334***
	(−10.252)	(−16.630)	(−11.764)	(−9.113)	(−12.690)	(−19.184)
AGE	0.001	0.008	0.001**	−0.008***	0.002**	0.014**
	(0.754)	(1.226)	(2.516)	(−2.789)	(2.532)	(2.441)
BOARDSIZE	0.000	−0.003	−0.001	−0.002	−0.002	−0.004*
	(0.014)	(−1.162)	(−1.116)	(−1.422)	(−1.260)	(−1.680)
DUAL	0.000	−0.000	0.000	0.001	−0.001	−0.001
	(0.334)	(−0.411)	(0.799)	(1.169)	(−1.312)	(−0.793)
TOP1_HOLD	0.000	0.007	−0.003*	−0.001	−0.004*	−0.004
	(0.110)	(1.371)	(−1.932)	(−0.161)	(−1.736)	(−0.898)
INSTI_HOLD	−0.006***	−0.028***	0.000	−0.009***	−0.005***	−0.022***
	(−3.330)	(−7.587)	(0.123)	(−4.053)	(−3.386)	(−6.252)
CONSTANT	0.187***	0.234***	−0.004	0.026*	0.065***	0.063***
	(16.062)	(9.786)	(−0.708)	(1.940)	(7.560)	(3.073)
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
IND	Yes	No	Yes	No	Yes	No
FIRM	No	Yes	No	Yes	No	Yes
Observations	18,982	18,982	21,339	21,339	21,615	21,615
adj_R^2	0.551	0.621	0.654	0.722	0.517	0.572

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (*t*-statistics are in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Table 11
Alternative measures of the domestic institutional environment.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Index for the relationship between government and market				Index for reducing government intervention in firms			
	COE_PEG		*COE_MPEG*		*COE_PEG*		*COE_MPEG*	
	High	Low	High	Low	High	Low	High	Low
FSALE	−0.004	−0.017***	−0.003	−0.016***	−0.006	−0.016***	−0.004	−0.015***
	(−0.869)	(−3.768)	(−0.542)	(−3.392)	(−1.206)	(−3.324)	(−0.879)	(−3.008)
DIFF		0.004***		0.001***		0.013**		0.011**
SIZE	−0.008***	−0.005***	−0.009***	−0.005***	−0.008***	−0.006***	−0.009***	−0.006***
	(−5.457)	(−4.639)	(−5.883)	(−4.414)	(−5.377)	(−5.338)	(−5.770)	(−4.969)
LEV	0.029***	0.024***	0.025***	0.021***	0.029***	0.025***	0.024***	0.022***
	(6.208)	(6.398)	(5.265)	(5.522)	(6.157)	(6.655)	(5.220)	(5.643)
ROA	−0.031***	−0.031***	−0.033***	−0.033***	−0.035***	−0.029***	−0.037***	−0.032***
	(−3.745)	(−4.124)	(−3.856)	(−4.193)	(−4.107)	(−3.876)	(−4.178)	(−4.066)
GROWTH	−0.003***	−0.005***	−0.004***	−0.005***	−0.003***	−0.005***	−0.004***	−0.006***
	(−3.168)	(−6.837)	(−4.054)	(−7.324)	(−3.228)	(−6.630)	(−4.137)	(−7.148)
BM	0.053***	0.048***	0.063***	0.056***	0.053***	0.048***	0.064***	0.055***
	(13.964)	(13.918)	(16.492)	(15.547)	(14.094)	(13.793)	(16.587)	(15.364)
BETA	0.012***	0.011***	0.011***	0.011***	0.012***	0.012***	0.011***	0.011***
	(7.450)	(7.606)	(6.744)	(7.239)	(7.155)	(8.018)	(6.432)	(7.654)
TURNOVER	−0.345***	−0.348***	−0.337***	−0.345***	−0.328***	−0.364***	−0.322***	−0.363***
	(−11.885)	(−13.106)	(−11.927)	(−13.085)	(−11.386)	(−13.798)	(−11.441)	(−13.838)
AGE	0.041***	0.000	0.031***	−0.004	0.040***	−0.002	0.030***	−0.005
	(4.308)	(0.002)	(3.249)	(−0.395)	(4.094)	(−0.213)	(3.069)	(−0.536)
BOARDSIZE	−0.006	0.002	−0.006	0.001	−0.004	0.001	−0.004	0.000
	(−1.370)	(0.440)	(−1.270)	(0.203)	(−1.003)	(0.412)	(−0.951)	(0.131)
DUAL	−0.001	0.001	−0.001	0.001	−0.001	0.001	−0.001	0.001
	(−0.749)	(0.434)	(−0.789)	(0.685)	(−0.778)	(0.417)	(−0.835)	(0.619)
TOP1_HOLD	0.001	0.003	0.005	0.003	−0.001	0.004	0.003	0.003
	(0.088)	(0.557)	(0.564)	(0.411)	(−0.123)	(0.629)	(0.366)	(0.519)
INSTI_HOLD	−0.026***	−0.027***	−0.025***	−0.030***	−0.026***	−0.026***	−0.026***	−0.030***
	(−4.691)	(−5.505)	(−4.512)	(−6.106)	(−4.707)	(−5.525)	(−4.518)	(−6.187)
CONSTANT	0.133***	0.180***	0.182***	0.194***	0.133***	0.202***	0.182***	0.213***
	(3.459)	(5.159)	(4.679)	(5.479)	(3.428)	(5.626)	(4.613)	(5.821)
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FIRM	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,110	9,724	8,110	9,722	8,136	9,661	8,136	9,659
adj_R^2	0.584	0.579	0.601	0.594	0.582	0.587	0.599	0.601

Notes: Standard errors are corrected for heteroskedasticity and clustering at the firm level (*t*-statistics are in parentheses). ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

institutional environment on the relationship between firm internationalization and cost of equity. Table 11 shows that the negative correlation between firm internationalization and cost of equity is more pronounced for firms located in areas with a weak institutional environment than for other firms. Our findings are consistent with Table 4 after using alternative institutional environment measures.

Finally, we use an alternative measure to proxy for domestic industry competition. For a specific industry, we calculate the ratio of sales from the largest five firms to the total sales from all firms within the industry. Using this ratio as the industry competition measure, we reexamine how the domestic industry competition affects the relationship between firm internationalization and the cost of equity. Untabulated results show that for firms with more intense industry competition, the firm internationalization effect on reducing the cost of equity capital is more pronounced than for other firms. The results are consistent with those in Table 5 after using alternative domestic industry competition measures.

6. Conclusion

Using data on China's A-share listed firms from 2007 to 2018, we examine the impact of international operations on the cost of equity. We find that firms with more international operations have a lower cost of equity, indicating that internationalization diversifies operational risks and thus reduces the cost of equity capital and improves resource allocation efficiency in the capital market. We further find that the negative relationship between firm internationalization and cost of equity is more salient for firms that have headquarters in provinces with weak institutional constraints and firms experiencing intense domestic industry competition pressure than for other firms. Our results remain robust after adopting a fixed effect model, PSM, DID regressions and alternative measurements of key variables.

Our findings have certain policy guidance implications. Chinese firms benefit from internationalization by accumulating capital and technology. To accelerate the coordinated development of domestic and international circulation, the financing function of the capital market should be enhanced further to reduce the financial cost of firm internationalization. Meanwhile, the domestic regional institutional environment has a significant impact on the negative correlation between firm internationalization and cost of equity. Therefore, regulators should carefully consider improving domestic regional institutional environments.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Variable definitions

	Variable	Definition
Implied cost of equity	*COE_PEG*	Implied cost of equity estimated from PEG model.
	COE_MPEG	Implied cost of equity estimated from MPEG model.
	COE_OJN	Implied cost of equity estimated from OJN model.
	COE_GLS	Implied cost of equity estimated from GLS model.
	COE_AVG	Equal-weighted average of *COE_PEG*, *COE_MPEG*, *COE_OJN* and *COE_GLS*.
Firm internationalization	*FSALE*	Firm's percentage of sales from international operations over a given fiscal year.
	FSUB	Natural log transformation of the number of distinct foreign subsidiaries except for those located in offshore financial centers, such as the Cayman Islands.
	FCNT	Natural log transformation of the number of distinct foreign countries in which a firm discloses operations over a given fiscal year except for offshore financial centers, such as the Cayman Islands.
	INTL	Composite measure constructed using principal component analysis based on *FSALE*, *FSUB* and *FCNT*.
Control variables	*SIZE*	Firm size calculated as the natural log transformation of a firm's assets at fiscal year-end.
	LEV	Leverage ratio calculated as the ratio of total liabilities to total assets.
	ROA	Return on assets calculated as the ratio of net income and book value of assets.
	GROWTH	Sales growth.
	BM	Ratio of book value of assets to market value at fiscal year-end.
	TURNOVER	Mean turnover rate in one year.
	BETA	Market beta calculated as the sensitivity of a firm's return to value-weighted market return.
	BOARDSIZE	Board size calculated as the natural log transformation of the number of directors in a firm's board.
	DUAL	CEO–chairperson duality.
	TOP1_HOLD	Stock ownership of the largest shareholder.
	INSTI_HOLD	Stock ownership of the institutional investors.
	AGE	Firm age calculated as the natural log transformation of the number of years the firm is established.

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