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Can information confusion caused by the financing model of new economy companies be eliminated?

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ABSTRACT

New economy companies often use convertible and redeemable preferred shares with equity and debt characteristics as financing tools to reduce risk during their early stages of growth. According to relevant accounting standards, such preferred shares should be classified as financial liabilities and measured at fair value, with changes in fair value recognized in profit or loss. This can lead to confusing financial information: the better a company's development prospects, the higher its redemption or conversion price and loss, which can result in a large negative net asset value. A successful initial public offering, however, could offset large losses and negative net asset value. Following the development of accounting standards, this article thoroughly analyzes various proposals to modify relevant accounting standards and eliminate confusing information. This article also proposes possible problems and solutions as a reference for accounting standard setters and the various stakeholders in new economy companies.

1. Introduction

New economy companies, such as information technology, biomedicine, and big data companies, have flourished since the 2008 financial crisis. In 2018, the new economy industry accounted for 16.1% of China's GDP, becoming the new engine of China's development. In the same year, the Shanghai Stock Exchange launched the Sci-Tech Innovation Board, and the Hong Kong Stock Exchange relaxed the conditions for the listing of biotech companies to provide a better financing environment for new economy companies. Also in 2018, the China Securities Regulatory Commission (CSRC) released a document outlining new rules for overseas-listed red-chip companies that return to the domestic market for listing. Recently, the CSRC issued

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another document that lowered the value threshold for returning companies but emphasized that they should have independent R&D, internationally leading technology, strong technological innovation capabilities, and other competitive advantages. The Shenzhen Stock Exchange has begun to reform the second-board market to serve growth-oriented innovative and entrepreneurial companies and support the deep integration of traditional industries with new technologies, industries, formats, and business models. In this paper, we examine whether current accounting standards meet the information-communication needs of new economy companies and provide users of financial statements with enough information to make informed investment decisions and contribute to China's economic growth.

In their early stages of growth, new economy companies often use convertible and redeemable preferred shares, which have both equity and debt characteristics, as financial tools to offset high risks, such as asset-light capital structures, low survival rates or short lives, and long-term losses. According to current accounting standards, these financing tools should be classified as financial liabilities and measured at fair value, with the changes in fair value recognized in profit or loss. This approach can lead to confusing financial information: the better a company's development prospects, the higher its conversion or redemption price and loss, resulting in a large negative net asset value. However, the large losses and negative net asset value could be offset by a successful initial public offering (IPO).

The literature includes an abundance of research on hybrid financial instruments such as convertible and redeemable preferred stocks and the financial information they provide. Studies focus on the classification and disclosure of hybrid financial instruments, with some studies demonstrating the economic importance of appropriate classification (Barth et al., 2013). Hopkins (1996) finds that the classification of financial instruments with both debt and equity characteristics affects US buy-side financial analysts' judgment of stock prices. Clor-Proell et al. (2016) report that classification is more important for inexperienced than experienced users. Godfrey et al. (2010) observe that appropriate accounting classification rules could result in more transparent information and reduce information asymmetry. However, studies suggest that a dichotomous classification does not provide users with enough information (Kimmel and Warfield, 1995). Users could evaluate firms better if the features of their hybrid instruments were disclosed (Kimmel and Warfield, 1995). The method of classification would have little impact if financial statement users were well informed (Peasnell, 2013). Bispo et al. (2016) replicate Hopkins's (1996) method and find that analysts are likely to treat a hybrid instrument conservatively, as a liability, regardless of the classification. Sufficient information is more important for experienced than inexperienced users because they make their judgments based largely on the instrument's underlying features (Clor-Proell et al., 2016). Fargher et al. (2019) propose that a mezzanine category for the classification of hybrid financial instruments, such as convertible and redeemable preferred stocks, is a possible way to provide users with better information.

We analyze ways to revise accounting standards on convertible and redeemable preferred shares to eliminate confusion about their financial characteristics, based on the historical formation and revision of the relevant accounting standards and the conceptual framework of financial reporting. We propose solutions to potential problems that domestic and international accounting standard setters and new economy company stakeholders could encounter during the revision process.

The remainder of this paper is structured as follows. Section 2 summarizes the main characteristics of new economy companies that have adopted hybrid financing instruments. Section 3 explains the accounting principles of convertible and redeemable preferred shares and the information confusion they can generate. Section 4 presents an in-depth analysis of various amendments to the relevant standards and proposes corresponding problems and solutions, based on the historical development of accounting standards and their conceptual framework. Finally, a summary is provided.

2. Basic characteristics of new economy companies

2.1. Asset-light

"Asset-light" means that a company's net asset value, recognized and measured by accounting standards, accounts for a small proportion of its market capitalization. The book value of net assets and market value of listed companies in major capital markets have diverged over the years, as shown in Table 1.

Table 1
Unrecognized value of listed companies in the world's major capital markets.

Area	Item	2007	2008	2009	2010	2011	2012	2013	2014
S&P	Net assets less goodwill to market value	23.36%	35.09%	34.21%	33.40%	34.93%	32.54%	28.52%	25.97%
	Ratio of goodwill to market value	13.25%	19.84%	17.20%	16.03%	17.19%	15.82%	13.32%	12.41%
	Unrecognized value to market value	63.39%	45.07%	48.61%	50.57%	47.88%	51.64%	58.15%	61.62%
European	Net assets less goodwill to market value	33.03%	50.35%	44.67%	47.50%	55.12%	50.31%	43.31%	44.52%
	Ratio of goodwill to market value	16.29%	28.32%	21.91%	21.20%	23.99%	20.15%	16.38%	16.95%
	Unrecognized value to market value	50.69%	21.31%	33.43%	31.30%	20.87%	29.54%	40.31%	38.54%
ASX	Net assets less goodwill to market value	24.78%	39.83%	37.92%	38.76%	47.92%	44.93%	41.35%	43.46%
	Ratio of goodwill to market value	9.14%	13.69%	10.40%	10.58%	12.25%	10.03%	8.48%	8.78%
	Unrecognized value to market value	66.08%	46.61%	51.68%	50.66%	39.71%	45.14%	50.26%	47.76%
Nikkei	Net assets less goodwill to market value	76.49%	106.08%	91.68%	105.78%	107.61%	96.73%	90.20%	82.32%
	Ratio of goodwill to market value	2.41%	4.56%	3.94%	4.31%	4.91%	4.46%	4.15%	3.23%
	Unrecognized value to market value	21.10%	−10.64%	4.48%	−10.09%	−12.52%	−1.19%	5.65%	14.45%

Source: European Financial Reporting Expert Group (2016).

Table 1 demonstrates the following. (1) Of the four markets, the S&P 500 companies have the lowest ratio of net assets minus goodwill to market value, averaging approximately 30%, with a low of 25% in 2007. The Nikkei companies have the highest ratio, higher than 90% in most years. The European index companies and the Australian Securities Exchange (ASX) companies are between the S&P 500 and Nikkei companies. (2) European companies have the highest ratio of goodwill to market value in each market, consistently between 16% and 29% and over 20% in most years. The Nikkei companies have the lowest ratio, less than 5% in each year. The S&P 500 companies and the ASX companies are between the European index companies and the Nikkei companies. The Nikkei companies have the lowest ratio for two reasons. First, Japanese companies generally do not develop through M&A. Second, Japanese accounting standards require amortization plus impairment of goodwill. Therefore, an M&A's goodwill, were it to be recognized, would have a low book value due to annual amortization and impairment. (3) Factors (1) and (2) are superimposed. The S&P 500 companies have the highest ratio of unrecognized value to market value. The ratio is over 45% each year, with some years reaching over 60%. The Nikkei companies have the lowest ratio. The European Index and ASX companies fall between the two.

A study by the European Financial Reporting Advisory Group (EFREG) (2016) covers 1,069 companies. Ninety of them were new economy companies. They account for 50% of the sample's total goodwill, indicating that new economy companies are more asset-light than the other companies. Thirty-six of the new economy companies are from the S&P 500. They account for 32% of the total market value of the sample's US companies. Another 36 are from the European index. They account for 29% of the total market value of the sample's European companies. Nine are from the Nikkei index. They account for 21% of the total market value of all Japanese companies in the sample. Another nine are from the ASX. They account for 47% of the total market value of the sample's Australian companies.

Asset-light companies have an increasing proportion of intangible assets and goodwill relative to their assets' total book value. As shown in Fig. 1, the ratio of intangible assets and goodwill to the total book value of assets of new economy companies listed in the US reached 44% in 2018, a 63% increase from 2009. In contrast, the proportion of traditional companies in 2018 was 29%, increasing only 31.8% from 2009. The ratio of intangible assets and goodwill to the book value of assets for new economy companies listed in China was 5.0% in 2018, increasing by 51.5% from 2009. The ratio for traditional Chinese companies in 2018 was only 1.1%, representing an increase of only 10% from 2009.

2.2. Short life span

New economy companies tend to have a shorter life than traditional companies because of their higher risk. According to statistics from the State Administration for Industry and Commerce of China, the average life span of Chinese companies is 6.09 years. Nearly 60% of Chinese companies have a life span of fewer than five

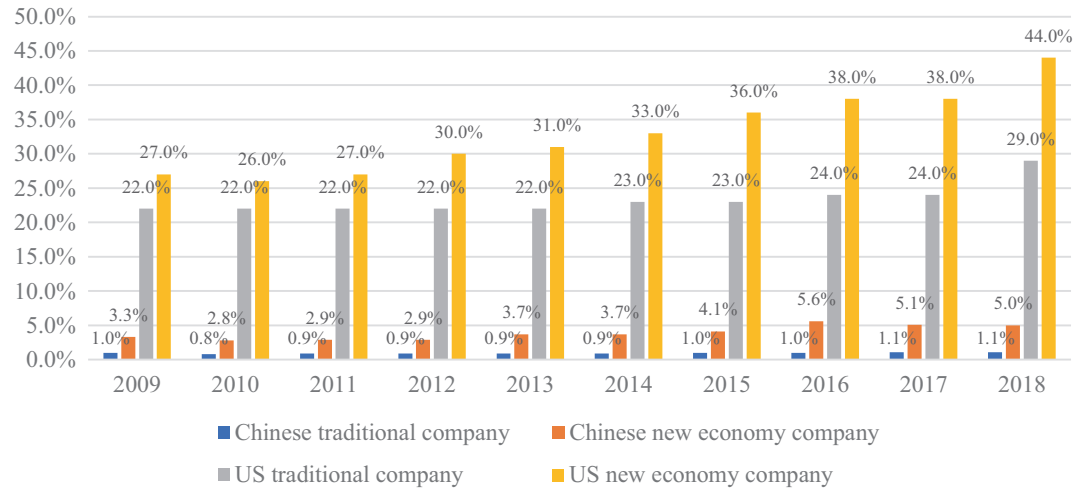

Fig. 1. The ratio of intangible assets and goodwill to total assets of Chinese and US listed companies. Source: CSMAR and COMPUSTAT.

years. The average life span of scientific R&D services companies is only 5.14 years (Liu et al., 2018). According to DT Finance (2020), startup companies in the 10 most popular industries had an average life span of below four years over the past five years (see Table 2 for details). They had short life spans because they had weak business models. Other factors are market pseudo demand, industry competition, business adjustment, product entry time, policy supervision, cash flow disruption, insufficient financing capacity, and excessive business fragmentation.

2.3. Long-term loss

Most new economy companies die in their early stages, and many of the survivors experience substantial long-term losses. In Table 3, we present the historical losses of US and Chinese new economy companies. Amazon, one of the most famous American companies, experienced eight years of losses, including six years of losses after going public. Uber, Tesla, and Dropbox have never been profitable. Similarly, of the 10 Chinese companies examined here, MI and Yixin have experienced losses, though they were profitable after going public. The other Chinese companies continued to lose money after IPOs.

New economy companies sustain continuous losses for six reasons. (1) New economy companies have to make large investments in R&D, but according to current accounting standards, most R&D expenditures can only be expensed. (2) Customer-oriented new economy companies have to make large investments in cus-

Table 2
Survival period of companies in the 10 most popular industries in the last five years.

Industry	Number of failed companies	Average survival period (months)
Game developer	200	47
Integrated e-commerce	195	44
Restaurant	147	43
Loan	134	43
Interest community	124	43
Human resources	118	40
Fresh food	118	38
Life information platform	113	41
E-commerce solutions	111	46
Online dating platform	111	41

Source: DT Finance (2020).

Table 3
Losses of US and Chinese new economy companies by year.

Corporation	Establishment	IPO	Turnaround	Loss duration	Listing place
					US
Amgen	1980	1985	1985	5	US
GILD	1987	1992	2000	13	US
Amazon	1995	1997	2003	8	US
Netflix	1997	2002	2002	5	US
Tesla	2003	2010		15	US
Dropbox	2007	2018		11	US
Groupon	2008	2011	2016	8	US
Uber	2009	2019		10	US
SNAP	2010	2017		8	US
Lyft	2012	2019		7	US
China					
JD	2004	2014	2017	13	US
Tuniu	2006	2014		12	US
Bilibili	2009	2018		9	US
iQIYI	2010	2018		8	US
Pinduoduo	2015	2018		3	US
MI	2010	2018	2018	8	HK
Meituan Dianping	2010	2018		8	HK
Yixin group	2014	2017	2017	3	HK
Ping An Healthcare	2014	2018		4	HK
Zelgen	2009	2019		10	China Mainland

Source: These Companies' Prospectus & Annual Report.

tomer services, and the majority have to be expensed. (3) New economy companies have to spend large amounts on salaries for managers or technical experts, and some companies use various equity incentive plans, both of which greatly increase labor costs. (4) Some new economy companies have to make large investments in fixed assets that are often highly technical and can only be produced in a few countries. These assets are expensive and their economic lives are short, resulting in high depreciation expenses. An asset could suffer impairment loss if it goes quickly out of date. (5) New economy companies often diversify their investments in the industrial chain or new growth points to expand their scale. The lucky few reap sizable profits, while the majority fail and lose substantial sums of money. (6) New economy companies rely on venture capital because of high risks, contributing to substantial long-term losses. This paper will discuss its financing models in depth in the next section.

2.4. Companies with losses still have high valuations and high market value

Many new economy companies have a high market value even though they have experienced large losses over long periods of time and their net assets have a negative book value before and after IPOs. For example, Bilibili is valued at over three billion USD, even though it consistently showed losses before going public Table 4.

Table 4
Bilibili's main financial data before IPOs (in billion RMB).

	2015	2016	2017
Net revenue	0.13	0.52	2.47
Cost of revenue and operating expenses	0.69	16.50	7.74
Gross profit/loss	−0.56	−15.98	−5.27
Loss before tax	−0.37	−0.91	−0.18
Net loss	−0.38	−0.91	−0.18

Source: Bilibili's Prospectus.

Table 5
Changes in market value for Chinese and US new economy companies still experiencing losses after listing (in billion USD).

Company	Financial indicator	IPO	1 year after IPO	2 years after IPO	3 years after IPO	4 years after IPO
Amazon	Net profit	−0.03	−0.12	−0.72	−1.41	−0.56
	Market value	1.44	17.05	26.27	5.56	4.04
Tesla	Net profit	−0.15	−0.25	−0.40	−0.07	−0.29
	Market value	2.53	2.99	3.87	18.52	27.95
JD	Net profit	−0.81	−1.45	−0.55	0.02	−0.36
	Market value	31.61	44.24	36.08	59.08	30.29
Tuniu	Net profit	−0.07	−0.23	−0.35	−0.12	−0.03
	Market value	0.75	1.53	1.10	0.97	0.61

Source: COMPUSTAT.

The valuations and total market capitalization of companies like Bilibili are high or on the rise, even though their financial statements show losses. This phenomenon is common among new economy companies. Table 5 shows four companies' valuations, two Chinese companies and two US companies. Their total market value is high, even though they experienced losses for several years after listing.

3. Financing models of new economy company and related accounting standards

3.1. The main features of the hybrid financial instruments of new economy companies

New economy companies have difficulty raising funds through traditional channels because of the high risk of light assets, low survival rates, short life spans and long-term losses, and unclear development prospects. They have difficulty borrowing money from banks because of their high risk and lack of collateralizable assets. They cannot raise funds through ordinary shares because of their unclear prospects. As a result, many new economy companies raise funds through hybrid financial instruments, such as convertible and redeemable preferred shares. The appendix summarizes the main features of the financing instruments used by some Chinese companies listed on the Hong Kong and US markets. They include the following four features: (1) dividend rights, the right to have priority over ordinary shareholders in receiving noncumulative dividends, plus fixed-rate interest at the original-issue price; (2) conversion rights, the right to convert to common stock at the effective conversion price after the IPO or when required by most holders; (3) redemption rights, the right to redeem the instruments at the higher of the outstanding interest and dividends or the fair value at a certain time following instrument issuance and before the IPO; and (4) liquidation preferences, which take precedence over ordinary shareholders' rights to recover investment capital, receive outstanding interest and dividends, or obtain a proportional share of the remaining assets during liquidation.

3.2. The relevant accounting standards and the main reasons for support and opposition

According to current accounting standards, new economy companies should classify hybrid financing instruments as financial liabilities. They should measure the instruments at fair value, with changes in fair value recognized in profits and losses. These stipulations derive from comprehensive consideration of the following factors:

Dividend rights. The relevant accounting standards stipulate that contractual obligations to deliver cash or other financial assets to another entity are financial liabilities. Hybrid financing instruments come with contractual obligations that require interest payments to the holders of preferred shares at a fixed rate of the original-issue price.

Conversion rights. According to relevant accounting standards, a contract should be classified as a financial liability if it will or may be settled in the entity's own equity instruments and is a nonderivative for which the entity is or may be obliged to deliver a variable number of the entity's own equity instruments. The holder of the above-mentioned preferred shares has the right to convert them into ordinary shares at the current

effective conversion price after the IPO or when requested by most holders. The number of common shares that the company will deliver is variable when the holder exercises its conversion right.

Redemption rights. The relevant accounting standards stipulate that the company is obligated to pay holders cash and redeem preferred shares in the event of an IPO failure.

Liquidation preferences. An agreed-upon clause stipulates that the holder has priority over ordinary shareholders to receive principal, interests, and dividends during liquidation or to obtain the remaining property of the company in proportion.

A new economy company experiences higher losses during its development when its stock redemption or conversion price is higher, resulting in a substantial negative net asset value, especially before the IPO. For example, MI's prospectus was based on the IFRS when it prepared to go public in spring 2018. Losses in 2017 amounted to 43.89 billion RMB. Convertible and redeemable preferred shares alone resulted in losses of 54.07 billion RMB. According to the IFRS, shareholders' equity at the end of 2017 was −127.21 billion RMB, of which 161.45 billion was the cumulative loss from convertible and redeemable preferred shares. Large losses and negative net asset value can be offset when a company goes public at a high premium. Some investors find the phenomenon appropriate for certain companies, whereas other investors find it confusing.

Supporters of the above phenomenon argue that the financial report reflects the issuer's or company's inevitable inflow or outflow of economic resource obligations and different times or levels of capital provision. These could be a possible wealth redistribution or rights dilution of potential capital providers, even when the occurrence of subsequent economic events (such as a successful IPO) completely erases the company's accumulated losses or the negative book value of its net assets due to a rise in fair value. However, current accounting standards stipulate that companies should classify the financial instruments as financial liabilities or equity because of their characteristics when issue such financial instruments. The subsequent remeasurement of the stock's value and recognition of the resulting profits and losses should be carried out accordingly. The relevant accounting standards do not include provisions for reclassification based on the probability of subsequent events, such as the possible success of an IPO.

Many people have questioned the accounting standards. Huang (2018) and Zhang (2020) argue that their requirements do not meet the principle of "substance over form," as convertible and redeemable preferred stock is only a "virtual liability," not debt in the traditional sense. Companies with successful IPOs only need to issue certain classes of shares to enable holders to convert preferred shares into common shares. This process does not require companies to pay cash or transfer assets to "liquidate" the "virtual liability" of preferred stock. Net assets increase with the reduction in or elimination of related "virtual liabilities," but cash flow does not decrease. In addition, the transactions are between shareholders. They have nothing to do with the company even though the company has to issue additional shares for conversion, diluting ordinary shareholders' rights. Wang and Bao (2020) and Li (2020) suggest that the accounting standards make it too difficult for some investors to judge the company's business status and for the company to meet the strict requirements for listing on the mainland Chinese capital market.

4. Solutions to disputes about the financing instruments of new economy companies

The International Accounting Standards Committee (IASC) was established in 1973. Initially, the US did not support the IASC. However, the US began to consolidate its position as a global financial center after the Reagan administration, with a gradual shift toward economic liberalization, globalization, and financial modernization. An increasing number of foreign companies began to pursue listings in the US. At that time, foreign companies were required to convert their financial statements to US GAAP and reconcile differences in net profit and net assets between their local GAAP and US GAAP to go public in the US. Initially, the US capital market regulator, that is, the SEC, and US investors had difficulty acting on financial information based on US GAAP and other accounting standards. In response, the US began to participate more actively in the international effort to harmonize accounting standards, supporting the IASC's work in formulating International Accounting Standards (IAS) and promoting the IAS through the International Organization of Securities Commissions. In the 1990s, the US lobbied the IASC to publish a series of accounting standards for financial instruments following the newly established US GAAP.

One standard, IAS 32, has the following three features. (1) It is based on the basic equation of "assets = liabilities + owner's equity" and the basic concepts of the two categories on the right side of the balance sheet. (2) It accepts "owner's equity" as residual or "owner's equity = assets – liabilities." The accounting standards for assets and liabilities are much more complicated due to the residual, while the accounting standards for owner's equity are simple. For example, there are detailed standards for different assets and liabilities, initial and subsequent measurements, and presentation and disclosure of the assets and liabilities. The accounting standards provide few requirements for owner's equity. Equity is the indirect consequence of the recognition and measurement of assets and debts. Accounting standards do not have to regulate owner's equity because company laws or securities laws in most countries already regulate owner's equity. (3) IAS 32 is rule-based. It has more exceptions and exemptions because it is based on US GAAP. The basic principles of IAS 32 cannot be changed easily, although they encounter many problems in practical application. It is difficult to deduce proper solutions based on the previous principles and rules.

For the aforementioned reasons, after the IASB was reorganized from the IASC in 2001, it has made several efforts to revise IAS 32 and related basic accounting theories comprehensively, as follows. (1) The IASB conducted joint projects with the Financial Accounting Standards Board (FASB) on financial instruments from 2006 to 2010. (2) From 2012 to 2018, the IASB attempted to revise basic concepts and principles related to financial instruments with characteristics of equity in its conceptual framework project. (3) the IASB relaunched a research project on financial instruments with characteristics of the equity from 2016 to 2019. In addition, the IASB has made several small-scale amendments to IAS 32 in response to requests from various parties dating back to 2001. A few projects were successful, but most failed. The successful revision passed but with a number of "nays," indicating its controversial nature.

We build on the history of the revisions to consider ways to make the financial information on new economy companies' convertible and redeemable preferred shares less ambiguous.

4.1. Should convertible and redeemable preferred shares be classified as equity from the perspective of their redemption rights?

IAS 32 is based on the premise that companies should recognize their contractual obligation to deliver cash or other financial assets as a liability. On this basis, the standard has resulted in a series of detailed rules and exceptions on nonderivative and derivative instruments. Before 2007, the IASB received many questions about puttable instruments and whether they should be classified as liabilities or equity. A puttable instrument is a financial instrument that gives its holder the right to put the instrument back to the issuer for cash or other financial assets. It could also be a financial instrument that is automatically put back to the issuer in the occurrence of an uncertain future event or the death or retirement of the holder (IAS 32). Puttable instruments can occur in the following situations: (1) a company, in the form of a cooperative, grants its members or shareholders the right to redeem their shares in the event of retirement or resignation; (2) after an infrastructure project that takes the form of a project company, as the company will be dissolved and the remaining assets are distributed to shareholders at the end of the project; and, (3) after an unsuccessful IPO and similar conditions, as high-tech companies give their preferred shareholders the right to put back their shares to the issuers. Holders and issuers frequently found it difficult to reach a consensus on the practice of puttable instruments before 2007, as their regulation varied greatly by entity. At the request of the parties, the IASB revised IAS 32 in 2008 and added the following exception: puttable instruments should be classified as equity instruments if they meet the definition of financial liabilities and the following criteria:

(a) The instrument entitles the holder to a pro-rata share of the entity's net assets in the event of the entity's liquidation. The entity's net assets are those assets that remain after deducting all other claims on the entity's assets. A pro-rata share is determined by dividing the entity's net assets on liquidation into units of equal amount and multiplying that amount by the number of units held by the financial instrument holder (IAS 32).

(b) The instrument is in the class of instruments that is subordinate to all other classes of instruments. To be in such a class, the instrument must have no priority over other claims to the assets of the entity on liquidation and not require conversion into another instrument before it is in the class of instruments that is subordinate to all other classes of instruments (IAS 32).
(c) All financial instruments in the class of instruments that is subordinate to all other classes of instruments have identical features. For example, they must all be puttable, and the formula or other method used to calculate the repurchase or redemption price is the same for all instruments in that class (IAS 32).
(d) Apart from the contractual obligation for the issuer to repurchase or redeem the instrument for cash or another financial asset, the instrument does not include any contractual obligation to deliver cash or another financial asset to another entity or to exchange financial assets or financial liabilities with another entity under conditions that are potentially unfavorable to the entity, and it is not a contract that will or may be settled in the entity's own equity instruments as set out in the definition of a financial liability (IAS 32).
(e) The total expected cash flows attributable to the instrument over its life are based substantially on profit or loss, the change in recognized net assets, or the change in the fair value of the recognized and unrecognized net assets of the entity over the life of the instrument (excluding any effects of the instrument) (IAS 32).

This revision is very controversial. IASB members from the US and South Africa voted against it. The reasons include the following: the revision violates the conceptual framework and classifies financing instruments that meet the definition of liabilities as equity; it does not treat financial instruments that meet the definition of liabilities as equity in the name of exceptions; and the revision cannot produce more relevant, understandable and comparable information (IAS 32).

New economy companies' convertible and redeemable preferred shares do not meet the above specific criteria, so they cannot treat their instruments as equity.

The IASB also faced a problem with puttable instruments that were non-controlling interests (NCI Put). NCI Put refers to the right granted by a company to its non-controlling shareholders to put their shares to the company or controlling shareholders under certain conditions. The IASB and its Interpretations Committee have discussed the matter numerous times since 2010. However, they have not resolved the issue because of a conflict between two standards: IAS 32 *Financial Instruments: Presentation* and IFRS 10 *Consolidated Financial Statements* reach opposite conclusions.

One stream of thought argues that the issuer should classify the instruments as liabilities and remeasure them at fair value, following IAS 32. Advocates of this approach also argue that the remeasurement difference during the period should goes to profit or loss. Their reasons include the following. (1) The issuer is contractually obligated to pay cash or other financial instruments at the agreed-upon price because they provide the financial instrument with the puttable right. (2) The use of financial instruments between controlling shareholders and non-controlling shareholders can involve many agreements. The transactions involved in the agreements cannot be considered transactions between the companies and their shareholders. Therefore, they should not be treated as equity. (3) The accounting for NCI Put and the accounting for any other puttable instruments should be consistent (the financing instruments with puttable rights discussed previously meet the definition of a liability and meet specific conditions to be treated as equity). (4) Classifying the instruments as liabilities, remeasuring them in accordance with relevant standards, and including the difference in remeasurement into equity creates another exception in IAS 32 that inevitably damages comparability.

Another group argues that the instruments should be classified as equity, and the results of remeasurement should be included in equity rather than profit or loss, following IFRS 10. Their reasons include the following. (1) IFRS 10 stipulates that non-controlling equity is part of equity. Therefore, from the perspective of consolidated statements, all transactions that affect the interests of noncontrolling shareholders should be considered transactions with the owners and should not affect profit or loss. (2) Including the value change of NCI Put into profit or loss would produce useless information. For example, the recognition of the change in the value of NCI Put that can be settled at the fair value of the underlying equity as profit or loss would produce

misleading information because the company as the issuer has to pay cash at fair value when the non-controlling shareholder exercises puttable rights. As a result, shares of the same value are obtained, though the company has no associated profit or loss. (3) NCI Put is different from simple contracts that include obligations to pay cash to third parties. The two should have different accounting requirements. Equity has the characteristics of equity prior to the exercises of the puttable right of equity. Therefore, it should be classified as equity.

The IASB has been unable to solve the problem because the two schools of thought are radically opposed, resulting in a divergence in practice. The practitioners of one school classify the instrument as a liability and include the periodical remeasurement difference in profit or loss, while the practitioners of the other classify the instrument as equity and include the periodical remeasurement difference in equity, and other methods in between. The IASB sought to solve the problem with a comprehensive revision of IAS 32 in 2016, but it failed. In September 2019, the IASB decided to abandon the original comprehensive revision plan and change the plan to a small-scope revision of IAS 32. Among possible revisions, there is the long-standing unresolved issue of NCI Put (IASB, 2019b). If the IASB launches this revision project in the near future, it would have to determine whether the scope of research is limited to NCI Put or includes other financing instruments' puttable rights. Specifically, it must decide whether to include the right to put shares to the issuer or the controlling shareholder; when a puttable right may be exercised; and whether the right is exercised at a fixed price, fair value, or some other price. Different scopes will cause different disputes. The exception that a puttable instrument could be classified as equity is a very narrow revision. The holders of the financing instruments involved in the exception were the companies' most subordinate equity holders. The remaining assets will be distributed in the same way as it was for ordinary shareholders. The method of distribution of residual assets will be the same as that of common shareholders when the company is liquidated.

4.2. Can the accounting standards for convertible and redeemable preferred shares be modified from the perspective of antidilution clauses?

The accounting standards for distinguishing between equity and liability have rule-oriented requirements, often called "fixed for fixed." Financial instruments that will or may be settled in the entity's own equity instruments should be classified as financial liabilities when they meet one of the following conditions: a non-derivative instrument for which the entity is or may be obliged to deliver a variable number of the entity's own equity instruments, or a derivative that will or may be settled other than by the exchange of a fixed amount of cash, or another financial asset for a fixed number of the entity's own equity instruments (IAS 32; CAS 37). However, the fixed for fixed rule-oriented accounting standard has been difficult to interpret and apply in complex financing agreements. Specifically, to what extent does the change in the number of exchanged equity instruments and cash or other financial assets violate the fixed for fixed rule, thereby changing the classification result between liabilities and equity? To this end, accounting standard setters have made various exceptions based on the fixed for fixed rule. The following are two examples.

During the 2008 financial crisis, HSBC sought to raise funds through capital markets to avoid failure, as it lacked capital. HSBC's revenue and profits were mainly from Asia because it was established in Hong Kong and Shanghai, and the financial crisis had little impact on the Asian market. HSBC decided to raise capital through right issue to its shareholders in the Hong Kong market. At that time, HSBC fixed the price and quantity for the right issue, which seemed to meet the principle of fixed for fixed. The placement of shares was settled in Hong Kong dollars, but the reporting currency of HSBC's headquarters was British pounds, so under the assumption that other conditions remained unchanged, changes in the exchange rate would cause changes in the amount of capital raised.

According to accounting standards, financing instruments should be classified as liabilities rather than equity and measured at fair value before the completion of the offering, and the remeasurement difference during the period should be included in the profit or loss. HSBC found the standard unreasonable and asked the IASB to explain whether its situation violated the fixed for fixed rule. Given the severe global financial crisis, the IASB went through a shortened process and made the following exceptions to the fixed for fixed rule in

IAS 32: rights, options, or warrants to acquire a fixed number of the entity's own equity instruments for a fixed amount of any currency are equity instruments if the entity offers the rights, options, or warrants pro-rata to all of its existing owners of the same class of its own nonderivative equity instruments (IAS32; CAS 37).

Another example is the share-based incentive plan. The share-based incentive plan is an important way for companies to encourage management and technical personnel to work harder for the benefit of shareholders. There are two types of share-based incentive plan based on the settlement tool, cash-settled or equity-settled. The former refers to a transaction that a company must pay cash or other assets based on the price of the share or other equity instruments for the purpose of obtaining services. The latter refers to a transaction in which a company uses equity instruments as the settlement tool based on the price of the share or other equity instruments for the purpose of obtaining services. Under the cash-settled share-based incentive plan, the company shall calculate the services obtained in the current period as the relevant asset cost or expense, and include it in liabilities based on the best estimate of the exercisable situation and the fair value of the liability, at each balance sheet date in the waiting period.

Under the equity-settled share-based incentive plan, companies should reasonably determine the fair value of the equity instruments granted to employees on the grant date. However, companies do not make a corresponding accounting treatment at that time. The company should obtain the current period value based on the best estimate of the number of available equity instruments on each balance sheet date based on the fair value of the equity instruments on the grant date during the waiting period between the grant date and the exercise date. The company should use the best estimate of the number of vesting equity instruments as the basis and the fair value of the equity instruments on the grant date to calculate the employees' service acquired in the cost of related assets or expenses and included in the capital reserve at each balance sheet date in the waiting period between the grant date and the vesting date. The companies will no longer adjust the recognized related costs or expenses and the total equity after the exercise date. The companies should calculate the amount of equity that should be transferred to capital based on the number of equity instruments exercised and transfer it into the capital on the exercise date. The amount included in the capital reserve during the waiting period is also transferred out to capital and share premium.

In summary, there are at least two differences between the two types of share-based incentive plans. (1) When cash settlement is used, it is treated as a liability; when equity settlement is used, it is treated as equity. (2) The recognized costs or expenses and liabilities have to be remeasured at fair value in a cash settlement. In an equity settlement, the companies no longer need to adjust the recognized costs or expenses and the total equity after the vesting date.

The equity-settled shared-based incentive plan changes the number and value of shares paid by the companies. According to the fixed for fixed rule, the equity-settled plan should not be treated as equity but as liability. However, the current accounting standards on the classification of liabilities and equity exclude share-based incentive plans from the scope of the standards. The IASB and FASB have had to discuss whether to include the share-based incentive plan each time they have started a financial instrument project with equity characteristics. The IASB and FASB have decided not to include it each time, even though there are significant differences between the accounting standards for the classification of liabilities and equity (IAS 32) and the accounting standards for the share-based incentive plan (IFRS 2).

New economy companies often raise multiple rounds of funding from venture capitalists, institutions, or funds before IPO. To balance the interests, rights, and obligations of the investors in each round, the agreement for each round of financing would contain various antidilution clauses. When the company's development prospects improved, each share's price in the new round of financing would rise; otherwise, it would decline. Table 6 shows the basic data of the rounds of preferred stock financing for Meituan and MI before their IPOs.

In addition, some characteristics of convertible and redeemable preferred stocks summarized in Appendix can be considered antidilution arrangements. For example, according to the conversion clause, when the preferred shareholders exercise the right, the value of the common shares that the company delivers will change with the stock price.

In September 2019, the IASB decided not to revise IAS 32 completely but with three small-scale projects. One project will determine how to apply the fixed for fixed rule in a situation with antidilution clauses. The

Table 6
Pre-IPO financing of Meituan and MI by preferred shares.

Preferred stock series	Issue date	Total number of preferred shares issued	Price per share (USD)	Capital raised (USD)
Meituan				
A-1 series	2013/11/07	11,111,111	0.4500	5,000,000
A-2A series	2014/01/28	41,730,994	1.0688	44,600,000
A-2B series	2014/01/28	144,444,444	0.7200	10,400,000
B series	2014/06/12	52,603,041	2.1767	114,500,000
C series	2015/01/09	34,457,408	5.5141	190,000,000
D series	2016/06/20	14,315,790	9.5000	136,000,000
MI				
A series	2010/09/28	410,000,000	0.0250	10,250,000
	2010/12/21			
B1 series	2010/12/21	243,103,448	0.1028	25,000,000
B2 series	2010/12/21	40,222,564	0.1454	5,850,000
	2011/04/11			
	2011/08/24			
C series	2011/09/30	43,023,587	0.5236	90,100,000
	2011/11/10			
	2012/03/29			
D series	2012/06/22	105,518,216	2.0471	216,000,000
	2012/12/21			
E1 series	2013/08/05	21,277,676	3.7598	80,000,000
E2 series	2013/08/05	4,264,064	4.6904	20,000,000
F1 series	2014/12/23	48,787,104	20.1682	983,950,000
	2015/03/25			
	2015/07/03			
	2017/08/24			
F2 series	2014/12/23	8,376,037	17.9273	150,160,000

Source: These Companies' Prospectus.

IASB should determine the scope of the revision, including whether it includes convertible and redeemable preferred shares with antidilution clauses, if it launches the small-scale revision project in the near future. The antidilution clause stipulates the rights and obligations of the capital providers of companies in different periods. The result will lead to the transfer of wealth between the capital providers. With the acceleration of financial innovation, accounting standard setters will face a dilemma. Amendments with a narrow scope could make it difficult to solve practical problems or create a gradual increase in exceptions and make accounting standards more rules-based. In contrast, an amendment may be too difficult to apply if it is too principled. As a result, people will ask for more guidance, similar to the embarrassment when the IASB issued the "Discussion Paper-Financial Instruments with Characteristics of Equity" in 2018. In it, the IASB proposed that the issuer should classify the financial instrument as a financial liability, and vice versa as equity, if the financial instrument has one or two of the following characteristics: First, a time feature; the instrument includes an unavoidable contractual obligation that requires the transfer of economic resources at a specified time other than at liquidation. Second, an amount feature; the instrument's amount is independent of the entity's available economic resources. All parties had more positive opinions of the time feature. They were generally more concerned about the amount feature, including whether they were consistent with the conceptual framework. The professional terminology still needs further clarification, which may require major changes in standards and practices.

4.3. Can reporting as a mezzanine equity solve the problem?

Chinese new economy companies listed in Hong Kong should classify convertible and redeemable preferred shares as financial liabilities measured at fair value with changes in fair value recognized in profits and losses. In contrast, Chinese companies listed in the US can classify the financing instruments as mezzanine equity in accordance with US GAAP and securities regulations, as shown in Table 7.

Table 7
Disclosure of mezzanine equity of Chinese companies listed in the US market (in billion RMB).[a,b]

	iQIYI		Pinduoduo		Bilibili		JD		Tuniu	
	IPO	2018	IPO	2018	IPO	2018	IPO	2014	IPO	2014
Mezzanine equity	22.60	0.00	2.20	0.00	4.02	0.00	7.17	0.00	0.72	0.00
Net income	−3.74	−9.06	−0.53	−10.22	−0.18	−0.57	−0.05	−5.00	−0.08	−0.45
Total equity	−14.32	18.16	−0.99	18.82	−1.94	7.19	2.07	37.50	−0.43	1.41
Total liabilities	11.92	26.60	12.11	24.36	1.40	3.30	16.77	29.00	0.78	1.24
Total assets	20.20	44.76	13.32	43.18	3.47	10.49	26.01	66.49	1.08	2.65

Source: These Companies' Prospectus & Annual Report.
[a] For companies that disclose mezzanine interests, total assets = total liabilities + mezzanine equity + total equity.
[b] Although in the balance sheet, the company discloses convertible and redeemable preferred shares as mezzanine equity, in subsequent measurements, the instrument is still treated as a financial liability.

Can Chinese accounting standards that converge with IFRS adopt regulations similar to the US? The IASB and FASB joint project, the IASB's two projects on financial instruments with equity characteristics, and the IASB's attempt to revise the concepts and principles related to hybrid instruments in its conceptual framework project prove that the conclusion is negative.

4.3.1. 2006–2010 IASB and FASB joint project: Financial instruments with equity characteristics

As part of the joint efforts to promote the international convergence of accounting standards, the IASB and FASB launched a project on financial instrument with characteristics of equity beginning in 2006. To this end, the FASB (2007) discussed three approaches: basic ownership, ownership-settlement, and reassessed expected outcomes. The FASB preferred the first approach because it was the easiest and would classify the fewest instruments as equity, which could prevent the structuring of contracts for specific accounting purposes. Soon, the IASB (2008) also issued a discussion paper. In this document, the IASB emphasized that the greatest difference between IAS 32 and the FASB preliminary view is as follows: according to IAS 32, the owner's equity is the residual item, which is the net amount after recognition and measurement of assets and liabilities, while the FASB preliminary view attempts to define equity separately and, on this basis, proposes the principles of recognition, measurement, presentation and disclosure. The IASB did not make its own claims in the document but analyzed how the IAS 32 would be revised according to FASB's initial ideas. Then, the two organizations spent more than two years in discussion. However, they decided to suspend the project in 2010. The main reasons were the following. (1) Unlike the IFRSs and US GAAP at that time, the FASB proposed a comprehensive reform plan based on the definition of owner's equity, which stakeholders do not accept. (2) The FASB favored the basic ownership approach to minimizing the owner's equity, which was different from the US GAAP and IFRS at the time. Adopting the FASB's proposal would require reclassifying many equity instruments as liabilities based on the two sets of standards at that time and determine the corresponding accounting principles, which could have greatly affected practice. As a result, the two organizations engaged in intense discussions on whether to reclassify certain hybrid instruments as liabilities or equity and which instruments would still be subject to exceptions or excluded from the project (e.g. share-based incentive plans). The organizations had difficulty reaching a consensus. (3) The two organizations hoped to focus their efforts on standards that were conducive to the US's decision to adopt IFRSs in 2011 or standards that needed urgent revisions following the 2008 global financial crisis, such as financial instruments, leases, insurance contract, fair value measurement, and consolidated financial statements.

4.3.2. 2012–2018 IASB's conceptual framework revision projects

In response to strong appeals from its stakeholders, the IASB included a project to revise its conceptual framework as a priority item on its 2012 midterm work plan. The project included the study of basic concepts and accounting principles related to financial instruments with characteristics of equity. When the IASB first

discussed the issue, it excluded the mezzanine instrument option and adhered to the dichotomy between debt and equity. The IASB issued a discussion paper on revising its conceptual framework in 2013, which discussed improving the accounting principles of the instruments from the perspective of element definition and presentation (IASB, 2013). However, the IASB decided to remove the content from the conceptual framework project and restart a project that comprehensively revised financial instruments with characteristics of equity. It then considered whether and how to revise the relevant content in the conceptual framework based on the project results. There were two main reasons for this decision. First, the instruments' basic concepts and principles were far more complicated than originally estimated, and the disputes between the parties could have been protracted, which would have made it difficult to complete the revision within the five-year period. Second, the IASB gradually reached a consensus during its discussion on how to revise the conceptual framework. The conceptual framework was to be "constitutional" and not very specific. A solution for the basic concepts and principles of such financial instruments was bound to complicate the constitutional form. The majority of IASB members supported the decision, but a few members voted against it. The opponents believed that a large number of issues related to hybrid instruments would remain unresolved for years because people interpret related basic concepts and principles differently. The IASB should use the opportunity to revise the conceptual framework to solve the related issues.

4.3.3. 2016–2019 IASB's new project on financial instruments with characteristics of equity

In 2016, the IASB reactivated the project on financial instruments with characteristics of equity. At the beginning of the project, the IASB reiterated the dichotomy between liability and equity and discussed the scope of liabilities and equity based on the classification. It chose a plan with a medium scope of liabilities. After two years of research, the IASB issued a discussion paper (IASB, 2018b). Under the premise that IAS 32 would be largely unchanged, the IASB's goals for the project were as follows: (1) use a clearer theory to clarify the basic principles of classification; (2) improve the consistency, completeness, and clarity of the guidelines; and (3) improve the presentation and disclosure requirements of related tools. Unfortunately, the majority of comments on the paper were relatively negative. In September 2019, the IASB discussed five approaches on how to continue the project. It initially decided to adopt a plan comprising three small-scale amendments to IAS 32.

Classifying convertible and redeemable preferred shares and other hybrid instruments as mezzanine instruments could provide some additional information but would not solve the basic problems of the classification, measurement, presentation and disclosure of the instruments themselves. The basic problems are the following. Are the instruments financial liabilities or equity? How can they be distinguished from other financial liabilities or equity instruments? Should they still be measured at fair value? Is the fair value change recognized in profits and losses, OCI, or shareholder's equity? The discussion draft issued by the IASB (2018b) offered some suggestions for improving presentation and disclosure. Some of the suggestions were supported by the IASB's stakeholders, such as the separate presentation of some liabilities in the balance sheet and disclosure of the order of settlement of financial instruments. Other suggestions were rejected, such as apportioning profit or loss and comprehensive income to different types of equity holders (i.e. preferred shareholders, minority shareholders, and controlling shareholders) according to a certain method or redistributing the entire shareholders' equity to different types of shareholders. Some suggestions were controversial, such as reflecting the income and expenses of some instruments in OCI. If the IASB discusses the recommendations in a future revision of the IAS 32 project, it should first determine whether to study the problem as a recognition and measurement issue or a pure presentation and disclosure issue, and whether to minimize or maximize equity or somewhere in between. Small-scale revisions cannot solve the two issues.

4.4. Can it be reclassified according to the possibility of conversion?

The IFRSs allow or require the reclassification of assets or liabilities in certain circumstances. IFRS 9 stipulates that financial assets with basic borrowing characteristics must be classified, based on the business model, as an amortized cost, fair value through profit or loss (FVTPL), or fair value through other comprehensive income (FVOCI) after passing the sole payments of principal and interest test. If the company's business model changes, the classification and measurement principles should change accordingly. IFRS 9

strictly defines business models and their changes to prevent companies from arbitrarily manipulating profits. However, IFRS 9 clearly stipulates that financial liabilities should not be reclassified under any circumstances.

The classification and measurement principles for the new economy companies' convertible and redeemable preferred shares are determined with agreed-upon terms at the time of issuance. In most cases, the companies' IPOs fail, so they are forced to pay cash or other financial instruments before the agreed expiry date. Nevertheless, some companies develop well and have successful IPOs. With this in mind, the standard could be revised to allow or require the reclassification of the instruments under certain conditions. The financing instruments could be classified as financial liabilities at an early stage and measured at FVTPL but reclassified as equity when certain conditions are met, such as prior to a successful IPO. The advantage of this treatment is that it can better reflect the "debt nature" of the instruments in early stages and better reflect the "equity nature" of the instruments in later stages. However, the revision would violate the basic accounting principles stipulating that the initial classification of liabilities and equity should not consider uncertainty and that financial liabilities cannot be reclassified. There are other questions to consider. What are the conditions for reclassification? Is it principle-based or rules-based? If it is rules-based, is it necessary to stipulate a probability level as a condition for reclassification, such as the probability of a successful IPO? If this is the case, a further issue is whether to reclassify instruments that have been reclassified as equity into liabilities if the company's IPO fails.

4.5. Can changes in the fair value of convertible and redeemable preferred shares be recognized in OCI?

The operating performance of new economy companies may turn profitable and lead to rapid growth in revenues and profits. However, the convertible and redeemable preferred shares could harm financial performance as a result. The better the operating performance is, the higher the conversion or redemption price, and the higher the value of the liabilities, and the greater the losses. Companies such as MI and Meituan had considerable negative net asset values before their IPOs. However, their preferred stockholders will certainly convert the preferred stock into common stock following a successful IPO. The company's negative net accumulated assets would be erased by the capital reserve formed from the high stock premium. The companies will no longer experience losses in book value caused by changes in the fair value of the instruments if the preferred shares are no longer issued after the IPO.

Can these fair value changes be included in OCI following the provisions of IFRS 9 on certain special financial liabilities? Based on its contractual cash flow characteristics and the issuer's business model, this special financial liability should have been accounted for at amortized cost, but the issuers choose fair value option to reduce or eliminate accounting mismatches, that is, the liabilities would be accounted for at FVTPL. When the IASB formulated new financial instrument standards in 2009, researchers suggested that the accounting standards would lead to puzzling financial information. They argued that the credit ratings and the fair value of financial liabilities would rise when companies perform well. The rise would result in a book loss, as it would result in a book profit otherwise. Therefore, they hoped that the IASB could handle the matter properly. To solve the problem, the IASB (2010) proposed five approaches. In the end, the IASB adopted one of the proposals in IFRS 9 based on the opinions of all parties. The proposal allowed changes in fair value caused by such factors to be included in OCI and stipulated that the OCI could not be recycled to profit or loss in the future, even if the company paid off the debts in full. Some IASB members strongly objected to the proposal because the actual operability is low. It would likely become a tool for companies to manipulate financial data. In addition, some IASB members argued that the profit generated by an increase in asset value would offset the loss caused by an increase in the fair value of the liability if both sides of the balance sheet were measured at fair value and the company's performance was good. The IASB should use fair value to fully measure assets and liabilities rather than OCI as a tool to reconcile conflicts when the asset owner does not fully measure assets and liabilities at fair value. This could solve the problem, but it cannot truly reflect the impact on financial performance of the fair value option adopted by companies to reduce or eliminate accounting mismatches.

Can the fair value changes of convertible and redeemable preferred shares be included in OCI by referring to the above standards? In the last 10 years, the number of items that could be included in OCI in the IFRS has increased to nearly ten, including the situation discussed above. However, the IASB experienced intense

debate each time a decision had to be made. The IASB issued a revised conceptual framework in April 2018 that clearly stated, "the Board may decide **in exceptional circumstances** that income or expenses arising from a change **in the current value** of an asset or liability are to be included in other comprehensive income when doing so would result in the statement of profit or loss providing more relevant information, or providing a more faithful representation of the entity's financial performance for that period (IASB, 2018a)" (emphasis added). Any new idea that involves adding OCI will understandably lead to fierce debate because of the term "in exceptional circumstances" in the new conceptual framework.

The preferred shares discussed in this paper can be redeemed at fair value. They are subsequently measured at fair value according to current accounting standards, which is in line with the conceptual framework that stipulates that only OCI can be considered when measured at current value. The IASB's discussion paper on "Financial Instruments with Characteristics of Equity" in June 2018 (IASB, 2018b) suggested that income and expenses related to instruments that can be redeemed at fair value but do not meet the current standard's exceptions for puttable instruments should be included in OCI. However, the IASB's discussion paper was poorly received. As a result, the IASB decided not to continue its project and replaced it with a small-scope revision of the IAS 32 project in September 2019. The small revisions would not include financing instruments that can be redeemed at fair value but do not meet the current standard, except for puttable instruments. Therefore, the IASB should first discuss whether to include this instrument in the scope of the research and whether it should be limited to the instruments with "redemption at fair value" when it initiates the small scope revision of the IAS 32 project. Of course, the IASB will have to study problems with OCI, such as which related income and expenses are included in OCI, if it decides to use OCI to solve problems related to the financing instruments. Should the interest and dividends normally distributed by the issuer be included in OCI? Should OCI be recycled? If it can be recycled, when will it be recycled? How can the recycled amount be calculated? The IFRS can refer to precedent.

The advantage of using FVOCI when measuring instruments at a fair value is that the impact of the changes on the financial performance of the company can be clearly distinguished from the company's operating performance. There are several examples of non-recycled OCI in IFRS that prevent companies from manipulating profits through OCI. For example, IFRS 9 stipulates that equity investment can be designated to be FVOCI, but the company cannot transfer OCI to profit or loss when disposing. Another example is that the fair value changes related to a company's credit can be included in OCI when a company chooses fair value options to account for financial liabilities that should have been accounted for at amortized cost to reduce or eliminate accounting mismatches. However, the OCI cannot be recycled back to profit or loss. In addition, some OCIs cannot be recycled because it is difficult to determine the time and amount of reversal. The impact of changes in actuarial assumptions on the remeasurement of a defined benefit retirement plan should be included in OCI but cannot be recycled. According to the newly revised financial reporting conceptual framework, current value measurement changes should not be included in OCI (IASB, 2018a).

The convertible and redeemable preferred shares discussed would only change when the holder converts shares, the issuer redeems shares, or the company is liquidated. The timing of the reversal of OCI would not be unclear and companies would not be able to dispose of preferred stocks to manipulate financial results. Therefore, OCI has no basis not to recycle the profits and losses in the above three cases. The reversal would reflect the company and its management's operating performance more accurately–especially when the company has to redeem the preferred stocks after a failed IPO and preferred shareholders would have priority in the distribution of residual assets during liquidation. The advantage of non-recycle is that it can reflect the characteristics of equity transactions between preferred shares and common shares shareholders more accurately, especially when the company has a successful IPO and it can convert preferred shares into common shares.

4.6. Is it a better choice to provide alternative performance measures?

The formulation of accounting standards will always experience disputes as business becomes more complex. Even if standards are issued, the information provided may not necessarily meet the needs of certain financial information users. In the last three decades, many companies have begun to provide various alter-

Table 8
Alternative performance measures disclosed by Hong Kong-listed Chinese new economy companies (unit: billion RMB).

	MI		Meituan		Yixin		Meitu		Inke	
	IPO	**2018**	**IPO**	**2018**	**IPO**	**2017**	**IPO**	**2016**	**IPO**	**2018**
GAAP earnings	−43.89	13.48	−18.99	−115.49	−1.40	−18.34	−2.22	−6.26	−0.24	1.10
Increase										
Change in fair value of convertible and redeemable preference shares	54.07	12.38	15.14	104.61	1.43	17.70	1.48	5.61	1.03	0.00
Issuance cost of convertible and redeemable preferred shares	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.04	0.00	0.00
Share-based compensation	0.91	0.00	0.97	1.87	0.01	0.91	0.02	0.04	0.00	0.01
Amortization of intangible assets arising from M&A	0.00	0.01	0.33	0.66	0.03	0.13	0.00	0.00	0.00	0.00
Impairment of goodwill	0.00	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.04	0.24	0.00	0.02	0.05	0.00	0.05	0.00	0.00
Decrease										
Gain or loss on the change of investment fair value	−5.73	−4.84	−0.54	−1.83	0.00	−0.01	0.00	0.00	0.00	0.00
Change in fair value of convertible and redeemable preference shares	0.00	−12.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	−0.52
Gain or loss on the sale of investments and subsidiaries	0.00	0.00	0.00	−0.03	0.00	0.00	0.00	0.00	0.00	0.00
Fair value of long-term investment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	−0.01	0.00	0.00
Non-GAAP earnings	5.36	8.56	−2.85	−8.52	0.10	0.46	−0.71	−0.54	0.79	0.60

Source: These Companies' Prospectus & Annual Report.

native performance measures in their financial reporting. Alternative performance measures are based on the net profit or loss measures specified by the accounting standards, adjusted for factors that have no cash consequences, are not directly related to operating performance, or cannot reflect continuous profitability. Alternative performance measures can compensate for lack of financial information to a certain extent so that users can make more appropriate assessments of the company's performance and value and better decisions, as a result (Jia et al., 2019).

Clinch et al. (2018) study the adjustment frequency and development trend of alternative performance measures in certain countries from 2005 to 2013. They find that the frequency growth rate reached 171% in Australia and 100% in Sweden. The UK had the highest frequency in the sample with 64%, followed by France with 54%. Their findings show that companies tend to report good news but not bad news when alternative performance measures are not regulated. In other words, the net profit calculated in accordance with accounting standards would be adjusted upwards rather than downwards or increased more often than decreased. To this end, the US SEC and EU securities market regulators have strengthened the supervision of the disclosure of alternative performance measures.

Table 8 summarizes the alternative performance information provided in the prospectus and first-year annual reports of some Chinese new economy companies listed in Hong Kong. The item with the largest increase was the change in the fair value of convertible and redeemable preferred shares. Among them, MI increased by 54.07 billion yuan in the prospectus and increased by 12.38 billion yuan and reduced by 12.51 billion yuan in its 2018 annual report. Meituan increased by 15.14 billion yuan in its prospectus and increased by 104.61 billion yuan in its 2018 annual report.

The literature on alternative performance indicator disclosures is expanding as their use becomes more common. Studies provide a range of information. For instance, Lougee and Marquardt (2004) find a negative correlation between unexpected earnings and the adjustment of alternative performance measures, which shows that companies use alternative performance measures to smooth their earnings and make their financial results more attractive to investors. The study also finds that companies with lower net profits under the original accounting standards are more likely to disclose alternative performance measures. This phenomenon is more pronounced in high-tech industries where information asymmetry is more serious. Marques (2006) reports that the decision to disclose alternative performance measures did not affect the value relevance of corporate earnings during the time when the US SEC lacked regulations on the disclosure of alternative performance measures. However, the earnings of companies that disclosed alternative performance measures showed a stronger value relevance after the US SEC strengthened supervision. Barth et al. (2012) observe that some companies chose to disclose alternative performance measures that deduct share-based incentive expenses because they increased earnings. Analysts only removed the share-based incentive portion of the alternative performance measures when the share-based incentive fee could not effectively predict the company's future performance. This shows that the alternative performance measures provided by the latter were of a higher quality. Doyle et al. (2013) show that companies used alternative performance measures to meet analysts' expectations after controlling their accrual and actual earnings management levels. This phenomenon was more pronounced in companies with a smaller earnings management space. This indicates that companies use alternative performance measures to achieve analysts' performance targets. Leung and Veenman (2018) report that loss-making companies excluded the components of net profit that cause losses and do not have information content when disclosing alternative performance measures, so the adjusted alternative performance measures had a stronger predictive ability for future earnings. In addition, loss-making companies that disclose alternative performance measures would perform better in the future, and investors did not overvalue them. This shows that alternative performance measures help investors eliminate unnecessary information and effectively reduce information asymmetry.

Developments in this area have attracted the attention of the IASB. The IASB's exposure draft, "General Presentation and Disclosure," issued in December 2019, discussed the disclosure of alternative performance measures. The draft recommended that companies disclose relevant information in the statement's notes and it proposed specific disclosure requirements (IASB, 2019a). Alternative information disclosures will become a widely accepted practice if the draft is accepted and converted into the IFRS, which would improve the comparability, consistency, and understandability of the information. The Chinese accounting standards

setters will follow the IASB standards once they are passed, as China is implementing a policy of convergence with IFRS. Prior to their passing, Chinese accounting standards setters, securities regulatory agencies, and stock exchanges should consider requiring or allowing companies to use the supplementary disclosure before the IASB standards are passed to alleviate confusion about the financial information of convertible and redeemable preferred shares.

5. Conclusion

New economy companies at an early stage of growth are high risky. They have light assets, low survival rates or short lives, long-term losses, and unclear development prospects. As a result, they have difficulty raising capital from traditional channels. Indirect financing is difficult because banks either refuse to lend or charge high interest rates. Raising capital in the form of common stock is also difficult. Investors are unwilling to invest because the returns may be unstable or impossible to collect. Therefore, many new economy companies use convertible and redeemable preferred stock financing before IPOs as a financing tool. This tool also allows new economy companies to frame a multilayer equity structure and solve corporate governance problems.

According to current accounting standards, new economy companies should classify convertible and redeemable preferred shares as financial liabilities and measure them at fair value. Changes in fair value during a given period are directly entered into current profits and losses.

The current accounting standards could lead to confusing financial information. A new economy company experiences higher losses during its development when its stock redemption or conversion price is higher, which can result in a substantial negative net asset value, especially before an IPO. This sizable loss and negative net asset value could be completely offset when the company successfully goes public at a high premium and converts the preferred stock into common stock.

Convertible and redeemable preferred shares are financing tools that have equity features. They have always been a problem in accounting practice, theory, standards, and supervision. This is largely because the relevant accounting standards have a clear rules-based tendency, and there are more exceptions and exemptions. Therefore, the basic accounting principles cannot be easily changed and reasonable solutions to complex problems cannot be easily deduced from the preceding principles and rules in a specific application. In the last 10 years, the IASB and FASB have launched three projects to comprehensively revise relevant accounting standards, but all have failed to create change. The IASB has also initiated a number of small-scale revisions to the guidelines, resulting in both successes and failures.

Based on the history of comprehensive and small-scale revisions to the accounting standards, this article analyzes possible ways to eliminate the confusion of convertible and redeemable preferred shares and proposes possible problems and solutions that can be referenced by various accounting standards-setting agencies and stakeholders. The various problems discussed in this article and the ways to solve the problems are not independent of each other. They can be considered comprehensively when accounting standards are revised.

The financial information of convertible and redeemable preferred shares will be difficult to clarify by revising relevant accounting standards because a revision of the relevant financial standards is itself a complex endeavor. According to Clor-Proell et al. (2016), sufficient information disclosure could also help users make decisions. Therefore, standardizing the disclosure of alternative performance measures may be the easiest option.

Declaration of Competing Interest

None.

Appendix A. Main features of convertible and redeemable preferred shares of new economy companies

Company	Dividend rights	Conversion rights	Redemption rights	Liquidation preferences
MI	The right to receive noncumulative dividends plus accrued interest at 8% of the original issue price.	From July 3, 2015, when MI succeeds in its IPO or if more than 50% of its holders request the conversion, it can be converted into ordinary shares at the effective conversion price.	From December 23, 2019, all preferred shares will be redeemed at the price of the higher of the issue price plus 8% accrued interest and the fair value of preferred shares.	The right to receive the remaining equity in priority at the time of liquidation based on the issue price plus accrued or declared unpaid dividends or 110% of the issue price. The holder has the right to receive the remaining equity in priority over the holders of ordinary shares if the remaining equity available for distribution is not sufficient to pay the compensation for the preferred stock.
Meituan	If the company declares 8% noncumulative dividends every year, it must first pay the shareholders of series C and series B, then the shareholders of series A from A-12 to A-1, and then the ordinary shareholders.	Convert preferred stocks into common stocks at any time after the issuance date at an initial conversion ratio of 1:1; preferred stocks will be automatically converted into common stocks at the applicable conversion price after IPO or on the date agreed by most preferred stockholders.	The shares can be redeemed in the agreed-upon method between the board of directors and the shareholders.	Holders of series B and C can receive the higher of the following two settlement fees: (1) 120% of the series B and C issue price plus declared but unpaid dividends; (2) if the B and C series have been converted to ordinary shares, the amount payable is 100% of the issue price of series A plus the declared but unpaid dividends. If the remaining assets are not sufficient to fully pay the preferred stock compensation, the remaining assets shall be distributed to preferred shareholders in proportion.

(*continued on next page*)

Appendix A (*continued*)

Company	Dividend rights	Conversion rights	Redemption rights	Liquidation preferences
Yixin	If the company declares 8% noncumulative dividends every year, it must first pay the shareholders of series C, series B, series A, and then ordinary shareholders.	When the company is publicly listed or more than 75% of A to C series holders require it, preferred shares will be converted into ordinary shares at the then effective conversion price.	After five years from May 11, 2017 and before the company's IPO, the holders have the right to request that the company redeem all of its preferred shares at any time. The redemption price is equal to the issue price plus 8% of the annual dividend and any accrued unpaid dividends.	The right to receive preferential compensation at the time of liquidation based on the higher of the following two: (1) dividends calculated by adding 8% of the issue price and accrued unpaid dividends; (2) preferred stockholders and common stock shareholders distribute the remaining assets proportionally. If the remaining assets are not sufficient to pay the compensation for the preferred shares, the remaining assets shall be distributed to the preferred shares in proportion.
Meitu	The company has the right to receive dividends at a rate of 8% of the issue price per share each year, and such distributions are not cumulative.	When the company is publicly listed, or more than a majority of holders' request redemption, preferred shares will be converted into ordinary shares at the effective conversion price.	If the company fails to go public before April 19, 2020, the company and its founders violate the law or seriously affect the normal operation of the company, or a series of investors request to redeem the preferred shares, the company must redeem all preferred shares at the issue price plus 8% accrued interest and unpaid dividends.	The right to receive the remaining assets based on the issue price plus the declared but unpaid dividends at the time of liquidation. If the remaining assets are not sufficient to fully pay the preferred stock compensation, the remaining assets shall be distributed to preferred shareholders in proportion.

(*continued on next page*)

Appendix A (*continued*)

Company	Dividend rights	Conversion rights	Redemption rights	Liquidation preferences
JD	Prior to the issuance of Series B preferred shares, the holders of the series A and A-1 preferred shares shall be entitled to receive, on an annual basis, preferential, noncumulative dividends at the 8% of the issue price, and such dividends shall be payable if declared by the board of directors.	Each preferred share is convertible at the option of the holder at any time after the date of issuance, and each preferred share is convertible into one ordinary share.	The preferred shares are redeemable if (i) the group failed to consummate a first qualified IPO by the end of the year 2013, or (ii) there is a material breach by any of the entities or the founder, subject to the applicable laws of the British Virgin Islands, and if so requested by holders of at least 50% of the series A and A-1 preferred shares. The redemption price was to have been equal to the higher of (i) or (ii) below: (i) Issuance price × (108%)N, "N" means a fraction the numerator of which is the number of calendar days from the date on which the series A, A-1 and B preferred shares were issued up to the date on which such preferred shares are redeemed and the denominator of which is 365. (ii) the fair market value of series A, A-1 and B at the redemption date.	The holders of the series A, A-1 and B shall be entitled to receive an amount equal to 120% of the original purchase price plus all declared but unpaid dividends, while the holders of the series C shall be entitled to receive an amount equal to 100% of the original purchase price plus all declared but unpaid dividends. In association with the issuance of the series C in 2010, the series A, A-1 and B holders waived their liquidation preference rights and ranked pari passu with the ordinary shareholders.

Source: Companies' Prospectuses

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Board faultlines and the value of cash holdings: Evidence from Chinese listed companies

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ABSTRACT

Faultlines can affect a board of director's effectiveness in supervising senior managers, which in turn affects the value of a company's cash holdings. Based on sample data from Chinese A-share listed companies from 2004 to 2016, we examine the relationship between board faultlines and the value of cash holdings. The empirical results indicate that board faultlines have a significant inhibitory effect on cash holding value. This inhibitory effect is stronger for board faultlines resulting from deep-level attributes. Furthermore, the inhibitory effect of board faultlines is stronger in state-owned enterprises (SOEs) than in non-SOEs. As an important governance mechanism, management shareholdings can reduce agency costs and mitigate the negative impact of board fissures on cash holdings. Overall, we enrich the literature on the economic consequences of board faultlines and their influence on cash holding value. We also offer companies practical suggestions for improving the supervisory mechanism of their board of directors.

1. Introduction

Cash is the "blood flow" of a company's daily production and operations. By holding cash, companies are able to guard against uncertainties precipitated by changes in the macro environment, industry competition, and financing constraints. However, as cash is highly liquid and difficult to trace, it is also easily pilfered and abused by company managers. Companies' senior managers often abuse cash through perks,

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excessive salaries, and investments in projects that do not maximize shareholder interests, which can all ultimately damage company value (Yang et al., 2014; Ward et al., 2018). Therefore, exploring the impact of cash holdings on company value in various situations is an important issue for researchers and practitioners.

The effective operation of a board of directors, who represent a company's shareholders' interests, can alleviate management agency problems and facilitate the supervision of manager behavior. For example, the supervisory function of a board is weakened and principal–agent conflict is strengthened when the general manager and the board chairman are the same individual (Burns and Kedia, 2006). Board capital, such as educational background and work experience, can increase cash value and significantly reduce the agency cost of management (Wang et al., 2017). The studies cited focus on the effects of single or several characteristics of board of director members. In addition to considering individual characteristics, the interaction and comprehensive effects of various characteristics should not be ignored when examining the influence of boards of directors on agency problems. Compared with other board studies, faultline theory focuses on the overall effect of gender, age, tenure, financial experience and other characteristics on the board of directors. Therefore, we adopt board faultline theory, proposed by Lau and Murnighan (1998), to reconceptualize the various characteristics and combinations of characteristics of board members and analyze their overall impact on the value of cash holdings. We seek answers to the following questions. Do board faultlines affect the value of cash holdings? What is the direction of board faultlines' impact on the value of cash holdings? Does this effect differ under different conditions?

Using a sample of Chinese A-share listed companies from 2004 to 2016, we examine the relationship between board faultlines and the value of cash holdings. The empirical results indicate that board faultlines have a significant inhibitory effect on the value of cash holdings. This inhibitory effect becomes stronger when the board faultlines arise from deep-level attributes. Furthermore, the inhibitory effect of the board faultlines is stronger in state-owned enterprises (SOEs) than in non-SOEs. As an important governance mechanism, management shareholdings can reduce agency costs and mitigate the negative impact of board fractures on cash holdings. We adopt a fixed effects model with a company–year two-dimensional cluster, excluding years of financial crisis, and adjust the model and variables to address potential endogeneity. The above findings hold even after controlling for potential endogeneity.

We make three main contributions to the literature. First, we enrich the research on the economic consequences of board faultlines. The literature has mainly focused on the impact of board faultlines on company performance, strategic decisions, entrepreneurial issues, and investment returns (Tuggle et al., 2010; Li et al., 2014; Crucke and Knockaert, 2016; Van Peteghem et al., 2018). Few studies have explored the effect of board faultlines on the value of cash holdings. We examine how board faultlines affect the supervisory mechanism of the board of directors and, in turn, managers' abuse of funds and damage to the value of cash.

Second, we enrich the literature on the determinants of the value of cash holdings. Research has established that corporate governance, chief executive officer (CEO) compensation incentives, investor protection, and industry growth affect cash value (Pinkowitz et al., 2006; Dittmar and Mahrt-Smith, 2007; Liu and Mauer, 2011; Yang et al., 2016). Using principal–agent theory and the measurement principle of board faultlines, we measure the characteristics of the internal structure of the board of directors and further open the "black box" of internal board governance. We find that the existence of subgroups within a board of directors affects its supervisory function and reduces the value of cash holdings. Thus, we introduce heterogeneity of the board of directors as a determinant of the value of cash holdings.

Third, we provide suggestions for establishing an effective board of directors. The characteristics of directors determine their behavior. A board of directors represented by diverse member characteristics can give rise to quite divergent member behavior. Our findings indicate that the similarities and differences between directors' characteristics can lead to a board dividing into various subgroups. This division in turn affects the board's cohesion and governance efficiency and weakens its effectiveness. In constructing their board of directors, companies should reasonably match directors' characteristics, so that they can enjoy the benefits of diversity while preventing any internal fracturing of the board. They should also make rational use of institutional arrangements and goal-setting to mitigate the potential harm of internal subgroup identity. This would help improve governance efficiency at the board level.

2. Literature review and hypothesis development

2.1. Literature review

2.1.1. Value of cash holdings

Many studies have focused on the factors that affect a company's cash holding value. Three main factors have been identified. First, the existence of either a Type I agency problem (i.e., a conflict between shareholders and managers) or a Type II agency problem (i.e., a conflict between large shareholders and minority shareholders) may affect the value of cash holdings. Managers consume internal funds through on-the-job consumption and investment in negative net present value projects, whereas larger shareholders use related transactions to transfer a company's cash and infringe upon minor shareholders' benefits. This ultimately results in a reduction in the company's cash holding value. Dittmar and Mahrt-Smith (2007) established that good corporate governance is essential to preventing management from damaging company value. Companies with high levels of governance have greater cash holding value than companies with low levels of governance. By examining the impact of CEO compensation incentives on cash value, Liu and Mauer (2011) showed how CEO compensation incentives can adjust the interests of managers and shareholders and ease agency conflict. Second, due to internal and external information asymmetry and high external financing costs, internal cash, with its relatively low transaction costs, alleviates financing constraints (e.g., cash shortages) a timely and effective manner. Based on a sample of 35 countries, Pinkowitz et al. (2006) used the value regression model of Fama and French (1998) and discovered that countries with weak investor protection and information asymmetry have lower cash holding values. By distinguishing between financing-constrained companies and non-financing-constrained companies, Denis and Sibilkov (2010) examined and explained why cash is more valuable in the former. Third, recent studies have demonstrated that the degree of product market competition and industry growth affect the value of cash holdings. Exploring the relationship between cash holdings and a company's future product market share, Fresard (2010) found that a company's cash holdings are conducive to performance improvement in the product market. The number of external competitors and the degree of financing constraints have a positive regulatory effect on this relationship. Yang et al. (2016) discovered that industry growth can influence a company's external operating environment. For example, high external financing costs in high-growth industries may cause companies in those industries to increase the use value of internal cash.

2.1.2. Board faultlines

Lau and Murnighan first proposed team faultline theory in 1998. They defined a faultline as a virtual dividing line wherein a team breaks into multiple subgroups based on one or more characteristics. The existence of subgroups influences the effectiveness of the entire team. Scholars have since conducted case studies and large sample studies on faultline measurement and theoretical construction. Thatcher et al. (2003) and Bezrukova et al. (2009) proposed two dimensions for faultline measurement—the strength of faultlines (the degree of similarity of the characteristics of subgroup members) and the distance between faultlines (the degree of difference in multiple characteristics among subgroups). Faultline theory is based on social identity theory (Tajfel, 1978), self-categorization theory (Turner, 1985), and same-sex attraction theory (Byrne, 1971). It proposes that team members interact and communicate with others who have similar characteristics, thus leading to the formation of different subgroups. The existence of faultlines makes team members identify more strongly with their subgroups than with the entire team (Liu et al., 2019). Thus, faultlines exacerbate team conflict (Li and Hambrick, 2005; Bezrukova et al., 2009), reduce trust and respect among team members (Harrison and Klein, 2007), divert team attention away from the common goal of addressing the fragmentation caused by the faultlines (Li and Hambrick, 2005), and negatively affect team performance (Crucke and Knockaert, 2016).

A board of directors is a team. Yet board members may separate into different subgroups according to their various characteristics, affecting the overall functionality of the entire board. Since the introduction of faultline theory to the field of board governance, domestic and foreign scholars have also conducted studies on the influence of board faultlines. Kaczmarek et al. (2012) pointed out that faultlines weaken boards' ability and motivation to provide supervision and resources, thereby negatively affecting company performance. Tuggle et al. (2010) discovered that board faultlines are not conducive to companies reaching agreements on

entrepreneurial issues. Barkema and Shvyrkov (2007) and Li et al. (2014) found that strong faultlines are significantly negatively correlated with company expansion and cross-border mergers and acquisitions. The stronger a board's faultlines, the more difficult it is to unify its members' opinions. Some scholars have also argued that faultlines can enrich the information sources of a board of directors and improve its information processing capabilities. Hutzschenreuter and Horstkotte (2013) indicated that the existence of faultlines optimizes the information process within the board of directors and positively regulates the relationship between product sampling and company performance.

Summarizing the above literature, agency problems, corporate governance, internal and external financing constraints, and other factors all affect the value of cash holdings. As an important internal governance mechanism, the effectiveness of a board of directors undoubtedly has an important impact on restricting agency problems and increasing the value of a company's cash holdings. Although studies have focused on the impact of board capital (e.g., educational background and work experience) on the value of cash holdings (Wang et al., 2017), these studies have explored the impact of a single feature or a simple aggregation of feature indicators, not the internal structure of a board. In addition, studies have ignored the interaction between various board characteristics and their overall impact on the board. Therefore, we adopt faultline theory. We are the first to examine the overall governance efficiency and impact of boards of directors on companies' cash holding value from the perspective of board faultlines. According to faultline theory, a board whose directors have diverse characteristics can be divided into different subgroups based on similar in-group characteristics. As such, we examine how multiple subgroups affect boards' supervision and governance efficiency, and in turn companies' cash holding value.

2.2. Hypothesis development

In contrast with developed economies, such as Europe and the United States, China's economy is undergoing a period of transformation and rapid development. As a result, various aspects of its internal corporate governance mechanism are not yet fully developed. Type I agency conflicts are serious due to the lack of incentives and supervisory measures for senior managers. Due to agency conflict, strong liquidity, cashability, and the difficulty of tracking and ease of manipulating cash, senior managers frequently abuse company cash for self-interested motives (e.g., increasing their salaries and building their own businesses). This damages their company's usage value of cash. Researchers have found that under the modern corporate system, which entails the separation of management and governance, company managers often use their power to invade a company's assets and damage its value through perks (Chen and Liang, 2010) and excessive investment (Yang et al., 2014).

Board faultlines may have positive and negative effects on the value of a company's cash holdings. For example, they may reduce the value of the company's cash holdings. As the bridge connecting a company's shareholders and management team, the board of directors is an important institutional arrangement for solving the problem of entrusted agency and supervising manager behavior. The division of a board of directors into multiple subgroups directly affects the board's supervision (willingness and capability) of senior managers. From the perspective of supervisory willingness, a fracture within the board of directors intensifies distrust and conflict among subgroups. Subgroup members tend to identify with each other and exclude members from other groups. This reduces the harmony and cohesion of the board and diverts members' attention away from bridging the divides created by the faultlines, thereby decreasing the board's willingness to supervise (Li and Hambrick, 2005; Schölmerich et al., 2016). According to the perspective of supervisory capability, faultlines divide the board of directors into different subgroups. Great conflict and emotional disagreement among the subgroups weaken communication between the directors inside and outside of the subgroups and restrains private information within subgroups. The lack of information and increase in communication costs prevent directors from fully grasping information about managerial capabilities and behaviors, which eventually decreases their supervisory capability (Lau and Murnighan, 2005; Halevy, 2008; Meyer et al., 2011). In addition to discovering that the existence of board faultlines reduces CEOs' sensitivity to salary performance and drives them to grant themselves abnormally high compensation (Van Peteghem et al., 2018), studies have also confirmed that faultlines can hinder directors' supervision of senior managers. This increases the space for

senior managers to abuse cash and seek personal gain, ultimately reducing the value of the company's cash holdings.

Board faultlines may also promote the value of a company's cash holdings. Studies have pointed out that similar characteristics between managers and directors can significantly affect the discretionary power of the managers. Fracassi and Tate (2012) found that if a company's directors and managers work part time at other companies, institutions, or organizations simultaneously, the supervisory function of the board of directors is weakened and the managers have more space for rent-seeking. This ultimately damages the company's value. Lu and Hu (2014) argued that fellowship between the CEO and directors weakens the board of directors' supervision over managers, grants the CEO more power, and consequently increases the company's risk. Directors and managers sharing similar characteristics, such as professional experience, educational background, and hometown, facilitates the establishment of close contacts. In turn, this can damage the board's supervisory function. Furthermore, the existence of faultlines means that the board of directors is divided into subgroups with different characteristics. The greater the difference between the subgroups caused by strong faultlines, the more difficult it is for management to establish contact with multiple subgroups simultaneously. The company management team builds a close relationship with a certain subgroup based on common characteristics but at the same time shows greater difference from other subgroups. As a result, the management team faces stronger checks and supervision from other subgroups. Therefore, board faultlines can prevent a close relationship from developing between managers and the board of directors and make it more difficult for managers to capture the entire board. The power and space of the managers' rent-seeking is reduced, thereby improving the efficiency of the company's usage of cash.

It should be noted that board faultlines not only affect the supervisory function of the board of directors over senior managers but also the decision-making of the board. The existence of board faultlines indicates that the board is divided into multiple, distinct subgroups with their own interests and power centers. When a certain subgroup wants to embezzle and abuse the company's cash assets for its own interests, it is subject to checks and balances from other subgroups. This can restrain the board of directors' decision to encroach upon the company's cash assets and improve the value of cash holdings. Tang et al. (2016) explored the impact of larger shareholders on the value of cash holdings from the perspectives of checks and balances and dictatorships. From the perspective of checks and balances, the decision-making behavior of larger shareholders is restricted by other shareholders and tunneling behavior is reduced. From the perspective of dictatorship, when larger shareholders have sufficient decision-making space, tunneling motivation is enhanced, which ultimately reduces the value of cash holdings. Therefore, from the board of directors' own decision-making perspective, board faultlines also increase the company's cash holding value. Therefore, we propose the following set of competing hypotheses.

H1a: Board faultlines decrease the value of cash holdings.
H1b: Board faultlines increase the value of cash holdings.

3. Research design

3.1. Sample selection

The initial data comes from the China Stock Market and Accounting Research Database. We use A-share listed companies from 2004 to 2016 as the initial research sample. Excluding companies labeled as ST (i.e., those that have suffered losses for 2 consecutive years) and *ST (i.e., those that have suffered losses for 3 consecutive years), financial companies, and companies with missing or abnormal data yields 19,467 company–year observations.[1] For all of the tests, we winsorize all of the continuous variables at the bottom and top 1% levels to reduce the influence of extreme values on the findings.

[1] As some of the control variables in the regression model include changes in previous and subsequent years, the actual data period is from 2003 to 2017.

3.2. Empirical models

Based on the research of Fama and French (1998), we follow Pinkowitz and Williamson (2003), Dittmar and Mahrt-Smith (2007), and Yang and Zhang (2008) in adapting the following model to examine our hypothesis:

$$MV_{it} = a_0 + a_1 Cash_{it} * Faultline_{it} + a_2 Cash_{it} + a_3 Faultline_{it} + \sum Control_{it} + \sum Industry_{it} + \sum Year_{it} + \varepsilon_{it} \tag{1}$$

where MV is the company's market value variable, which equals the sum of the market value of tradable shares, non-tradable shares, and liabilities. Following prior studies, the market value of tradable shares is measured by the market price of the stock, the market value of non-tradable shares is measured by multiplying the number of non-tradable shares by the net assets per share, and the market value of liabilities is measured by the book value of liabilities (Yang and Zhang, 2008; Wang et al., 2014). *Cash* is the variable of the cash holding level, which equals the sum of the company's cash and short-term net investment.[2] *Faultline* is the variable of the board faultlines, including faultline strength (*Fstrength*), faultline distance (*Fdistance*), and the faultline intersection term (*Fau*) (Thatcher et al., 2003; Bezrukova et al., 2009).[3] *Fstrength* represents the similarity between the members of subgroups. It is calculated as the ratio of the sum of the squared variances between different subgroups to the total squared variance of the total. *Fdistance* represents the degree of difference between various subgroups. It is calculated as the Euclidean distance between different subgroups. *Fau* represents the similarity within subgroups and the difference between subgroups, which is the intersection of faultline strength and faultline distance. *Fstrength* is calculated using the following formula:

$$Fstrength_g = \frac{\sum_{j=1}^{p}\sum_{k=1}^{q} n_k^g \left(\bar{x}_{kj} - \bar{x}_j\right)^2}{\sum_{j=1}^{p}\sum_{k=1}^{q}\sum_{i=1}^{n_k^g} \left(x_{ijk} - \bar{x}_j\right)^2} \quad g = 1, 2, \ldots s \tag{2}$$

where $\bar{x}_{kj}$ represents the average value of feature j for the members of subgroup k, $\bar{x}_{kj}$ represents the average value of feature j for all group members, x_{ijk} represents the value of feature j for member i of subgroup k, and n_k^g represents the number of members in the kth subgroup under split g. The value range of *Fstrength* calculated based on this formula is (0, 1). The greater this value is, the more similar those within a given subgroup are. *Fdistance* is calculated using the following formula:

$$Fdistance_g = \sqrt{\sum_{j=1}^{p} \left(\bar{x}_{j1} - \bar{x}_{j2}\right)^2} \tag{3}$$

where $\bar{x}_{j1}$ represents the average value of feature j for the members of Subgroup 1 and $\bar{x}_{j2}$ represents the average value of feature j for the members of Subgroup 2. The greater the value of *Fdistance* is, the greater the difference is between subgroups.

Following the literature (Luo and Qin, 2009; Wang et al., 2014; Yang et al., 2016; Liang et al., 2019), we control other variables that affect the value of cash holdings, namely cash flow and changes in cash flow (Cf_t, Dif_Cf_t, and Dif_Cf_{t+1}), changes in non-cash assets (Dif_Nocash_t and Dif_Nocash_{t+1}), cash dividends and changes in cash dividends (Div_t, Dif_Div_t, and Dif_Div_{t+1}), capital expenditure and changes in capital

[2] Short-term investment refers to a company's purchase of securities that can be realized at any time for which the holding time does not exceed 1 year (including 1 year) and other investments for which it does not exceed 1 year (including 1 year), including various stocks and bonds. The amount excludes the provision for decreasing prices. The short-term net investment data come from the China Stock Market and Accounting Research Database.

[3] The director characteristics for calculating board faultlines are independence, gender, financial experience, tenure, and shareholdings and whether the directors are part-time directors, retired directors, and internal directors. Based on these characteristics, we perform a cluster analysis of the annual directors of each company to determine whether faultlines exist in the companies' boards of directors and, if so, to identify their subgroup compositions.

Table 1
Variable definitions.

Variable	Definition
MV_t	The ratio of the sum of the market value of tradable shares, non-tradable shares, and liabilities to the total assets at the end of year t.
$Cash_t$	The ratio of cash to total assets at the end of year t.
$Fstrength_t$	The ratio of the sum of the squares of variance between different subgroups to the sum of the squares of the overall variance.
$Fdistance_t$	The Euclidean distance between different subgroups.
Fau_t	The intersection of faultline strength and faultline distance.
Cf_t	The ratio of the net cash flow from operating activities in year t to the total assets at the end of year t.
Dif_Cf_t	The ratio of the difference between the net cash flow of operating activities in year t and year $t-1$ to the total assets at the end of year t.
Dif_Cf_{t+1}	The ratio of the difference between the net cash flow of operating activities in year $t+1$ and year t to the total assets at the end of year t.
Dif_Nocash_t	The ratio of the difference between the non-cash assets at the end of year t and the end of year $t-1$ to the total assets at the end of year t.
Dif_Nocash_{t+1}	The ratio of the difference between the non-cash assets at the end of year $t+1$ and the end of year t to the total assets at the end of year t.
Div_t	The ratio of the cash dividends paid in year t to the total assets at the end of year t.
Dif_Div_t	The ratio of the difference between the cash dividends issued in year t and year $t-1$ to the total assets at the end of year t.
Dif_Div_{t+1}	The ratio of the difference between the cash dividends issued in year $t+1$ and year t to the total assets at the end of year t.
$Capex_t$	The ratio of the net expenditures on the acquisition, construction, and disposal of fixed assets, intangible assets, and other long-term assets in year t to the total assets at the end of year t.
Dif_Capex_t	The ratio of the difference between the capital expenditures in year t and year $t-1$ to the total assets at the end of year t.
Dif_Capex_{t+1}	The ratio of the difference between the capital expenditures in year $t+1$ and year t to the total assets at the end of year t.
Dif_MV_{t+1}	The ratio of the difference between the market value at the end of year $t+1$ and the end of year t to the total assets at the end of year t.

expenditure ($Capex_t$, Dif_Capex_t, and Dif_Capex_{t+1}), and changes in market value (Dif_MV_{t+1}).[4] $Control_t$ is the level of *Control* in year t, $Dif\_Control_t$ is the change in the value of *Control* from $t-1$ to year t, and $Dif\_Control_{t+1}$ is the change in the value of *Control* from t to $t+1$.

All of the variables in Model (1) are divided by total assets at the end of year t for standardization, with the exception of the board faultlines variable. We also control for the influence of industry (*Industry*) and year (*Year*). If the coefficient a_1 of the intersection variable (*Cash* * *Faultline*) is significantly negative, H1a holds and board faultlines decrease the value of cash holdings. If the coefficient a_1 of the intersection variable (*Cash* * *Faultline*) is significantly positive, H1b holds and board faultlines increase the value of cash holdings. Table 1 presents detailed definitions of the variables.

3.3. Descriptive statistics

Panel A of Table 2 presents the summary statistics of the final sample. The mean and median of the market value (MV_t) are 2.015 and 1.585, respectively, which is consistent with Dou and Lu (2016). The mean and median of cash holdings ($Cash_t$) are 0.178 and 0.144, respectively, which is consistent with Yang et al. (2014). The mean (standard deviation) of faultline strength ($Fstrength_t$), faultline distance ($Fdistance_t$), and faultline intersection (*Faut*) is 0.577 (0.123), 1.423 (0.181), and 0.830 (0.240), respectively. These results are similar to those of Li et al. (2014) and Van Peteghem et al. (2018), indicating that large differences exist between the board faultlines of the sample companies. The statistical description and distribution of the other variables are within a reasonable range.

[4] Cash flow (Cf_t) refers to a company's annual net cash flow from operating activities. Capital expenditures ($Capex_t$) are a company's annual net expenditures for the purchase and construction of fixed assets, intangible assets, and other long-term assets.

Table 2
Descriptive statistics and correlation matrix.

Panel A: Descriptive statistics

Variable	Obs.	Mean	P25	Median	P75	St. Dev.
MV_t	19,467	2.015	1.217	1.585	2.308	1.290
$Cash_t$	19,467	0.178	0.089	0.144	0.231	0.126
$Fstrength_t$	19,467	0.577	0.489	0.569	0.654	0.123
$Fdistance_t$	19,467	1.423	1.298	1.411	1.537	0.181
Fau_t	19,467	0.830	0.658	0.812	0.979	0.240
Cf_t	19,467	0.047	0.007	0.046	0.090	0.075
Dif_Cf_t	19,467	0.006	–0.031	0.006	0.043	0.079
Dif_Cf_{t+1}	19,467	0.006	–0.036	0.005	0.047	0.093
Dif_Nocash_t	19,467	0.110	0.020	0.097	0.186	0.156
Dif_Nocash_{t+1}	19,467	0.164	0.014	0.098	0.213	0.337
Div_t	19,467	0.011	0.000	0.005	0.016	0.016
Dif_Div_t	19,467	0.001	–0.001	0.000	0.003	0.011
Dif_Div_{t+1}	19,467	0.002	–0.001	0.000	0.004	0.013
$Capex_t$	19,467	0.053	0.014	0.038	0.076	0.054
Dif_Capex_t	19,467	0.005	–0.015	0.001	0.021	0.047
Dif_Capex_{t+1}	19,467	0.007	–0.016	0.000	0.021	0.057
Dif_MV_{t+1}	19,467	0.480	–0.106	0.215	0.763	1.376

Panel B: Correlation matrix

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)	(Q)
(A) MV_t	1.000																
(B) *Casht*	0.128***	1.000															
(C) $Fstrength_t$	−0.053***	−0.008	1.000														
(D) $Fdistance_t$	0.022**	0.021**	0.449***	1.000													
(E) Fau_t	−0.026***	0.003	0.912***	0.761***	1.000												
(F) *Cft*	0.082***	0.135***	0.016*	0.018*	0.020**	1.000											
(G) Dif_Cf_t	0.008	0.050***	0.004	0.018*	0.012	0.617***	1.000										
(H) Dif_Cf_{t+1}	−0.003	−0.087***	0.011	−0.000	0.007	−0.408***	−0.373***	1.000									
(I) Dif_Nocash_t	−0.077***	−0.062***	−0.011	0.007	−0.005	−0.193***	−0.106***	0.102***	1.000								
(J) Dif_Nocash_{t+1}	0.132***	0.083***	−0.012	0.012	−0.003	−0.008	−0.007	0.015*	0.113***	1.000							
(K) Div_t	0.108***	0.268***	0.013	0.045***	0.029***	0.333***	0.067***	0.010	0.058***	0.020**	1.000						
(L) Dif_Div_t	0.040***	0.029***	0.002	0.006	0.004	0.124***	0.081***	0.001	0.058***	−0.003	0.485***	1.000					
(M) Dif_Div_{t+1}	0.075***	0.001	−0.023**	−0.006	−0.018*	0.073***	0.045***	0.108***	0.008	0.156***	−0.184***	−0.241***	1.000				
(N) $Capex_t$	−0.087***	−0.056***	0.026***	0.004	0.018*	0.187***	0.042***	0.017*	0.317***	0.081***	0.117***	−0.015*	−0.015*	1.000			
(O) Dif_Capex_t	0.005	0.061***	0.006	−0.010	0.000	0.044***	0.033***	−0.015*	0.296***	0.074***	0.048***	0.018*	−0.009	0.547***	1.000		
(P) Dif_Capex_{t+1}	0.088***	0.075***	0.004	−0.003	0.001	0.050***	0.010	0.079***	−0.054***	0.334***	0.031***	0.032***	0.057***	−0.233***	−0.163***	1.000	
(Q) Dif_MV_{t+1}	−0.018*	0.052***	−0.019**	0.019**	−0.005	0.025***	0.038***	0.089***	−0.014*	0.442***	0.044***	0.013	0.106***	0.016*	−0.004	0.148***	1.000

Panel B of Table 2 presents the Pearson correlation coefficient matrix of the main variables. The correlation coefficients between $Fstrength_t$, $Fdistance_t$, and Fau_t are 0.449, 0.912, and 0.761, respectively. These values indicate the consistency of the three measures of board faultlines. The correlation coefficients between the other variables are generally lower than 0.5, indicating that the correlations between them are weak and that no serious multicollinearity problem exists.

4. Empirical analysis

4.1. Regression results

Table 3 reports the regression results for H1a and H1b. We conduct ordinary least squares regression, control the year- and industry-fixed effects, cluster them by company, and report the robust standard errors and adjusted t values. The dependent variable is market value (MV). Column (1) lists the regression results with only the control variables added. Columns (2) to (4) present the regression results for both the independent variables and the control variables.

As Column (1) shows, the coefficient of $Cash_t$ is 0.681, which is significant at the 1% level. This indicates that the market value of 1 yuan of cash held by the company is approximately 0.681 yuan during the sample period. The coefficients of Cf_t and Div_t are significantly positive and the coefficient of $Capex_t$ is significantly negative. This indicates that the greater the company's internal operating activity and cash dividend cash flow are, the lower its capital expenditures are and the greater its market value is. These findings are similar to those of Luo and Qin (2009), Wang et al. (2014), and Yang et al. (2016). The coefficients of the other control variables are also consistent with prior studies. As Columns (2) to (4) show, the coefficient of $Fstrength_t * Cash_t$ is -1.725, which is significant at the 5% level; the coefficient of $Fdistance_t * Cash_t$ is -0.746, which is not significant; and the coefficient of $Fau_t * Cash_t$ is -0.793, which is significant at the 5% level. These results demonstrate that board faultlines negatively affect the value of cash holdings. Thus, the existence of board faultlines weakens the supervisory function of the board, intensifies Type I agency conflict within the company, and damages the value of cash holdings. These results validate H1a but not H1b.[5]

4.2. Robustness testing

4.2.1. Firm-fixed effects model

To alleviate endogeneity problems caused by unobservable variables that do not change over time, we use the firm-fixed effects model to regress our samples. Columns (1) to (3) of Panel A of Table 4 show the regression results. The coefficients of $Fstrength_t * Cash_t$, $Fdistance_t * Cash_t$, and $Fau_t * Cash_t$ are significantly negative at the 5% level, indicating that the conclusion is valid when controlling for firm-fixed effects.

4.2.2. Firm–year two-dimensional cluster

The results may have some problems related to the residual sequence at the firm and time levels from the panel data, leading to ordinary least squares model bias.[6] To solve the problem of intra-group correlation, we use the firm–year two-dimensional cluster to re-test and improve the robustness of the results. This method considers the correlation between the residuals, making the coefficient and standard deviation more effective. Columns (4) to (6) of Panel A of Table 4 report the results. The coefficients of $Fstrength_t * Cash_t$, $Fdistance_t * Cash_t$, and $Fau_t * Cash_t$ are negative. With the exception of $Fdistance_t$ ($t = -1.54$), the coefficients are significant at the 10% level. Therefore, the results are robust.

4.2.3. Excluding years of financial crisis

The volatility of the business cycle and changes in macroeconomic policies significantly affect companies' micro behavior. Wang et al. (2014) found that the uncertainty of a company's external environment affects

[5] The regression result holds after removing the market value change item, thus supporting H1a.

[6] Company-level serial correlation: the residuals of the same companies at different times are correlated. Time-level serial correlation: the residuals of different companies at the same time are correlated.

Table 3
Board faultlines and the value of cash holdings.

DepVar =	(1) *MV*	(2) *MV*	(3) *MV*	(4) *MV*
Fstrength$_t$ * Cash$_t$		**−1.725****		
		(−2.38)		
Fstrength$_t$		0.398***		
		(2.80)		
Fdistance$_t$ * Cash$_t$			**−0.746**	
			(−1.46)	
Fdistance$_t$			0.072	
			(0.72)	
Fau$_t$ * Cash$_t$				**−0.793****
				(−2.12)
Fau$_t$				0.156**
				(2.14)
Cash$_t$	0.681***	1.670***	1.743**	1.337***
	(5.07)	(3.69)	(2.31)	(3.78)
Cf$_t$	1.180***	1.171***	1.178***	1.171***
	(3.28)	(3.25)	(3.27)	(3.25)
Dif_Cf$_t$	−0.552***	−0.551***	−0.551***	−0.551***
	(−3.14)	(−3.14)	(−3.13)	(−3.13)
Dif_Cf$_{t+1}$	0.505***	0.496***	0.504***	0.499***
	(3.55)	(3.49)	(3.55)	(3.51)
Dif_Nocash$_t$	−0.822***	−0.822***	−0.822***	−0.822***
	(−9.32)	(−9.34)	(−9.32)	(−9.33)
Dif_Nocash$_{t+1}$	0.433***	0.432***	0.432***	0.432***
	(7.53)	(7.53)	(7.52)	(7.52)
Div$_t$	6.128***	6.181***	6.207***	6.190***
	(5.07)	(5.14)	(5.16)	(5.15)
Dif_Div$_t$	−0.848	−0.812	−0.873	−0.827
	(−0.99)	(−0.95)	(−1.02)	(−0.97)
Dif_Div$_{t+1}$	3.770***	3.832***	3.767***	3.814***
	(4.37)	(4.44)	(4.37)	(4.42)
Capex$_t$	−1.953***	−1.954***	−1.947***	−1.953***
	(−6.17)	(−6.19)	(−6.16)	(−6.18)
Dif_Capex$_t$	1.945***	1.947***	1.939***	1.944***
	(8.14)	(8.16)	(8.12)	(8.15)
Dif_Capex$_{t+1}$	0.148	0.151	0.148	0.148
	(0.70)	(0.72)	(0.71)	(0.71)
Dif_MV$_{t+1}$	−0.002	−0.002	−0.002	−0.002
	(−0.09)	(−0.11)	(−0.09)	(−0.10)
Constant	1.411***	1.175***	1.304***	1.280***
	(12.43)	(8.24)	(6.88)	(9.68)
Industry & Year	Yes	Yes	Yes	Yes
Obs.	19,467	19,467	19,467	19,467
Adj. R^2	0.246	0.246	0.246	0.246

Note: The *t* values reported in parentheses are adjusted based on robust standard errors and clustered by firm, where *, **, and *** denote significance levels of 1%, 5%, and 10%, respectively.

its cash holding behavior and manager opportunism, which in turn reduces the marginal value of cash. Therefore, to reduce the interference of the external economic environment, we exclude years of financial crisis from our sample and conduct our analysis again. After excluding the observations from 2008 and 2009, our sample is reduced to 16,938 from 19,467. Columns (7) to (9) of Panel A of Table 4 present the results. The coefficients of *Fstrength$_t$ * Cash$_t$*, *Fdistance$_t$ * Cash$_t$*, and *Fau$_t$ * Cash$_t$* are significantly negative at the 1% or 10% level. This indicates that the negative impact of board faultlines on the value of cash holdings remains significant even after excluding the impact of the financial crisis. The results are robust.

Table 4
Robustness testing.

Panel A: Robustness tests 1 to 3

	Firm-fixed effects model			Firm–year two-dimensional cluster			Excluding years of financial crisis		
DepVar =	(1) *MV*	(2) *MV*	(3) *MV*	(4) *MV*	(5) *MV*	(6) *MV*	(7) *MV*	(8) *MV*	(9) *MV*
Fstrength$_t$*Cash$_t$	**−1.346****			**−1.725***			**−2.049*****		
	(−2.16)			**(−1.92)**			**(−2.82)**		
Fstrength$_t$	0.161			0.398**			0.488***		
	(1.42)			(2.29)			(3.29)		
Fdistance$_t$*Cash$_t$		**−0.919****			**−0.746**			**−0.963***	
		(−2.06)			**(−1.54)**			**(−1.86)**	
Fdistance$_t$		0.079			0.072			0.106	
		(0.93)			(0.82)			(1.00)	
Fau$_t$*Cash$_t$			**−0.746****			**−0.793***			**−0.981*****
			(−2.42)			**(−1.80)**			**(−2.61)**
Fau$_t$			0.084			0.156*			0.199***
			(1.46)			(1.89)			(2.60)
Cash$_t$	−0.267	0.259	−0.426	1.670**	1.743*	1.337**	1.887***	2.088***	1.525***
	(−0.67)	(0.39)	(−1.38)	(2.19)	(1.91)	(2.14)	(4.14)	(2.72)	(4.26)
Cf$_t$	2.148***	2.141***	2.145***	1.171**	1.178**	1.171**	1.094***	1.099***	1.094***
	(6.49)	(6.47)	(6.49)	(2.06)	(2.07)	(2.06)	(2.81)	(2.82)	(2.81)
Dif_Cf$_t$	−0.712***	−0.708***	−0.710***	−0.551**	−0.551**	−0.551**	−0.424**	−0.423**	−0.424**
	(−4.97)	(−4.94)	(−4.96)	(−2.12)	(−2.11)	(−2.12)	(−2.22)	(−2.21)	(−2.22)
Dif_Cf$_{t+1}$	0.706***	0.705***	0.705***	0.496*	0.504*	0.499*	0.482***	0.492***	0.486***
	(5.77)	(5.76)	(5.76)	(1.77)	(1.80)	(1.78)	(2.99)	(3.05)	(3.01)
Dif_Nocash$_t$	−0.687***	−0.687***	−0.687***	−0.822***	−0.822***	−0.822***	−0.851***	−0.852***	−0.851***
	(−9.92)	(−9.92)	(−9.92)	(−4.41)	(−4.41)	(−4.42)	(−8.57)	(−8.56)	(−8.56)
Dif_Nocash$_{t+1}$	0.834***	0.834***	0.834***	0.432	0.432	0.432	0.519***	0.519***	0.519***
	(18.97)	(18.95)	(18.97)	(1.32)	(1.32)	(1.32)	(8.02)	(8.02)	(8.02)
Div$_t$	6.373***	6.388***	6.380***	6.181***	6.207***	6.190***	5.995***	6.039***	6.008***
	(4.86)	(4.86)	(4.86)	(4.18)	(4.22)	(4.20)	(4.75)	(4.79)	(4.77)
Dif_Div$_t$	−0.330	−0.355	−0.336	−0.812	−0.873	−0.827	−1.181	−1.263	−1.200
	(−0.41)	(−0.44)	(−0.42)	(−0.61)	(−0.66)	(−0.62)	(−1.21)	(−1.29)	(−1.23)
Dif_Div$_{t+1}$	3.876***	3.835***	3.865***	3.832**	3.767**	3.814**	3.865***	3.789***	3.839***
	(5.07)	(5.02)	(5.05)	(2.49)	(2.45)	(2.48)	(4.20)	(4.11)	(4.17)
Capex$_t$	−0.158	−0.154	−0.157	−1.954***	−1.947***	−1.953***	−1.966***	−1.957***	−1.966***
	(−0.45)	(−0.44)	(−0.45)	(−4.47)	(−4.45)	(−4.47)	(−5.78)	(−5.74)	(−5.77)
Dif_Capex$_t$	0.902***	0.898***	0.900***	1.947***	1.939***	1.944***	1.926***	1.917***	1.922***
	(4.18)	(4.16)	(4.17)	(4.99)	(4.99)	(4.99)	(7.39)	(7.35)	(7.38)
Dif_Capex$_{t+1}$	0.718***	0.721***	0.718***	0.151	0.148	0.148	0.282	0.275	0.277
	(3.89)	(3.90)	(3.89)	(0.60)	(0.58)	(0.58)	(1.15)	(1.12)	(1.13)
Dif_MV$_{t+1}$	−0.222***	−0.222***	−0.222***	−0.002	−0.002	−0.002	−0.037	−0.037	−0.037
	(−15.77)	(−15.75)	(−15.76)	(−0.01)	(−0.01)	(−0.01)	(−1.58)	(−1.57)	(−1.58)
Constant	1.504***	1.477***	1.525***	1.175***	1.304***	1.280***	1.109***	1.241***	1.230***
	(4.09)	(3.79)	(4.15)	(6.91)	(6.86)	(8.39)	(7.43)	(6.19)	(8.86)
Industry & Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	19,467	19,467	19,467	19,467	19,467	19,467	16,938	16,938	16,938
Adj. R^2	0.371	0.371	0.371	0.246	0.246	0.246	0.239	0.239	0.239

Panel B: Robustness tests 4 to 5

	Changing control variables			Adding control variables			Changing variable measurement		
DepVar =	(1) *MV*	(2) *MV*	(3) *MV*	(4) *MV*	(5) *MV*	(6) *MV*	(7) *MV*	(8) *MV*	(9) *MV*
Fstrength$_t$*Cash$_t$	**−1.476****			**−1.541****			**−1.664****		
	(−2.12)			**(−2.10)**			**(−2.29)**		
Fstrength$_t$	0.321**			0.290**			0.420***		
	(2.32)			(2.04)			(2.88)		
Fdistance$_t$*Cash$_t$		**−0.497**			**−0.608**			**−0.603**	
		(−1.00)			**(−1.19)**			**(−1.12)**	
Fdistance$_t$		0.007			0.009			0.069	
		(0.07)			(0.09)			(0.66)	

Fau_t*$Cash_t$			**−0.632***			**−0.677***			**−0.722***
			(−1.75)			**(−1.80)**			**(−1.89)**
Fau_t			0.110			0.096			0.161**
			(1.53)			(1.32)			(2.14)
$Cash_t$	1.317***	1.177	0.993***	0.826*	0.803	0.501	2.213***	2.117***	1.856***
	(3.05)	(1.60)	(2.92)	(1.80)	(1.06)	(1.39)	(4.72)	(2.65)	(4.95)
Cf_t	6.106***	6.138***	6.116***	1.319***	1.332***	1.323***	1.089***	1.099***	1.090***
	(9.23)	(9.27)	(9.24)	(3.62)	(3.66)	(3.63)	(3.00)	(3.03)	(3.00)
Dif_Cf_t	−0.171	−0.191	−0.180	−0.584***	−0.585***	−0.584***	−0.497***	−0.496***	−0.497***
	(−0.47)	(−0.53)	(−0.49)	(−3.26)	(−3.26)	(−3.26)	(−3.50)	(−3.48)	(−3.50)
Dif_Cf_{t+1}	2.168***	2.173***	2.167***	0.489***	0.496***	0.492***	−0.081	−0.068	−0.076
	(7.44)	(7.45)	(7.43)	(3.49)	(3.53)	(3.50)	(−0.45)	(−0.37)	(−0.42)
Dif_Nocash_t	−1.194***	−1.195***	−1.194***	−1.001***	−1.002***	−1.001***	0.063	0.065	0.063
	(−16.35)	(−16.33)	(−16.34)	(−11.02)	(−11.02)	(−11.01)	(0.53)	(0.55)	(0.53)
Dif_Nocash_{t+1}	0.310***	0.309***	0.310***	0.426***	0.425***	0.426***	−1.241***	−1.236***	−1.238***
	(5.65)	(5.64)	(5.65)	(7.44)	(7.44)	(7.44)	(−6.73)	(−6.70)	(−6.71)
Div_t	−2.817*	−2.830*	−2.822*	1.957	1.967	1.962	5.819***	5.814***	5.816***
	(−1.88)	(−1.88)	(−1.88)	(1.50)	(1.51)	(1.50)	(4.62)	(4.62)	(4.63)
Dif_Div_t	−0.114	−0.151	−0.122	1.717*	1.672*	1.704*	−2.276***	−2.320***	−2.286***
	(−0.12)	(−0.16)	(−0.13)	(1.92)	(1.87)	(1.91)	(−3.10)	(−3.16)	(−3.12)
Dif_Div_{t+1}	−0.241	−0.304	−0.258	3.015***	2.955***	2.995***	1.731*	1.669*	1.715*
	(−0.27)	(−0.34)	(−0.29)	(3.45)	(3.38)	(3.43)	(1.95)	(1.88)	(1.94)
$Capex_t$	−1.780***	−1.772***	−1.779***	−2.008***	−2.003***	−2.009***	−2.066***	−2.065***	−2.067***
	(−5.83)	(−5.80)	(−5.82)	(−6.28)	(−6.26)	(−6.28)	(−6.54)	(−6.52)	(−6.54)
Dif_Capex_t	1.813***	1.804***	1.810***	2.040***	2.034***	2.039***	1.293***	1.284***	1.290***
	(7.48)	(7.44)	(7.46)	(8.85)	(8.82)	(8.84)	(6.58)	(6.53)	(6.56)
Dif_Capex_{t+1}	−0.039	−0.040	−0.042	0.257	0.258	0.256	0.117	0.108	0.111
	(−0.20)	(−0.20)	(−0.21)	(1.24)	(1.24)	(1.23)	(0.52)	(0.48)	(0.50)
Dif_MV_{t+1}	−0.010	−0.009	−0.010	−0.011	−0.011	−0.011	−0.320***	−0.320***	−0.320***
	(−0.51)	(−0.49)	(−0.50)	(−0.58)	(−0.57)	(−0.58)	(−14.61)	(−14.60)	(−14.60)
Fin_t	–	–	–	−20.633***	−20.746***	−20.676***	–	–	–
				(−10.83)	(−10.88)	(−10.84)			
Dif_Fin_t	–	–	–	8.789***	8.929***	8.862***	–	–	–
				(5.07)	(5.15)	(5.11)			
Dif_Fin_{t+1}	–	–	–	−7.614***	−7.538***	−7.559***	–	–	–
				(−5.08)	(−5.03)	(−5.05)			
Constant	1.353***	1.528***	1.451***	1.683***	1.834***	1.773***	1.040***	1.190***	1.154***
	(9.83)	(8.24)	(11.36)	(11.45)	(9.54)	(12.92)	(7.04)	(6.03)	(8.42)
Industry & Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	19,467	19,467	19,467	19,466	19,466	19,466	19,466	19,466	19,466
Adj. R^2	0.269	0.269	0.269	0.263	0.263	0.263	0.277	0.277	0.277

Note: The *t* values reported in parentheses are adjusted based on robust standard errors and clustered by firm, where *, **, and *** denote significance levels of 1%, 5%, and 10%, respectively.

4.2.4. Changing the model and variables

When testing the cash holding value regression model, Luo and Qin (2009) replaced cash flow and the changes in cash flow in Model (1) with return on assets and the changes in return on assets to control for the impact of profitability on cash value. Therefore, we change some of the control variables and re-test the model. Columns (1) to (3) of Panel B of Table 4 show that the coefficients of $Fstrength_t$ * $Cash_t$, $Fdistance_t$ * $Cash_t$, and Fau_t * $Cash_t$ are negative. However, of the three interaction terms, only $Fstrength_t$ * $Cash_t$ and Fau_t * $Cash_t$ are significant (at the 5% and 1% levels, respectively). Following Dou and Lu (2016), we add financial expenses and changes in financial expenses to our model. Columns (4) to (6) of Panel B of Table 4 present the regression results, which show that the coefficients of $Fstrength_t$ * $Cash_t$, $Fdistance_t$ * $Cash_t$, and Fau_t * $Cash_t$ are negative. Again, only $Fstrength_t$ * $Cash_t$ and Fau_t * $Cash_t$ are significant (at the 5% and 1% levels, respectively).

4.2.5. Changing the method of variable measurement

We use the total non-cash asset deflator at the end of year t or the total asset deflator at the end of the corresponding year to re-test the regression model. Columns (7) to (9) of Panel B of Table 4 report the results, which are consistent with previous findings.

5. Additional analysis

5.1. Types of board faultlines

Following Van Peteghem et al. (2018), we distinguish between the different types of board faultlines and divide them into those formed by surface-level attributes and those formed by deep-level attributes. The impact of board faultlines formed by deep-level attributes is more profound and lasting. Surface board faultlines are formed based on gender and age and deep board faultlines are formed based on tenure, director independence, part-time directors, internal directors, shareholding, and financial experience.

Table 5 reports the results based on the type of board faultlines. Columns (1) to (3) report the results for surface board faultlines and Columns (4) to (6) report the results for deep board faultlines. The coefficients of $Fstrength1_t * Cash_t$, $Fdistance1_t * Cash_t$, and $Fau1_t * Cash_t$ are negative and not significant. The coefficient of $Fstrength2_t * Cash_t$ is significantly negative at the 5% level. The coefficient of $Fdistance2_t * Cash_t$ is positive and not significant. The coefficient of $Fau2_t * Cash_t$ is significantly negative at the 10% level. The above results indicate that different types of board faultlines have different effects on the value of cash holdings. Deep board faultlines are adverse to the performance of the board's supervisory function and weaken the supervision of management, thereby damaging the value of cash holdings.

5.2. Management shareholdings

The analysis of the impact of board faultlines on the value of cash holdings from the perspective of the board supervisory function indicates that a fracture within a board of directors weakens its supervisory ability, promotes management opportunism, and increases management agency costs, thereby reducing the value of cash holdings. However, as Jensen and Meckling (1976) pointed out, aside from board supervision, another fundamental source of agency problem is the inconsistency of interests between managers and owners and the lack of appropriate incentive mechanisms for management. Appropriate incentives can effectively alleviate agency conflict between managers and shareholders. The "coordination of interests" can encourage managers to work hard and reduce behavior that seeks private gain and damages company value. Equity and monetary compensation incentives are the most common methods for listed companies. Equity incentives are more compelling than monetary compensation incentives. Only by holding shares and enjoying a residual claim to the company can management fundamentally solve the agency problem between managers and owners (Jensen and Murphy, 1990). Therefore, we predict that if managers hold shares of a listed company, the coordination of interests can alleviate the negative impact of board faultlines on the value of cash holdings.

We divide the sample according to whether managers hold shares and re-test our model. Table 6 reports the results. Columns (1) to (3) report the results of board faultlines on the value of cash holdings when managers hold shares. The coefficients of $Fstrength_t * Cash_t$, $Fdistance_t * Cash_t$, and $Fau_t * Cash_t$ are negative and not significant. Columns (4) to (6) report the impact of board faultlines on the value of cash holdings when managers do not hold shares. The coefficients of $Fstrength_t * Cash_t$, $Fdistance_t * Cash_t$, and $Fau_t * Cash_t$ are negative. With the exception of the coefficients in Column (5), the other coefficients are significant at the 5% level.[7] These results support the previous inference that managers shareholding promotes the coordination of interests, which partially compensates for the supervisory failures caused by board faultlines.

[7] The coefficient of $Fdistance_t * Cash_t$ in Column (5) is negative but not significant. This means that the similarity (i.e., fault line strength) of the subgroups within the board has a greater impact than the difference between the subgroups represented by the fault line distance.

Table 5
Additional analysis: Types of board faultlines.

	Surface board faultlines			Deep board faultlines		
DepVar =	(1) *MV*	(2) *MV*	(3) *MV*	(4) *MV*	(5) *MV*	(6) *MV*
Fstrength1$_t$*Cash$_t$	**−0.077**					
	(−0.23)					
Fstrength1$_t$	−0.029					
	(−0.45)					
Fdistance1$_t$*Cash$_t$		**−0.223**				
		(−0.55)				
Fdistance1$_t$		−0.085				
		(−1.11)				
Fau1$_t$*Cash$_t$			**−0.106**			
			(−0.33)			
Fau1$_t$			−0.017			
			(−0.27)			
Fstrength2$_t$*Cash$_t$				**−1.443****		
				(−1.98)		
Fstrength2$_t$				0.220		
				(1.60)		
Fdistance2$_t$*Cash$_t$					**0.026**	
					(0.05)	
Fdistance2$_t$					−0.059	
					(−0.63)	
Fau2$_t$*Cash$_t$						**−0.491***
						(−1.79)
Fau2$_t$						0.058
						(0.96)
Cash$_t$	0.733***	0.887**	0.756***	1.255***	0.651	0.928***
	(2.67)	(2.10)	(2.71)	(3.70)	(1.08)	(6.00)
Cf$_t$	1.186***	1.186***	1.184***	1.170***	1.179***	1.173***
	(3.29)	(3.29)	(3.29)	(3.25)	(3.27)	(6.73)
Dif_Cf$_t$	−0.556***	−0.556***	−0.555***	−0.549***	−0.549***	−0.550***
	(−3.16)	(−3.16)	(−3.16)	(−3.12)	(−3.12)	(−4.03)
Dif_Cf$_{t+1}$	0.505***	0.505***	0.505***	0.503***	0.505***	0.504***
	(3.55)	(3.55)	(3.55)	(3.54)	(3.55)	(4.92)
Dif_Nocash$_t$	−0.822***	−0.824***	−0.822***	−0.823***	−0.821***	−0.822***
	(−9.32)	(−9.35)	(−9.32)	(−9.35)	(−9.34)	(−13.91)
Dif_Nocash$_{t+1}$	0.433***	0.433***	0.433***	0.433***	0.434***	0.433***
	(7.53)	(7.52)	(7.53)	(7.52)	(7.55)	(14.52)
Div$_t$	6.105***	6.176***	6.113***	6.222***	6.173***	6.209***
	(5.06)	(5.11)	(5.06)	(5.17)	(5.15)	(9.38)
Dif_Div$_t$	−0.844	−0.904	−0.846	−0.887	−0.870	−0.886
	(−0.99)	(−1.05)	(−0.99)	(−1.04)	(−1.02)	(−1.03)
Dif_Div$_{t+1}$	3.737***	3.731***	3.741***	3.782***	3.783***	3.782***
	(4.32)	(4.29)	(4.32)	(4.39)	(4.39)	(5.61)
Capex$_t$	−1.950***	−1.929***	−1.950***	−1.955***	−1.944***	−1.951***
	(−6.17)	(−6.12)	(−6.16)	(−6.19)	(−6.15)	(−9.15)
Dif_Capex$_t$	1.940***	1.931***	1.940***	1.945***	1.938***	1.941***
	(8.12)	(8.09)	(8.12)	(8.17)	(8.14)	(9.16)
Dif_Capex$_{t+1}$	0.145	0.151	0.146	0.146	0.146	0.145
	(0.69)	(0.72)	(0.70)	(0.70)	(0.70)	(0.90)
Dif_MV$_{t+1}$	−0.002	−0.002	−0.002	−0.002	−0.002	−0.002
	(−0.10)	(−0.11)	(−0.10)	(−0.10)	(−0.10)	(−0.24)
Constant	1.431***	1.480***	1.423***	1.325***	1.478***	1.383***
	(11.93)	(10.86)	(11.83)	(10.34)	(9.10)	(17.95)
Industry & Year	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	19,467	19,467	19,467	19,467	19,467	19,467
Adj. R^2	0.246	0.247	0.246	0.246	0.246	0.246

Note: The *t* values reported in parentheses are adjusted based on robust standard errors and clustered by firm, where *, **, and *** denote significance levels of 1%, 5%, and 10%, respectively.

Table 6
Additional analysis: Management shareholdings.

	Management shareholdings > 0			Management shareholdings = 0		
DepVar =	(1) *MV*	(2) *MV*	(3) *MV*	(4) *MV*	(5) *MV*	(6) *MV*
Fstrength$_t$*Cash$_t$	**−1.209**			**−2.573****		
	(−1.35)			**(−2.23)**		
Fstrength$_t$	0.325*			0.512**		
	(1.85)			(2.35)		
Fdistance$_t$*Cash$_t$		**−0.634**			**−1.116**	
		(−1.17)			**(−1.24)**	
Fdistance$_t$		0.151			0.102	
		(1.41)			(0.59)	
Fau$_t$*Cash$_t$			**−0.602**			**−1.239****
			(−1.39)			**(−1.98)**
Fau$_t$			0.166*			0.207*
			(1.93)			(1.77)
Cash$_t$	1.420***	1.647**	1.233***	2.129***	2.197*	1.652***
	(2.68)	(2.10)	(3.20)	(2.85)	(1.66)	(2.72)
Cf$_t$	2.126***	2.131***	2.129***	0.259	0.267	0.254
	(5.18)	(5.19)	(5.18)	(0.48)	(0.50)	(0.47)
Dif_Cf$_t$	−0.888***	−0.889***	−0.892***	−0.131	−0.135	−0.130
	(−4.16)	(−4.17)	(−4.18)	(−0.49)	(−0.50)	(−0.49)
Dif_Cf$_{t+1}$	0.558***	0.564***	0.560***	0.499**	0.510**	0.501**
	(3.03)	(3.06)	(3.04)	(2.37)	(2.42)	(2.38)
Dif_Nocash$_t$	−0.241**	−0.238**	−0.239**	−1.326***	−1.328***	−1.327***
	(−2.30)	(−2.28)	(−2.29)	(−10.48)	(−10.45)	(−10.47)
Dif_Nocash$_{t+1}$	0.507***	0.507***	0.507***	0.376***	0.377***	0.377***
	(8.86)	(8.86)	(8.87)	(4.00)	(4.00)	(4.00)
Div$_t$	8.000***	7.969***	7.984***	3.999**	4.056**	4.042**
	(5.80)	(5.78)	(5.79)	(2.00)	(2.02)	(2.02)
Dif_Div$_t$	−2.178**	−2.194**	−2.169**	0.852	0.809	0.829
	(−2.24)	(−2.25)	(−2.23)	(0.56)	(0.53)	(0.55)
Dif_Div$_{t+1}$	3.850***	3.809***	3.845***	4.320***	4.277***	4.311***
	(3.85)	(3.81)	(3.85)	(2.74)	(2.70)	(2.73)
Capex$_t$	−1.196***	−1.198***	−1.197***	−2.639***	−2.630***	−2.634***
	(−3.29)	(−3.30)	(−3.30)	(−5.23)	(−5.19)	(−5.21)
Dif_Capex$_t$	0.820***	0.819***	0.819***	2.853***	2.839***	2.843***
	(3.16)	(3.16)	(3.16)	(7.51)	(7.46)	(7.48)
Dif_Capex$_{t+1}$	−0.223	−0.228	−0.225	0.564	0.559	0.560
	(−0.98)	(−1.01)	(−0.99)	(1.63)	(1.61)	(1.62)
Dif_MV$_{t+1}$	−0.075***	−0.075***	−0.075***	0.053*	0.054*	0.054*
	(−3.74)	(−3.73)	(−3.74)	(1.85)	(1.87)	(1.86)
Constant	0.987***	0.964***	1.038***	1.295***	1.446***	1.427***
	(6.73)	(5.24)	(8.13)	(5.50)	(4.42)	(6.42)
Industry & Year	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	11,262	11,262	11,262	8,205	8,205	8,205
Adj. R^2	0.285	0.285	0.285	0.240	0.239	0.240

Note: The *t* values reported in parentheses are adjusted based on robust standard errors and clustered by firm, where *, **, and *** denote significance levels of 1%, 5%, and 10%, respectively.

5.3. Types of ownership

We divide the sample into SOEs and non-SOEs and further examine the impact of various types of ownership. Compared with non-SOEs, such as private enterprises, the absence of the pyramidal ownership structure among SOEs weakens the supervisory function of the board. Operational decision-making and manager appointments are generally determined by high-level government departments, which serve as an external board of directors. The external board significantly weakens the power and functions of the company's inter-

Table 7
Additional analysis: Types of ownership.

	SOEs			Non-SOEs		
DepVar =	(1) *MV*	(2) *MV*	(3) *MV*	(4) *MV*	(5) *MV*	(6) *MV*
Fstrength$_t$*Cash$_t$	**−2.180****			**−0.844**		
	(−2.32)			**(−0.81)**		
Fstrength$_t$	0.432***			0.114		
	(2.84)			(0.47)		
Fdistance$_t$*Cash$_t$		**−1.073**			**0.269**	
		(−1.42)			**(0.40)**	
Fdistance$_t$		0.156			−0.287*	
		(1.26)			(−1.80)	
Fau$_t$*Cash$_t$			**−1.158****			**−0.122**
			(−2.21)			**(−0.24)**
Fau$_t$			0.205**			−0.060
			(2.46)			(−0.50)
Cash$_t$	2.215***	2.463**	1.903***	0.783	−0.097	0.400
	(3.79)	(2.30)	(4.03)	(1.22)	(−0.09)	(0.82)
Cf$_t$	0.191	0.204	0.192	2.307***	2.307***	2.307***
	(0.47)	(0.50)	(0.47)	(4.14)	(4.13)	(4.13)
Dif_Cf$_t$	−0.020	−0.018	−0.019	−1.192***	−1.188***	−1.190***
	(−0.11)	(−0.10)	(−0.10)	(−4.30)	(−4.28)	(−4.28)
Dif_Cf$_{t+1}$	0.470***	0.477***	0.469***	0.604***	0.609***	0.608***
	(2.70)	(2.75)	(2.70)	(2.86)	(2.88)	(2.88)
Dif_Nocash$_t$	−0.626***	−0.624***	−0.625***	−1.166***	−1.170***	−1.167***
	(−6.25)	(−6.22)	(−6.24)	(−8.57)	(−8.58)	(−8.57)
Dif_Nocash$_{t+1}$	0.410***	0.410***	0.410***	0.398***	0.397***	0.398***
	(4.93)	(4.92)	(4.93)	(5.38)	(5.38)	(5.38)
Div$_t$	10.884***	10.887***	10.900***	1.956	2.074	1.976
	(7.44)	(7.43)	(7.46)	(1.09)	(1.15)	(1.10)
Dif_Div$_t$	−0.437	−0.450	−0.431	−0.593	−0.741	−0.640
	(−0.37)	(−0.38)	(−0.36)	(−0.49)	(−0.61)	(−0.53)
Dif_Div$_{t+1}$	6.963***	6.915***	6.957***	1.273	1.219	1.236
	(5.50)	(5.43)	(5.49)	(1.13)	(1.08)	(1.09)
Capex$_t$	−1.055***	−1.050***	−1.051***	−2.632***	−2.601***	−2.627***
	(−2.97)	(−2.94)	(−2.95)	(−5.34)	(−5.29)	(−5.33)
Dif_Capex$_t$	1.366***	1.354***	1.358***	2.506***	2.482***	2.501***
	(4.88)	(4.84)	(4.85)	(6.76)	(6.72)	(6.75)
Dif_Capex$_{t+1}$	0.059	0.054	0.057	0.257	0.266	0.257
	(0.23)	(0.21)	(0.23)	(0.78)	(0.80)	(0.78)
Dif_MV$_{t+1}$	−0.068**	−0.068**	−0.068**	0.023	0.023	0.023
	(−2.21)	(−2.21)	(−2.22)	(0.93)	(0.94)	(0.94)
Constant	0.993***	1.020***	1.078***	1.468***	1.932***	1.586***
	(5.04)	(4.04)	(5.64)	(7.69)	(7.35)	(9.92)
Industry & Year	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	9,681	9,681	9,681	9,434	9,434	9,434
Adj. R^2	0.261	0.261	0.261	0.243	0.243	0.243

Note: The *t* values reported in parentheses are adjusted based on robust standard errors and clustered by firm, where *, **, and *** denote significance levels of 1%, 5%, and 10%, respectively.

nal board. Therefore, for SOEs, the presence of an external board diminishes and undermines the supervision of management, further damaging the value of cash holdings.

Table 7 reports the results based on ownership. Columns (1) to (3) report the results for the SOEs. The coefficients of *Fstrength$_t$* * *Cash$_t$*, *Fdistance$_t$* * *Cash$_t$*, and *Fau$_t$* * *Cash$_t$* are negative. With the exception of the coefficients in Column (2), the other coefficients are significant at the 5% level. Columns (4) to (6) report the results for the non-SOEs; the coefficients of *Fstrength$_t$* * *Cash$_t$*, *Fdistance$_t$* * *Cash$_t$*, and *Fau$_t$* * *Cash$_t$* are negative and not significant. These results indicate that for SOEs, the board's ability to supervise managers is weaker and the negative impact of the board on the value of cash holdings is more significant.

6. Conclusion

Board faultlines influence a board of directors' effectiveness in supervising senior managers, which in turn affects the value of cash holdings. Using Chinese listed A-share company data from 2004 to 2016 as the research sample, we systematically investigate the impact of board faultlines on the value of cash holdings from the agency theory perspective. The empirical results indicate that board faultlines are negatively correlated with the value of cash holdings. Furthermore, board faultlines formed from deep-level attributes have a greater inhibitory effect. Finally, the inhibitory effect of the board faultlines is stronger in SOEs than in non-SOEs. The results hold after conducting a number of robustness checks. As an important governance mechanism, management shareholdings can reduce agency costs and mitigate the negative impact of board fissures on cash holdings.

We make contributions of both theoretical and practical significance. First, we enrich the literature on board faultlines and the value of cash holdings. From the perspective of the diminishing value of cash holdings amid faultlines, we further confirm the subsequent weakening of the board of directors' ability to supervise managers on the basics of previous studies. From the perspective of manager's agency problems, we expand the research on the factors affecting the value of cash holdings. We also provide certain practical insight for listed companies on how to construct their boards of directors. For example, we establish that the existence of subgroups within a board of directors is not conducive to its harmony or cohesion and reduces its supervisory ability. This indicates that a company should choose appropriate directors according to a combination of specific characteristics. When pursuing director diversification, companies must avoid the formation of board faultlines. This would ultimately have practical significance for improving the governance structure of listed companies.

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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Family involvement, family member composition and firm innovation

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ABSTRACT

Based on the data of Chinese listed family firms from 2008 to 2016, we investigate the impact of family involvement on firm innovation and the moderating effect of family member composition. The results show that increased family involvement significantly reduces R&D investment intensity and the number of patent applications. With the increased richness of the kinship of family members involved in management, the negative impact of family involvement on patent applications is weakened, but family member composition does not have a significant moderating effect on the relationship between family involvement and R&D investment intensity. Further analysis shows that the number of invention patent applications decreases as the degree of family involvement increases, but family involvement has no significant effect on utility model patent and design patent applications. Family member composition has a significant moderating effect on the relationship between family involvement and invention patent applications. The results have value as a reference for exploring how family involvement affects firm innovation and can also help the actual controller to take effective measures to optimize family member composition and improve the innovation performance of family firms.

1. Introduction

Innovation has been recognized as a primary means of firms' future investment. It is not only the basis for a firm to gain market competitiveness, but also a source of vitality for economic and social development (Ettlie, 1998). For family firms, innovation can integrate existing resources, cultivate sustainable competitive advantages, and create economic value (De Massis et al., 2014). In other words, innovation is the cornerstone of

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family firms' prosperity. However, as *The Chinese Family Business Health Index Report 2014* shows, the R&D intensity of Chinese family firms is generally less than the average level of private firms. Increasing evidence also suggests that the R&D investment of family firms is significantly lower than that of non-family firms (Block, 2010; Classen et al., 2014; Wu and Chen, 2014).

Different from non-family firms, family firms combine "family" and "firm"; their most distinctive feature is that family members are involved in corporate governance (Chua et al., 1999; Songini and Gnan, 2015). Among them, socioemotional wealth has become the essential feature of family involvement (Gómez-Mejía et al., 2007), which creates a series of non-economic goals for the firm, primarily (a) enhancing and perpetuating family image and reputation (Chrisman et al., 2012; Evert et al., 2018), (b) maintaining family control of ownership and management, and (c) sustaining the family's dynastic aspirations and ensuring that the business remains viable across future generations (Evert et al., 2018). Hence, family involvement can give firms a long-term strategic motivation, create a positive environment, and bring reliable and unique resources, thereby promoting firm innovation (Sirmon and Hitt, 2003). However, these socioemotional wealth goals do not always benefit firms; in fact, they often conflict with the economic interests of firms (Yan and Ye, 2014; Qi and Li, 2017), result in a lack of talent, and bring agency problems. In these cases, family firms often reduce their innovative activities to avoid the associated high risks and protect their socioemotional wealth (Gómez-Mejía et al., 2007). We set out to disentangle the family firm's decision process by asking how family involvement influences firm innovation.

The current research on this question has not reached a unified conclusion. Most research focuses on comparing family firms and non-family firms and regards family members as highly homogeneous. However, differences in the kinship of family members involved in the firm leads to different types of family member compositions, thereby affecting governance efficiency and business decisions. Influenced by the traditional family culture, the governance structure of Chinese family firms shows an obvious "differential order pattern" centered on family kinship (Wang et al., 2014, p. 146). The closer the kinship between family members, the easier it is to create intimacy, unconditional trust, and other emotions (Hu, 2016). Therefore, different compositions of kinship contribute to different tradeoffs between socioemotional wealth and economic interests, which in turn affect the behavior of family members involved in the business. Based on family member composition, our study explores the impact of family involvement on firm innovation.

Using a sample of Chinese listed family firms from 2008 to 2016, we find a significant relationship between family involvement and firm innovation. Family firms with higher degrees of family involvement tend to have lower levels of R&D investment intensity and patent applications. We divide our sample into three types, controlling ownership, sibling partnership, and cousin consortium firms, based on the kinship between family members and the actual controller, and find a significant moderating effect of family member composition. With the increased richness of the kinship of family members involved in management, the negative impact of family involvement on patent applications is weakened, but family member composition does not have a significant moderating effect on the relationship between family involvement and R&D investment intensity. Further analysis shows that increased family involvement mainly contributes to the reduction of invention patent applications but has no significant effect on utility model patent and design patent applications. Furthermore, the negative relationship between family involvement and invention patent applications is weakened by the richness of kinship of family members involved in management. The conclusions hold when we control for endogeneity problems and perform robustness tests.

The remainder of our study is organized as follows. Section 2 reviews the relevant literature and develops hypotheses. Section 3 describes the sample and variables, and documents the methodology. Section 4 presents the data analyzed, empirical results, endogeneity analysis, and robustness tests. The final section serves as a conclusion.

2. Hypothesis development

2.1. Family involvement and firm innovation

In family firms, family members are usually involved not only in ownership but also in management (Chua et al., 1999; La Porta et al., 1999; Yang and Li, 2009; Astrachan and Shanker, 2013; Songini and Gnan, 2015).

Family involvement in ownership refers to the proportion of equity possessed by family members (Sciascia and Mazzola, 2008; Chen and Chen, 2014; De massis et al., 2015). Family involvement in management reflects family participation in strategic decision making, which is usually measured by the proportion of family members in the top management team (e.g., Zahra, 2003; Sciascia and Mazzola, 2008; Sciascia et al., 2012; De massis et al., 2015; Pan et al., 2019; Yan et al., 2019), the proportion of family employees (e.g., Pan et al., 2019), and whether family members are senior managers (e.g., Chen and Chen, 2014; Songini and Gnan, 2015; Pan et al., 2019; Yan et al., 2019).

Family involvement provides the family with the ability and power to influence the firm's innovation decisions by shaping firm goals, strategies, and behaviors (Chrisman et al., 2012). Specifically, a greater degree of family ownership enables the family to exercise more unrestricted discretion due to its status as a business owner (Chen and Chen, 2014) and to impose significant influence over strategic and tactical options presented to the top management team by virtue of their voting power (Evert et al., 2018). Likewise, more family involvement in management strengthens family members' influence on penetration of the firm (Chen and Chen, 2014), enhancing the ability to develop firm innovation decisions. Innovation, as a firm's future investment (Ettlie, 1998), is vital for long-term success in many business contexts (Wu et al., 2005; Banno, 2016) and is usually positively related to sales and stock performance, thus improving the reputation of firms. Therefore, family members have strong motivations to encourage innovation. To achieve sustained control of the firm, family members tend to maintain the prosperity of both the family and the firm (Chua et al., 1999; Gu et al., 2017), so the strategy is usually long-term rather than short-term oriented (Sirmon and Hitt, 2003; Le Breton-Miller and Miller, 2006). Thus, the greater the family's involvement is, the more positive the firm's attitude toward innovation will be. Further, high ownership concentration can diversify the risks of family firms by implementing innovative strategies and exploring new business areas (Hsu et al., 2016), which lead to a positive motivation for innovation. Family involvement in management also determines the emotional identification of family members with the business (Berrone et al., 2012). Family members regard the business as a family asset and have a strong desire to inherit the family business (Ward, 2004). In turn, corporate inheritance makes family firms pay more attention to sustainable development and active innovation (Zhu et al., 2016).

Second, family involvement can form a positive environment for innovation. Family firms provide family employees with a sense of professional security (Zhou, 2014). In return, family employees exhibit stronger commitment to the firm (Stark and Falk, 1998; Zahra et al., 2008). Within the domain of the altruism perspective, employee empowerment and the promotion of discretionary contributions can help family owners to orient themselves toward a stewardship role rather than self-interested agency action (Stark and Falk, 1998; Schulze et al., 2003b; Zahra et al., 2008). As the degree of family involvement increases, family members' sense of ownership and emotional attachment to the firm also increase (Schulze et al., 2003a), which contributes to the formation of a stewardship culture (Zahra et al., 2008). The stewardship culture is conducive to family members' adjusting their preferences, focusing on long-term competitiveness, using corporate resources efficiently for family interests (Carney et al., 2019), and being more courageous in the face of the potential risks associated with innovation (Cai et al., 2016). At the same time, family power in the business continues to increase with the degree of family involvement, which can allow the family to form a high level of cohesion and trust, making it smoother to communicate and cooperate (Schulze et al., 2003b) and thus facilitating firm innovation.

Finally, family involvement brings intangible resources for innovation. On the one hand, family firms have the advantage of low supervision costs (Chrisman et al., 2007). Firms with a high degree of family involvement, especially in management, can create a family culture atmosphere, which naturally urges family members to form a strong commitment to the firm (Zhou, 2014). This commitment encourages family managers to associate personal interests with corporate interests, greatly reducing the agency cost between shareholders and managers (Jensen and Meckling, 1976) and allowing family firms to invest in innovation activities. On the other hand, families are likely to simultaneously participate in both business and family relationships in their personal and professional lives. The duality of these relationships increases human resource diversity and creates a unique support system for intellectual capital and social capital (Sirmon and Hitt, 2003), which are what family firms need for innovation activities (Yan et al., 2019).

According to the above analysis, as the degree of family involvement increases, the active motivation, positive environment, and intangible resources of innovation in the firm increase, which are beneficial to the development of firm innovation. Thus, Hypothesis 1a is proposed as follows:

H1a. Family involvement has a positive effect on firm innovation, ceteris paribus.

Family involvement is a "double-edged sword" (Dyer, 2003, p.405). Increased family involvement may also become an obstacle to firm innovation (Block, 2010; Classen et al., 2014). First, the innovation strategy may conflict with family goals. In the operation of a family firm, socioemotional wealth plays a central role in this conflict (Yan and Ye, 2014). According to socioemotional wealth theory, increased family involvement leads to a closer relationship between family and business, and a higher psychological dependence of family members on the firm. Although innovation is beneficial to the long-term development of firms, there are uncertainties regarding the financial pay-offs due to R&D investment (Dai et al., 2012), which pose a huge threat to family interests (Wu and Chen, 2014; Cucculelli et al., 2016; Zhu et al., 2016). Therefore, the willingness of family members to protect socioemotional wealth becomes stronger as family involvement increases (Gómez-Mejía et al., 2013). Firms with greater family involvement are less willing to engage in such high-risk innovative activities (Duran et al., 2016), and thus tend to be conservative and cautious in the process of strategy development and investment plan selection (Wu et al., 2005).

Second, family firms lack innovative talent. On the one hand, family firms usually have a high degree of distrust of "outsiders" (Qi and Li, 2017, p.1144), while showing strong or even unconditional trust in family members (Gold et al., 2002). As a result, the actual controllers are more willing to appoint trusted family members, even if they are not competent, to work for the firm (Le Breton-Miller and Miller, 2009; Carney et al., 2019). Therefore, the increase in family involvement disperses, to some extent, the innovative enthusiasm of talents. On the other hand, as family power in firms grows, the influence of family culture, a fundamentally relationship-oriented culture, gradually deepens. Influenced by family culture, it is not rules and regulations that judge and restrict the actual controller's behavior, but interpersonal relationships. The manifestation of this perceptual talent evaluation system in family firms reflects the fact that managers appreciate employees' having a close relationship with them, whether they are family or non-family employees (Qi and Li, 2017) and regardless of their performance. On this condition, overemphasizing interpersonal relationships results in a lack of an effective talent incentive mechanism (Schulze et al., 2003b) and eliminates professional work enthusiasm. Therefore, a high degree of family involvement leads to a relationship-oriented culture and ineffective incentives for innovative professionals.

Finally, family involvement may create agency problems. With involvement in ownership, management, control, and other aspects, family members are likely to pursue more of their private goals (Block, 2010; Huang et al., 2018; Yan et al., 2019), which leads to fewer available resources and less efficient innovation activities in firms (Le Breton-Miller and Miller, 2009). In addition, the use of external expertise and capital in the R&D process may dilute family control and damage the family's socioemotional wealth (Gómez-Mejía et al., 2007). Therefore, as the degree of family involvement increases, family owners increasingly favor less R&D investment and focus on conservation rather than growth. Moreover, emotional conflicts mean that family members are not always united (Schulze et al., 2003a). Family managers have the dual identities of "steward" and "agent" (Zahra et al., 2008, p. 1037). When more family members are involved in management, families play more of the role of agent than steward (Tosi et al., 2003). Due to these agency problems, family members preferentially seek control-oriented benefits and self-interest rather than firm growth (Schulze et al., 2003a), which makes the overall investment vision of family firms short-sighted (Su and Lee, 2013), thereby neglecting opportunities for innovation.

Previous analysis suggests that a higher degree of family involvement in a firm is more likely to cause conflict, less innovative talent, and more agency problems, which taken together result in higher constraints on innovation resources. Thus, Hypothesis 1b is proposed as follows:

H1b. Family involvement has a negative effect on firm innovation, ceteris paribus.

2.2. The moderating effects of family member composition

Some scholars focus on differences among family members. Compared with distant relatives, close relatives have stronger cohesion and a greater sense of identity (Schulze et al., 2003a). They construct a foundation of

trust and have a similar and strong sense of responsibility to the family business, so it is easier to form a consensus in decision-making (He et al., 2010). However, family members with different kinship relationships have different degrees of willingness to protect socioemotional wealth (Yu et al., 2018). Close relatives are more willing to preserve socioemotional wealth at the expense of governance efficiency, while distant relatives usually do not attach firm interest to socioemotional wealth, which restrains the efficiency of corporate governance and the effectiveness of decision-making. Therefore, based on the kinship between family members involved in business management and the actual controller and inspired by Gersick et al. (1997), we divide family firms into three types: controlling ownership, sibling partnership, and cousin consortium firms.

Conflicts in family firms may originate from sibling rivalry, identity conflict, the following generations' desire to be different from their parents, or the different goals of individual family members regarding the development of the firm. These conflicts lead to divergence in preferences and different levels of cohesion (Gersick et al., 1997). The biggest characteristic of controlling ownership firms is that family members involved in management are limited to the nuclear relatives of the actual controller, such as the actual controller's spouse and his, her, or their parents and/or children. The nuclear family members usually regard themselves as the owners of the business (Stark and Falk, 1998), and will take actions that they believe will benefit the nuclear family and business (Schulze et al., 2003b). The nuclear family members are closely related to each other, with the same experience, shared cognition, and a strong spirit of reciprocity (Schulze et al., 2003a), and tend to be more loyal to family firms and willing to invest more financial support and other resources in business operations (Chen et al., 2016), which gives the family firms strong cohesion. In sibling partnership firms, new family members who are closely related to the actual controller, such as his, her, or their siblings and/or spouses, are involved in management. The nature of altruism in sibling partnerships weakens gradually, while egoism makes this alignment of interests among family members much more difficult to obtain. This is because egoism gives each sibling manager an incentive to place their own nuclear household's welfare ahead of the welfare of their extended family members and even the firm (Lubatkin et al., 2005), so that rent-seeking and moral hazard are intensified with the enrichment of family involvement (Gersick et al., 1997), leading to a decline in the cohesion of family firms. In cousin consortium firms, the actual controller's cousins and even distant relatives are involved in management. Compared with nuclear family members, distant family members have a weaker sense of loyalty and belonging, which can reduce effectiveness as they value self-interest more than socioemotional wealth (Miller et al., 2013). In this case, family conflicts that arise among core and non-core family members are more likely to cause agency problems and additional coordination costs (He et al., 2010), leading to a further reduction in family cohesion. In addition, affected by the traditional family culture, the actual controllers of Chinese family firms often treat family members differently, based on kinship rather than ability, which can easily lead to multiple discrimination (Lubatkin et al., 2005). In summary, family member composition ranges from controlling ownership to sibling partnership and then to cousin consortium firms. The richer the kinship ties between family members involved in management, the more likely egoism and agency problems are to contribute to a lower level of cohesion and governance efficiency and thus negatively moderate the relationship between family involvement and firm innovation. Thus, hypothesis 2a is proposed as follows:

H2a. With increased richness of the kinship of family members involved in management, the negative effect of family involvement on firm innovation will be strengthened, whereas the positive effect will be weakened, ceteris paribus.

The richness of kinship ties among family members involved in management may also improve corporate governance efficiency. In controlling ownership family firms, the actual controllers usually have a dominant position both in firms and families, which makes the board of directors a ''rubber stamp board'' or a ''paper board'' (Gersick et al., 1997, p.32). In both cases, these boards cannot perform the real advisory role and only serve to endorse what the owner-manager has already decided (Gersick et al., 1997). When siblings participate in the management of the firm, although the closeness of their blood ties allow them to maintain a sense of loyalty and identification with the family (Schulze et al., 2003a), they also desire respect and involvement in good decision making. As a result, family employees will not follow the decisions of the actual controller blindly, limiting the absolute authority of the actual controller (Gersick et al., 1997). Therefore, in the process of corporate governance and decision-making with siblings, family members are independent and supervise each other, improving corporate governance efficiency to a certain extent. When distant relatives are involved

in business management, firms transit into extended family. The power of management becomes more dispersed or fractionalized, with a dilution of control, and the family's attachment to the organization tends to weaken. Family employees work toward above-target performance, which is independent from financial considerations and socioemotional wealth (Yu et al., 2018). Therefore, in cousin consortium firms, professional and effective governance helps to restrain unreasonable resource allocation, improve resource utilization, and encourage innovative activities. Theoretically, the richer the kinship in a family firm, the more effective the corporate governance mechanism is likely to be, which can positively moderate the relationship between family involvement and innovation performance. Thus, Hypothesis 2b is proposed as follows:

H2b. With the increased richness of the kinship of family members involved in management, the negative effect of family involvement on firm innovation will be weakened, while the positive effect will be strengthened, ceteris paribus.

3. Data and variables

3.1. Sample and data

We select family firms listed on the Chinese A-share market from 2008 to 2016 as our initial sample. Following Wang et al. (2014) and Pan et al. (2019), only firms that meet the following conditions are selected: (a) the ultimate actual controller of the firm is an individual or a family; and (b) at least one family member is involved in top management teams. Moreover, we exclude firms in the financial sector, firms in severe financial distress/undergoing bankruptcy, and firms with missing variables and details of family members. Finally, all continuous variables are winsorized at the 1% and 99% levels, resulting in a total sample of 925 family firms with a total of 3882 observations. All data are from the CNRDS database. Based on these data, family involvement in ownership and family member composition are calculated manually.

3.2. Variables

3.2.1. Family involvement

Ownership and management are the most essential features to measure family involvement (La Porta et al., 1999; Astrachan and Shanker, 2013). Therefore, we adopt family ownership, namely the percentage of shares held by family members (FI_{own}), to measure the degree of family involvement in ownership. In the robustness tests, family involvement is measured by calculating the proportion of family members involved in top management teams ($FI_{manager}$) from the perspective of involvement in management.

3.2.2. Firm innovation

It makes sense to differentiate innovation input and output as variables used to measure the innovation efficiency of family firms (Carney et al., 2019). We adopt the ratio of R&D investment to operating revenue (RD_{OR}) to measure innovation input, and the natural logarithm of the number of patent applications plus 1 (PA_{apply}) to measure innovation output. In the robustness tests, the ratio of R&D investment to total assets (RD_{AS}) and the natural logarithm of the number of patent grants plus 1 (PA_{grant}) are used as the alternative measures of innovation input and output, respectively.

3.2.3. Family member composition

Following Gersick et al. (1997), we divide family firms into three types, namely controlling ownership, sibling partnership, and cousin consortium firms, based on the kinship between the family members involved in management and the actual controller. In controlling ownership firms, only the actual controller's spouse and his, her, or their parents and/or children are involved in top management teams. In sibling partnership firms, there are new family managers who are closely related to the actual controller, such as his, her, of their siblings and/or spouses. In cousin consortium firms, the actual controller's cousins and even distant relatives are involved in management. We use a dummy variable to measure the family member composition (*Type*), where 1 indicates that the sample firm belongs to a controlling ownership, 2 indicates that the sample firm belongs to a sibling ownership, and 3 indicates that the sample firm belongs to a cousin consortium.

Table 1
Definitions of the variables.

Variables	Symbols	Variable measurement
Dependent variables		
Innovation input	RD_{OR}	The ratio of R&D investment to operating revenue
Innovation output	PA_{apply}	The natural logarithm of the number of patent applications plus 1
Independent variable		
Family involvement	FI_{own}	The percentage of shares held by family members
Moderating variable		
Family member composition	*Type*	Dummy variable equals to 1 if the sample is a controlling ownership firm, 2 if the sample is a sibling partnership firm, and 3 if the sample is a cousin consortium firm.
Control variables		
Firm size	*Size*	The natural logarithm of total assets at the end of the year
Firm age	*Age*	The year of establishment
Leverage	*Lev*	The asset-liability ratio
Profitability	*Roa*	The ratio of net profit to average total assets
Ownership concentration	Top_1	The percentage of shares held by the largest shareholder
CEO duality	*Dual*	Dummy variable equals to 1 if the CEO is also the board president and 0 otherwise
Board independence	*Inde*	The percentage of independent directors
Separation of two rights	*Sep*	The ratio of ownership to control right of the actual controller
Marketization index	*Market*	The marketization index of the registered location of sample firms

Table 2
Descriptive statistics of the full sample.

Variables	*N*	Mean	S.D.	Minimum	25%	50%	75%	Maximum
RD_{OR}	3882	0.044	0.041	0.000	0.027	0.036	0.052	0.627
PA_{apply}	3882	2.527	1.144	0.693	1.609	2.398	3.258	7.402
FI_{own}	3882	0.436	0.155	0.123	0.313	0.436	0.558	0.749
Type	3882	1.800	0.744	1.000	1.000	2.000	2.000	3.000
Size	3882	21.508	0.923	19.341	20.808	21.404	22.064	25.846
Age	3882	13.149	5.431	1.000	9.000	13.000	16.000	40.000
Lev	3882	0.319	0.183	0.008	0.167	0.299	0.446	0.861
Roa	3882	0.017	0.024	−0.059	0.005	0.011	0.021	0.252
Top_1	3882	0.361	0.129	0.042	0.261	0.353	0.449	0.738
Dual	3882	0.403	0.491	0.000	0.000	0.000	1.000	1.000
Inde	3882	0.376	0.049	0.250	0.333	0.333	0.429	0.667
Sep	3882	0.905	0.177	0.000	0.875	1.000	1.000	1.000
Market	3882	8.296	1.691	0.800	7.393	8.890	9.680	10.000

3.2.4. Control variables

To control for other effects, we include the set of standard control variables in the regression models, including firm size (*Size*), firm age (*Age*), leverage (*Lev*), profitability (*Roa*), ownership concentration (Top_1), CEO duality (*Dual*), board independence (*Inde*), separation of two rights (*Sep*), and marketization index (*Market*). We also control for year effect (*Year*), industry effect (*Industy*), and area effect (*Area*). Table 1 summarizes the definitions and the measurements of the variables used in our empirical analysis.

3.3. Empirical model

To test the hypotheses, the standard OLS regression models are carried out as follows.

$$RD_{OR}\left(PA_{apply}\right) = \alpha_0 + \alpha_1 FI_{own} + \alpha_i \sum Control + \varepsilon \quad (1)$$

Table 3
Pearson correlation coefficient analysis.

	RD_{OR}	PA_{apply}	FI_{own}	*Type*	*Size*	*Age*	*Lev*	*Roa*	Top_1	*Dual*	*Inde*	*Sep*	*Market*
RD_{OR}	1												
PA_{apply}	0.045***	1											
FI_{own}	−0.015**	−0.037**	1										
Type	−0.014	−0.064***	0.125***	1									
Size	−0.180***	0.306***	−0.198***	−0.005	1								
Age	−0.080***	0.012	−0.097***	−0.024	0.188***	1							
Lev	−0.310***	0.1506***	−0.261***	−0.024	0.545***	0.141***	1						
Roa	−0.071***	−0.012	0.135***	0.031*	−0.124***	−0.100***	−0.234***	1					
Top_1	−0.076***	0.047***	0.457***	0.004	−0.011	−0.052**	−0.045***	0.110***	1				
Dual	0.074***	0.044	0.105***	−0.012	−0.138***	−0.047***	−0.105***	0.060***	0.090***	1			
Inde	0.065***	0.054***	0.168***	−0.018	−0.005	−0.003	−0.021	−0.011	0.075***	0.152***	1		
Sep	0.098***	−0.016	−0.173***	0.0285	−0.176***	−0.051***	−0.172***	0.006	−0.134***	0.133***	0.162	1	
Market	0.037**	0.039***	0.103***	−0.001	0.103***	0.125***	0.039**	−0.027	0.038**	0.066***	0.047***	0.000	1

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

Table 4
Regression results.

	Model (1)		Model (2)	
	RD_{OR}	PA_{apply}	RD_{OR}	PA_{apply}
Constant	0.099***	−4.981***	0.066***	−3.973***
	(3.63)	(−9.26)	(3.54)	(−6.87)
FI_{own}	−0.012***	−0.322**	−0.009	−0.067**
	(−2.68)	(−2.55)	(−0.83)	(−2.39)
Type			0.022	0.144***
			(0.88)	(5.06)
FI_{own}·*Type*			−0.007	0.229***
			(−1.35)	(7.24)
Size	−0.003***	0.295***	−0.001	0.279***
	(−3.77)	(12.34)	(−0.81)	(10.68)
Age	−0.001***	−0.009**	−0.001***	−0.009**
	(−6.12)	(−2.48)	(−4.65)	(−2.44)
Lev	−0.066***	−0.115	−0.074***	−0.323**
	(−16.49)	(−0.96)	(−17.59)	(−2.54)
Roa	−0.207***	0.356	−0.228***	0.223
	(−7.94)	(0.46)	(−8.74)	(0.28)
Top_1	−0.020***	0.005***	−0.001*	0.006***
	(−4.11)	(3.34)	(−1.81)	(3.13)
Dual	0.003***	0.093**	0.003**	0.106***
	(2.81)	(2.52)	(2.03)	(2.72)
Inde	0.037***	0.137	0.041***	0.173
	(3.30)	(0.41)	(3.48)	(0.48)
Sep	0.001	0.810***	0.012**	0.096
	(0.43)	(8.17)	(2.33)	(0.68)
Market	0.004***	0.056***	0.001***	0.026**
	(6.63)	(3.35)	(3.41)	(2.36)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Area	Yes	Yes	Yes	Yes
N	3882	3882	3882	3882
Adjusted R^2	0.178	0.090	0.141	0.089

Notes: The numbers in parentheses are *t*-values. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

$$RD_{OR}(PA_{apply}) = \beta_0 + \beta_1 FI_{own} + \beta_2 Type + \beta_3 FI_{own} \cdot Type + \beta_j \sum Control + \mu \quad (2)$$

Eq. (1) tests the empirical results of family involvement and firm innovation. Eq. (2) tests the moderating effect of family member composition. RD_{OR} and PA_{apply} represent innovation input and output. FI_{own} represents family involvement. *Type* represents family member composition. *Control* represents control variables. α_i and β_j represent coefficients. ε and μ represent random error terms.

4. Empirical results

4.1. Data analysis

Data analyses are performed in two steps. The first is the calculation of descriptive statistics. Table 2 summarizes the descriptive statistics of the full samples for the main regression variables. The mean of RD_{OR} and PA_{apply} are 4.4% and 2.527, respectively. On average, 43.6% and 36.1% of shares are held by family members and the largest shareholders, 40.3% of CEOs are also board president, and 37.6% of board members are independent directors. On average, the separation degree of ownership and control is 0.905. Financial characteristics suggest that the samples have an average leverage of 31.9% and average *Roa* of 1.7%. Moreover, 1561 observations, approximately 40.22%, are controlling ownership firms; 1565 observations, approximately 40.31%, are sibling partnership firms; and 756 observations, approximately 19.47%, are cousin consortium

Table 5
Endogeneity test results I: Instrumental variables estimation.

Variables	I	II	III	IV
	FI_{own}	RD_{OR}	FI_{own}	PA_{apply}
Constant	0.145	0.074***	0.017	−4.760***
	(0.53)	(3.26)	(0.60)	(−5.37)
$FI_{own}\_IV_1$	0.032***		0.031***	
	(3.46)		(3.40)	
$FI_{own}\_IV_2$	0.909***		0.910***	
	(110.90)		(110.67)	
FI_{own}		−0.012**		−0.348**
		(−2.17)		(−2.27)
Size	−0.002	0.001	−0.002	0.285***
	(−1.49)	(0.49)	(−1.55)	(7.29)
Age	0.001***	−0.001***	0.001***	−0.006
	(4.35)	(−5.96)	(4.29)	(−1.39)
Lev	−0.010	−0.084***	−0.010	−0.114
	(−1.64)	(−12.70)	(−1.52)	(−0.78)
Roa	0.137**	−0.658***	0.145**	2.699
	(2.05)	(−7.15)	(2.19)	(1.56)
Top_1	0.001***	−0.000***	0.001***	0.005***
	(9.07)	(−3.53)	(9.04)	(2.79)
Dual	0.000	0.002	0.000	0.117**
	(0.12)	(1.49)	(0.19)	(2.58)
Inde	0.005	0.035***	0.004	0.522
	(0.30)	(2.85)	(0.28)	(1.32)
Sep	−0.000	0.003	−0.000	0.793***
	(−0.04)	(0.80)	(−0.09)	(6.54)
Market	−0.000	0.000	−0.000	0.026**
	(−0.44)	(1.05)	(−0.58)	(2.22)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Area	Yes	Yes	Yes	Yes
Weak instrumental variable test	7331.92		7292.150	
Sargan Score	1.792		0.216	
	($p = 0.181$)		($p = 0.64$)	
N	2800	2800	2800	2800
Adjusted R^2	0.925	0.162	0.925	0.075

Notes: The numbers in parentheses are *t*-values. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

firms. The next step is Pearson correlation coefficient analysis. Table 3 reveals the relationships between the main variables. The results show that most of the control variables are significantly correlated with RD_{OR} and PA_{apply}, suggesting that the control variables are effective. The maximum correlation between the control variables does not exceed 0.6 and the maximum VIF is 1.991. There is no serious problem of multicollinearity, which is considered meaningful for further analysis.

4.2. Regression results

Table 4 reports the main regression results. Model 1 tests the impact of family involvement on firm innovation. The results show that the coefficients of FI_{own} to RD_{OR} and PA_{apply} are significantly negative at the 1% and 5% level, respectively. These results suggest that increased family involvement significantly reduces both innovation input and output, which supports Hypothesis 1b. The results indicate that the decision-making of Chinese family firms is mainly based on family interests. Due to the ownership and management characteristics of family members, the ambition to secure the firm's survival leads family firms to protect socioemotional wealth and focus on a conservative strategy (Miller et al., 2011). Due to uncertain pay-offs of R&D investment, family firms make tradeoffs between socioemotional wealth loss and innovation revenue, causing a greater preference for socioemotional wealth than innovation activities (Gómez-Mejía et al., 2007; Gómez-

Table 6
Endogeneity test results II: PSM.

	RD_{OR}	PA_{apply}
Constant	0.141***	−6.219***
	(11.47)	(−14.72)
FI_{own}	−0.022***	−0.995***
	(−8.47)	(−11.43)
Size	−0.004***	0.386***
	(−6.89)	(20.02)
Age	−0.001***	−0.009***
	(−7.43)	(−2.78)
Lev	−0.063***	−0.152
	(−19.88)	(−1.41)
Roa	−0.092***	1.983***
	(−4.66)	(2.93)
Top_1	−0.000***	0.007***
	(−4.65)	(5.75)
Dual	0.002**	0.078**
	(2.38)	(2.26)
Inde	0.037***	0.812***
	(4.19)	(2.68)
Sep	−0.000**	−0.005**
	(−2.16)	(−2.55)
Market	0.001**	0.041***
	(2.49)	(3.83)
Year	Yes	Yes
Industry	Yes	Yes
Area	Yes	Yes
N	5254	5254
Adjusted R^2	0.179	0.174

Notes: The numbers in parentheses are *t*-values. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Mejía et al., 2013). Therefore, the higher the degree of family involvement, the greater the aversion to risk, leading to less innovation input and output and less innovation efficiency in family firms.

Model 2 reports the moderating effect of family member composition. The coefficient of $FI_{own}{\cdot}Type$ to RD_{OR} is negative but insignificant. However, the coefficient of $FI_{own}{\cdot}Type$ to PA_{apply} is significantly negative at the 1% level. These results show that when the richness of the kinship of family members involved in management increases, the negative impact of family involvement on patent applications is weakened. However, family member composition does not have a significant moderating effect on the relationship between family involvement and R&D investment intensity. Hypothesis 2b is partially confirmed. The family's attachment to the organization is greatest when the firm is owned and managed by the nuclear family members. This attachment tends to weaken as the firm's ownership transitions to extended family (Schulze et al., 2003a), because family influence becomes more dispersed or fractionalized, with a dilution of control. As a result, with the increased richness of the kinship of family members, firms are more willing to attempt to limit irrational behavior by placing restrictions on the employment of family members and increasingly adopting professional management practices. The efficiency of corporate governance in extended family firms is better than that in controlling ownership firms. Thus, the richness of the kinship of family members solves the conflicts between corporate interests and family interests. The extension of family involvement probably has a positive impact on innovation output. However, control concentration is highly pronounced among Chinese listed family firms (Carney et al., 2019). These controllers tend to play leading roles in the strategic decision-making process. Therefore, regardless of the degree of family involvement, decision-making power in terms of strategy, especially innovation, still belongs to a few family members (Wu, 2016), resulting in an insignificant moderating effect of family member combination on R&D investment intensity.

Table 7
Robustness test I: Alternative measure of family involvement.

Variables	Model (1)		Model (2)	
	RD_{OR}	Pa_{apply}	RD_{OR}	PA_{apply}
Constant	0.118***	−4.020***	0.077***	−2.406***
	(6.08)	(−6.94)	(3.88)	(−3.44)
FI_{manger}	−0.692***	–32.221***	−0.360	−58.525***
	(−3.18)	(−4.85)	(−0.64)	(−7.38)
Type			−0.002*	0.008
			(−1.68)	(0.16)
FI_{manger}·*Type*			0.145	0.163*
			(0.60)	(1.67)
Size	−0.004***	0.251***	−0.001***	0.212***
	(−4.51)	(9.72)	(−3.73)	(6.91)
Age	−0.001***	−0.008**	−0.001***	−0.005
	(−5.86)	(−2.19)	(−4.58)	(−1.27)
Lev	−0.066***	−0.116	−0.071***	−0.200
	(−16.48)	(−0.98)	(−17.07)	(−1.36)
Roa	−0.206***	0.480	−0.233***	−0.614
	(−7.87)	(0.62)	(−8.93)	(−0.68)
Top_1	−0.028***	0.003**	−0.028***	0.006***
	(−6.25)	(2.22)	(−4.91)	(3.08)
Dual	0.003***	0.093**	0.003**	0.093**
	(2.80)	(2.53)	(2.18)	(2.09)
Inde	0.034***	0.058	0.037***	−0.062
	(3.06)	(0.17)	(3.16)	(−0.15)
Sep	0.001	0.806***	0.003	0.225***
	(0.38)	(8.15)	(0.65)	(−3.47)
Market	0.004***	0.055***	0.001***	0.012***
	(6.52)	(3.33)	(3.34)	(3.93)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Area	Yes	Yes	Yes	Yes
N	3882	3882	3882	3882
Adjusted R^2	0.179	0.094	0.137	0.095

Notes: The numbers in parentheses are *t*-values. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

4.3. Endogeneity test

We adopt both instrumental variable estimation and propensity score matching (PSM) to solve possible endogenous problems.

4.3.1. Instrumental variable estimation

We select both the average family ownership of other sample firms in the same province and the same year ($FI_{own}\_IV_1$) and the one-year lagged family ownership ($FI_{own}\_IV_2$) as instrumental variables. The degree of family involvement is similar for firms in the same province, as shared culture has no direct relationship with innovation efficiency. Similarly, lagged family ownership relates to the degree of family involvement in ownership in this period but has no relation to innovation efficiency. Both instrumental variables are assumed to be exogenous. Table 5 reports the results of instrumental variable estimation using the two stage least squares method (2SLS). Column I and III in Table 5 are the first stage regression results of innovation input and output, respectively, showing that the coefficients of instrumental variables are both significantly positive. The exogenous original assumption of the instrumental variables is accepted by the weak instrumental variables test and the over identification test. Column II and IV in Table 5 report the second stage regression results. The coefficients of FI_{own} are both negative and significant, which are consistent with the previous conclusions.

Table 8
Robustness test II: Alternative measures of innovation.

Variables	Model (1)		Model (2)	
	RD_{AS}	PA_{grant}	RD_{AS}	PA_{grant}
Constant	0.048***	−3.960***	0.038***	−3.037***
	(5.16)	(−6.99)	(3.84)	(−4.55)
FI_{own}	−0.007***	−0.256*	−0.006	−0.230**
	(−3.04)	(−1.93)	(−1.05)	(−2.59)
Type			0.010	0.524***
			(0.77)	(4.64)
FI_{own}·*Type*			−0.002	0.241***
			(−0.80)	(7.13)
Size	−0.001***	0.236***	−0.001**	0.228***
	(−3.57)	(9.38)	(−2.57)	(7.56)
Age	−0.000***	−0.011***	−0.000***	−0.005
	(−4.49)	(−2.79)	(−3.78)	(−1.15)
Lev	−0.008***	0.108	−0.009***	−0.182
	(−3.94)	(0.86)	(−4.19)	(−1.24)
Roa	−0.013	0.170	−0.020	0.617
	(−0.97)	(0.21)	(−1.44)	(0.67)
Top_1	−0.007	0.005***	−0.000	0.006***
	(−1.099)	(2.89)	(−0.61)	(2.90)
Dual	−0.003	0.060	−0.001	0.095**
	(−1.35)	(1.56)	(−0.94)	(2.10)
Inde	−0.001	−0.010	0.009	0.037
	(−1.01)	(−0.03)	(1.49)	(0.91)
Sep	−0.000	0.823***	0.005**	0.231
	(−0.28)	(7.89)	(2.23)	(1.48)
Market	0.002***	0.058***	0.001***	0.011***
	(6.30)	(3.32)	(5.62)	(3.80)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Area	Yes	Yes	Yes	Yes
N	3882	3882	3882	3882
Adjusted R^2	0.048	0.075	0.027	0.062

Notes: The numbers in parentheses are *t*-values. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

4.3.2. PSM method

We adopt the PSM method to alleviate the potential endogeneity problem caused by the self-selection of samples. A sample of non-family firms with similar characteristics to the sample family firms is constructed under the 1:1 matching principle to compare the relationship between family involvement and firm innovation. The matching results in Table 6 suggest that the coefficients of FI_{own} are both significantly negative, indicating that increased family involvement has a negative effect on innovation input and output, which is consistent with the main findings.

4.4. Robustness tests

To assess the robustness of the findings, we conduct four robustness tests. First, following Zahra (2003) and Pan et al. (2019), we develop regression analysis by alternative measure of family involvement. From the perspective of involvement in management, the proportion of family members involved in top management teams ($FI_{manager}$) is adopted to measure the degree of family involvement in management. Table 7 shows the results. Second, following Carney et al. (2019), we conduct regression analyses for alternative measures of innovation. The ratio of R&D investment to total assets (RD_{AS}) and the natural logarithm of the number of patent grants plus 1 (PA_{grant}) are used as the alternative measures of innovation input and innovation output, respectively. Table 8 shows the results. Third, following Yan and Ye (2014), we redefine family firms. Ceteris paribus, fam-

Table 9
Robustness test III: Re-define family firms.

Variables	Model (1)		Model (2)	
	RD_{OR}	PA_{apply}	RD_{OR}	PA_{apply}
Constant	0.092***	−5.144***	0.028*	−2.319***
	(5.11)	(−9.33)	(1.76)	(−4.03)
FI_{own}	−0.012**	−0.289**	−0.010	−0.008***
	(−2.64)	(−2.05)	(−0.97)	(−2.74)
Type			−0.001	0.002**
			(−0.52)	(3.57)
FI_{own}·*Type*			0.002	0.382***
			(0.33)	(7.51)
Size	−0.003***	0.296***	−0.001***	0.204***
	(−3.35)	(12.03)	(−3.23)	(7.88)
Age	−0.001***	−0.009**	−0.000***	−0.006
	(−5.46)	(−2.47)	(−4.39)	(−1.56)
Lev	−0.066***	−0.104	−0.083***	−0.138
	(−16.31)	(−0.84)	(–23.26)	(−1.09)
Roa	−0.203***	0.280	−0.257***	−0.271
	(−7.82)	(0.35)	(−10.63)	(−0.35)
Top_1	−0.017***	0.005***	−0.010***	0.006***
	(−3.32)	(3.41)	(−3.62)	(3.48)
Dual	0.004***	0.092**	0.005***	0.090**
	(3.30)	(2.42)	(4.05)	(2.30)
Inde	0.035***	0.238	0.026**	0.027
	(3.08)	(0.68)	(2.53)	(0.77)
Sep	0.000	0.845***	0.011**	0.187**
	(0.14)	(8.27)	(2.53)	(2.62)
Market	0.004***	0.057***	0.003***	0.011***
	(6.72)	(3.34)	(7.46)	(5.50)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Area	Yes	Yes	Yes	Yes
N	3655	3655	3655	3655
Adjusted R^2	0.180	0.095	0.162	0.067

Notes: The numbers in parentheses are *t*-values. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

ily firms should meet the condition that the total family ownership is greater than 15%. The results are listed in Table 9. Forth, given the lag effect of family involvement on innovation decision-making, regressions are conducted on the lagged independent and control variables. The results are shown in Table 10. All of the results of the robustness tests are consistent with the main regression results.

4.5. Additional analysis

The Patent Law of the People's Republic of China divides patents into three categories: invention patent, utility model patent, and design patent. Unlike utility model patent and design patent, invention patent should meet the requirements of novelty, inventiveness, and practical applicability. Invention patent is associated with higher R&D costs and a longer research and development time, which can greatly enhance the core competitiveness of firms. However, family firms prefer less risky, short-term, conservative investments to risky, long-term, radical investments (Gómez-Mejía et al., 2007). Due to the high level of family involvement in family firms, the fear of socioemotional wealth loss produced by investment in invention patent may be greater than that for utility model patent and design patent. Accordingly, family involvement may have different effects on innovation strategy, resulting in different decisions concerning the types of patents for which a firm applies. We further analyze the influence of family involvement on the three types of patent applications and the moderating role of family member composition. Table 11 reports the results.

Table 10
Robustness test VI: One-year lagged independent and control variables.

Variables	Model (1)		Model (2)	
	RD_{OR}	PA_{apply}	RD_{OR}	PA_{apply}
Constant	0.010***	−4.603***	0.100***	−4.642***
	(4.50)	(−7.07)	(4.47)	(−7.03)
FI_{own}	−0.013**	−0.343**	−0.007	−0.548***
	(−2.52)	(−2.32)	(−1.12)	(−2.99)
FI_{own}·*Type*			−0.003	0.102*
			(−1.27)	(1.68)
Size	−0.003**	0.307***	−0.003**	0.297***
	(−2.54)	(10.46)	(−2.51)	(9.97)
Age	−0.001***	−0.007	−0.001***	−0.006
	(−4.90)	(−1.56)	(−4.93)	(−1.48)
Lev	−0.068***	−0.111	−0.001***	−0.144
	(−14.07)	(−0.78)	(−14.05)	(−0.98)
Roa	−0.153***	1.211	−0.152***	2.597
	(−4.76)	(1.28)	(−4.71)	(1.43)
Top_1	−0.024***	0.005***	−0.000***	0.005***
	(−4.03)	(2.64)	(−4.10)	(2.79)
Dual	0.003**	0.104**	0.004**	0.093**
	(2.25)	(2.37)	(2.21)	(2.15)
Inde	0.040***	0.288	0.040***	0.212
	(2.91)	(0.71)	(2.88)	(0.54)
Sep	0.004	0.414***	0.004	0.771***
	(1.01)	(3.59)	(1.01)	(6.71)
Market	0.003***	0.042**	0.003***	0.035*
	(4.51)	(2.10)	(4.50)	(1.78)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Area	Yes	Yes	Yes	Yes
N	2801	2801	2801	2801
Adjusted R^2	0.170	0.077	0.170	0.089

Notes: The numbers in parentheses are *t*-values. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Model 1 in Table 11 shows the results of tests of the impacts of family involvement on three types of patent applications. The results show that there is a significantly negative relationship between family involvement and invention patent applications (INV_{apply}). However, the effects on utility model patent (APP_{apply}) and design patent applications (DES_{apply}) are statistically insignificant. In other words, the negative effect of family involvement on innovation output mainly contributes to the reduction of invention patent applications. Invention patent has the most risks and uncertain pay-offs at the cost of socioemotional wealth loss. Family members are likely to implement conservative strategies and pursue the interests of the family. As such, family involvement in firms leads to the increased rejection of invention patent. Therefore, the negative effect of family involvement on invention patent applications is significant. In addition, the risks of utility model patent and design patent are not as great as those of invention patent. As such, family involvement has insignificant effects on utility model patent and design patent applications.

Model 2 in Table 11 shows the results of tests of the moderating effect of family member composition. For the regression results for invention patents, the coefficient of the interaction is positive and significant at the 1% level, indicating that the negative effects of family involvement on invention patent applications are weakened when the kinship of family member composition is richer. These results further suggest that the increased richness of kinship leads to improved corporate governance efficiency and more rational innovation decisions, which is beneficial for family firms in achieving business objectives.

Table 11
Additional analysis.

Variables	Model (1)			Model (2)		
	INV_{apply}	APP_{apply}	DES_{apply}	INV_{apply}	APP_{apply}	DES_{apply}
Constant	−7.082***	−3.809***	−1.814***	−7.355***	−4.901***	−2.755***
	(−13.31)	(−6.35)	(−3.48)	(−11.67)	(−7.23)	(−4.56)
FI_{own}	−0.548***	−0.023	0.024	−0.526***	−0.026	−0.349
	(−4.38)	(−0.17)	(0.19)	(−2.99)	(−0.65)	(−1.47)
Type				0.054***	−0.835	0.537***
				(3.41)	(0.91)	(2.94)
FI_{own}·*Type*				0.190***	0.225	0.059
				(3.66)	(1.13)	(0.93)
Size	0.377***	0.179***	0.113***	0.385***	0.265***	0.135***
	(15.93)	(6.71)	(4.88)	(13.50)	(8.90)	(4.83)
Age	−0.004	−0.011***	−0.004	−0.002	−0.004	−0.002
	(−1.00)	(−2.79)	(−1.19)	(−0.49)	(−0.81)	(−0.48)
Lev	−0.458***	0.557***	−0.374***	−0.562***	0.422***	−0.305**
	(−3.87)	(4.17)	(−3.22)	(−3.97)	(2.90)	(−2.07)
Roa	1.097	−0.983	0.069	−0.146	−1.538	−0.328
	(1.43)	(−1.13)	(0.09)	(−0.17)	(−1.62)	(−0.37)
Top_1	0.004***	0.004**	0.002	0.005***	0.007***	0.003
	(3.00)	(2.49)	(1.32)	(3.11)	(3.32)	(1.38)
Dual	0.104***	0.066	0.181***	0.108***	0.107**	0.220***
	(2.85)	(1.61)	(5.08)	(3.97)	(2.24)	(4.90)
Inde	0.058	0.031	−0.076	0.125	−0.018	−0.130
	(0.17)	(0.08)	(−0.23)	(0.36)	(−0.04)	(−0.84)
Sep	0.467***	0.741***	0.278***	0.244*	0.314*	0.749*
	(4.76)	(6.70)	(2.89)	(1.69)	(1.98)	(1.75)
Market	0.058***	0.060***	0.024	0.044***	0.023	0.012
	(3.52)	(3.23)	(1.49)	(3.43)	(1.58)	(0.93)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Area	Yes	Yes	Yes	Yes	Yes	Yes
N	3882	3882	3882	3882	3882	3882
Adjusted R^2	0.101	0.065	0.033	0.102	0.063	0.032

Notes: INV_{apply}, APP_{apply}, and DES_{apply} represent the number of patent applications for invention, utility model and design, respectively. The numbers in parentheses are *t*-values. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

5. Discussion and conclusion

Using data of Chinese listed family firms from 2008 to 2016, we focus on whether and how family involvement impacts firm innovation and the moderating effect of family member composition. First, a noteworthy finding is that family involvement has negative effects on innovation efficiency, leading to the reduction of innovation input and output. Second, the diversification of kinship involved in management yields a high level of governance efficiency. The negative effect of family involvement on innovation output is weakened when the kinship of family member composition is richer. Third, the negative effect of family involvement on innovation output mainly contributes to the reduction of invention patent applications, whereas the adverse effects gradually weaken as the kinship of family members involved in management becomes richer. The findings are robust regarding endogeneity problems, alternative measures of variables, alternative definition of family firms, and one-year lagged independent and control variables. In summary, family firms prefer family interest to corporate interest, meaning that they do not maximize firm value but rather attempt to realize non-economic goals such as socioemotional wealth. These findings suggest that to ensure long-term survival, the actual controllers of family firms should establish the idea of a firm-centered standard instead of a family-centered standard, avoid the typical preference for short-term and irrational behavior, and optimize the governance structure.

The contributions of our study to the current family firm literature may be summarized as follows. First, our study highlights the differences among family firms. Although the importance of innovation has been well recognized in the family firm literature, most of the current research focuses on differences between family firms and non-family firms and regards family members as highly homogeneous. Our study provides empirical evidence for the kinship between family members and the actual controllers, thus enhancing our knowledge of the relationship between family involvement and innovation efficiency. Second, our study examines Chinese listed family firms, which provide a unique context to further test the influence of family involvement on innovation. In terms of the Chinese unique patent system, we further examine the family's influence on each category of innovation output, even strategy, which provides additional empirical evidence of and new perspectives on family firm innovation and enriches the existing literature. Third, our study has practical significance for research on the innovation effects of family involvement, and provides important evidence to further promote governance efficiency, maintain long-term competitiveness, and realize the sustainable development of family firms.

Aside from its contributions, our study has several limitations that represent opportunities for future research. First, each family member composition includes various forms of kinship. The diversity of kinship of family members and its influence on the results of the innovation process is only partially addressed in the literature. Further research is needed to study in detail and explore how various relatives interact and distribute their roles with respect to innovation. Second, family involvement is not only in ownership and management, but also in other dimensions, such as family spirite and intergenerational inheritance (Yang and Li, 2009). Further research should measure the family's influence on these different aspects.

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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Does overcapacity prompt controlling shareholders to play a propping role for listed companies?

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ABSTRACT

A major risk currently facing the Chinese economy is overcapacity, which affects the efficiency of social resource allocation (Xi et al., 2017; Huang et al., 2019). When a company is in crisis, the internal capital market often plays a propping role. This study approached this issue from the perspective of the controlling shareholder and examined whether controlling shareholders provide financial support to enterprises in industries with excess capacity. According to the data for China's A-share listed companies from 2007 to 2019, companies in industries with excess capacity received more financial support from controlling shareholders compared with those in non-overcapacity industries. Analysis of the mechanism revealed that state-owned enterprises and companies with relatively poor financial status received more financial support from controlling shareholders. This study also examined the economic consequences of such support and found that it is conducive to enhancing enterprise value. This study enriches the literature on overcapacity and internal capital markets by demonstrating that internal capital markets play a propping role for companies facing industry-level crises. This finding has both theoretical value and practical implications related to supply-side reform and capacity reduction.

1. Introduction

Along with local government debt and real estate bubbles, overcapacity is one of the three major risks facing China's economy (Zhang and Jiang, 2017). Overcapacity affects the efficiency of social resource allocation (Xi et al., 2017; Huang et al., 2019) and is essentially a problem of structural imbalance; that is, a mismatch

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between supply and demand. This has become an important factor hindering China's economic development. To address overcapacity and the related economic problems, the government has put forward a supply-side reform proposal; the reforms would start from the production and supply side, with the goal of improving the quality of supply (and hence the quality of economic development) through structural adjustments.

In addition to attracting the attention of the market and government, the problem of overcapacity has long been of interest to academics. The literature mainly focuses on the calculation of overcapacity (Yu et al., 2018; Zhang and Jiang; 2017; Han et al., 2011), its causes (Ma et al., 2018; Xi et al., 2017; Bai, 2016; Guo, 2016; Shen et al. 2012; Jiang et al. 2012; Lin et al. 2010; Zhou and Sheng, 2007; Liu, 2006), and countermeasures (Xu and Zhou, 2015). How to deal with the market risks of overcapacity is an urgent issue for companies, yet there have been few in-depth investigations of this problem in the literature. Wang and Bai (2017) found that companies can expand into overseas markets to deal with overcapacity in their industry. However, there are many obstacles to overseas expansion, including technical barriers, institutional barriers, and institutional distance. In particular, heightened tensions in the global economy since the subprime mortgage crisis have led to greater competition among regional economies. As a result, companies face dual risks: domestic operating risks caused by sluggish domestic demand and uncertainties in overseas investment.

Against a backdrop of heightened risks in both the domestic and overseas markets, how can companies deal with the impact of industry overcapacity on business activities? We investigated this issue from the perspective of internal capital markets. According to the literature, internal capital markets often play a propping role for companies in crisis. Listed companies facing financial difficulties or that need refinancing receive support from major shareholders in the form of related-party transactions (Jian and Wong, 2010; Jia et al., 2013). In their examination of Indian business groups, Gopalan et al. (2007) found that member companies in financial crisis are often rescued by the group. Business groups use internal fund transfers to support poorly performing member companies to avoid default problems. During crises, large shareholders often have a strong sense of stewardship; the higher their shareholding ratio, the stronger their stewardship function is (Lian et al., 2012). Controlling shareholders can help ease financing constraints on listed companies by providing financial support, particularly during a company's growth phase or during the recovery period after a recession (Tan et al., 2018).

Research on the propping role of the internal capital market has mainly focused on corporate-level crises and macro-financial crises. When a company faces an industry-level crisis, does the internal capital market still exert a propping effect? This study approached this question by considering overcapacity as the institutional background. According to data on China's A-share listed companies from 2007 to 2019, enterprises in industries with excess capacity received more financial support from controlling shareholders compared with those in non-overcapacity industries. Further analysis showed that such support from controlling shareholders mainly occurred in state-owned enterprises. In addition, enterprises with relatively poor financial status received more financial support. This study also found that such support is conducive to enhancing enterprise value.

This study makes two major contributions. First, it enriches the literature on overcapacity. Most studies on overcapacity have focused on its calculation (Yu et al., 2018; Zhang and Jiang, 2017; Han et al., 2011), its underlying causes (Ma et al., 2018; Xi et al., 2017; Bai, 2016; Guo, 2016; Shen et al., 2012; Jiang et al., 2012; Lin et al., 2010; Zhou and Sheng, 2007; Liu, 2006), and related characteristics and risks (Policy Research Group of the Development Research Center of the State Council, 2015). Less attention has been paid to the economic consequences of overcapacity (Xu and Zhou, 2015; Wang and Bai, 2017), especially its impact on corporate behavior. By examining overcapacity from the perspective of internal capital market operations, this paper broadens the understanding of the economic consequences of overcapacity.

Second, this article enriches the literature on the internal capital market. Related studies have mainly focused on the efficiency of internal capital markets (Stein, 1997) and the tunneling behavior of controlling shareholders (Johnson et al., 2000). Most have adopted the perspective of corporate governance, exploring how corporate governance factors affect internal capital. Few studies have examined the operation of the internal capital market from the perspective of the external environment. Regarding the propping role of the internal capital market in crisis situations, the literature has mainly examined the Asian financial crisis (Almeida et al., 2015) and the European sovereign debt crisis (Raffaele et al., 2020). This article deepens

the understanding of the propping role of the internal capital market by exploring the issue from the perspective of overcapacity.

The remainder of this article is organized as follows. Section 2 summarizes the institutional background, and Section 3 presents the literature review and theoretical hypotheses. Section 4 describes the research design. Section 5 presents the empirical results, and further analysis of the mechanism is presented in Section 6. Section 7 concludes the article.

2. Background

2.1. Overcapacity

The Chinese economy is currently in a period of transition, and one of the key factors hindering its development is the imbalance of the economic structure. The imbalance is mainly a consequence of excess low-end production capacity. Along with local government debt and real estate bubbles, overcapacity is one of the three major risks facing China's economy (Zhang and Jiang, 2017). Overcapacity, which affects the efficiency of social resource allocation (Xi et al., 2017), was believed by the earliest scholars to refer to the excess capacity that still exists during a period of maximum demand (Bain, 1962). Now, Chinese scholars generally understand overcapacity to refer to excess production capacity or the under-utilization of existing capacity (Zhou and Sheng, 2007). Full utilization of production capacity/equipment does not necessarily mean a 100% utilization rate; for an industry to be in overcapacity, its utilization rate only has to be lower than optimal after considering technical characteristics and demand conditions.

In the United States and Europe, capacity utilization rates are typically between 79% and 83% under normal (i.e., non-excess capacity) conditions. If the rate is more than 90%, capacity is considered to be insufficient, and the overloading of production equipment can occur. If the rate is lower than 79%, there may be overcapacity (Han et al., 2011). In China, the industries facing overcapacity mainly include ferrous metals, nonferrous metals, petrochemical coking, chemical raw materials, non-metallic mineral products, and chemical fibers and paper products (Han et al., 2011).

Regarding the causes of overcapacity, there are generally two views, the first being the market mechanism theory (Lin et al., 2007; Zhou and Sheng, 2007; Lin et al., 2010; Jiang et al., 2012; Policy Research Group of the Development Research Center of the State Council, 2015). When the economy transitions from prosperity to recession, total social demand shrinks, but the withdrawal of production capacity occurs with a time lag. As a result, investment demand growth is stronger than the withdrawal of production capacity caused by shrinking demand, leading to a state of excess production capacity. The other view is the government promotion theory. Under this view, overcapacity has accompanied China's economic transition in large part because of the unreasonable investment system and the government's strong will to participate in industrial investment (Zhou and Sheng, 2007; Geng et al., 2011; Jiang et al., 2012; Wang et al., 2014; Yu and Lv, 2015), along with other factors (e.g., financial convenience, sunk costs, enterprise size, and employment flexibility) also playing a role (Ma et al., 2018).

To address overcapacity and other economic problems, the Chinese government has put forward a proposal for supply-side reforms. The structural imbalance between supply and demand has become the biggest roadblock to the continued growth of China's economy and, as such, cannot be ignored. On one hand, excess capacity is a major burden restricting China's economic transformation. On the other hand, the supply system in China is incompatible with the demand side. Generally, there is a surplus of low-end products and an insufficient supply of high-end products. In addition, China's supply side is inefficient and cannot meet demand. In this regard, the government has proposed a major macro-control policy for supply-side reforms; the reforms would start from the production and supply side, with the goal of improving the quality of supply (and hence the quality of economic development) through structural adjustments.

2.2. Financial support

According to the *Shanghai Stock Exchange Information Disclosure Announcement Category Registration Guidelines*, financial support generally refers to an entity directly or indirectly providing its own monetary

funds or other forms of assets to other entities in a certain manner or under certain conditions. The usage fee charged is lower than the industry average. This behavior is not directly related to daily production and business activities, including borrowing or entrusting loans, providing labor services or the right to use assets, and assuming expenses.

The provision of external financial support by listed companies is a strictly regulated behavior. The *Guidelines for Standardized Operation of the Shenzhen Stock Exchange* clearly stipulate that listed companies shall not provide financial support to related parties such as directors, supervisors, senior managers, controlling shareholders, actual controllers, and their controlled subsidiaries. Furthermore, the *Company Law of the People's Republic of China* stipulates that companies shall not directly or through subsidiaries provide loans to directors, supervisors, and senior managers. In addition, under the *Notice on Regulating Funds Exchanges between Listed Companies and Related Parties and Several Issues Concerning External Guarantees of Listed Companies*, listed companies shall not directly or indirectly provide funds to controlling shareholders and other related parties. The *Administrative Measures for Equity Incentives* stipulates that listed companies shall not provide loans or any other forms of financial support for incentive objects to obtain relevant rights and interests in accordance with the equity incentive plan, including providing guarantees for their loans.

Accordingly, listed companies must strictly abide by all relevant regulations when providing financial support. When a listed company provides external financial support, it must sign an agreement with the funding target and other relevant parties, stipulating conditions, the amount of financial support, the time limit, and the liability for breach of contract. The Shenzhen Stock Exchange requires that more than two-thirds of the directors present at the board meeting agree and pass resolutions to provide financial support to external parties, and they are required to meet information disclosure obligations in a timely manner. When a board of directors deliberates on financial support matters, independent directors and sponsors (if any) are required to express independent opinions on the legality and compliance of the matters, the impact on the company, and the risks. A review by the general meeting of shareholders is required if certain conditions are met: (1) the most recent audited asset-liability ratio of the funded objects exceeded 70%; (2) the amount of financial support or the cumulative amount of financial aid provided for 12 consecutive months exceeds 10% of the company's most recent audited net assets; and (3) other circumstances stipulated by the exchange or the company's articles of association.

However, regulatory authorities do not impose equally stringent restrictions on listed companies' acceptance of financial support. Rather, they have adopted a supportive stance in terms of the approval process and interest expenses. Under the regulations, a listed company's acceptance of financial support from related parties may be exempt from submission to the general meeting of shareholders for deliberation, but the company must promptly disclose and fully explain the reasons for the gratuitous provision and whether there are other agreement arrangements. According to the *Shanghai Stock Exchange Implementation Guidelines for Related Transactions of Listed Companies*, the interest rate applied to financial support from related parties cannot be higher than the benchmark lending rate for the same period set by the People's Bank of China, and the listed company may apply to the exchange for exemption from review and disclosure when there is no corresponding mortgage or guarantee for the funding.

Thus, financial support can include not only support provided by listed companies to external parties but also aid received by listed companies from stakeholders. This study examined controlling shareholders' funding behaviors toward listed companies from the perspective of the controlling shareholder. Financial support from controlling shareholders is one method of resource allocation in the internal capital market, and it has no direct relationship with the normal business activities of the enterprise.

3. Literature review and theoretical hypotheses

3.1. Literature review

3.1.1. Overcapacity

Studies on overcapacity have mainly focused on its calculation (Yu et al., 2018; Zhang and Jiang, 2017; Han et al., 2011), reasons for its formation (Ma et al., 2018; Xi et al., 2017; Bai, 2016; Guo, 2016; Shen et al., 2012; Jiang et al., 2012; Lin et al., 2010; Zhou and Sheng, 2007; Liu, 2006), related characteristics

and risks (Policy Research Group of the Development Research Center of the State Council, 2015), and countermeasures (Xu and Zhou, 2015). Less attention has been paid to the economic consequences of overcapacity, especially its impact on corporate behavior.

For the calculation of overcapacity, the key to distinguishing between an appropriate level of idle capacity and overcapacity lies in the identification of reasonable limits. In the literature, there is no unified standard for this so-called reasonable limit. Europe and the United States generally use capacity utilization as the main indicator of overcapacity. The capacity/equipment utilization rate is the direct response of the manufacturer to the degree of utilization of input factors; if the value of this indicator is large, the utilization degree of input elements is high. Otherwise, some elements are idle, or management coordination of the production chain has not reached the optimal level. In Europe and the United States, equipment utilization rates are generally between 79% and 83% under normal circumstances. A rate higher than 90% could be an indicator of insufficient production capacity/overdrawn equipment, whereas a rate lower than 79% could indicate overcapacity (Han et al., 2011). Currently, the main methods of calculating capacity utilization are peak to peak, minimum cost analysis, data envelopment analysis, and production capacity utilization (Han et al., 2011; Zhang and Jiang, 2017).

The causes of overcapacity include market and non-market factors. Lin et al. (2010) proposed a micro-theoretical basis of the surge phenomenon and analyzed the formation mechanism of overcapacity from the perspective of enterprise investment decision-making. The authors argued that, due to incomplete information about an industry at the time of investment (especially regarding the total number of enterprises in the industry), a positive consensus view on the industry's growth prospects will trigger a large amount of social investment concentrated on the relevant industry, leading to overcapacity problems. If the consensus view strengthens or if the industry's growth outlook improves further, more corporate and social investments will flow into the industry, exacerbating the problem of overcapacity.

Under the current decentralized system, promotion incentives provide local government officials a very strong motivation to promote the rapid development of the local economy (Zhou, 2004). Against this backdrop, economic efficiency is not the primary concern. In China, local governments are mainly accountable to the upper (not lower) echelons; driven by yardstick competition for positive assessments by higher-level governments, they inevitably introduce various investment promotion policies and methods to attract investment. This leads to some degree of vicious investment competition, which increases domestic production capacity and ultimately results in overcapacity in the national market. Indeed, local governments' promotion of investments in major industries is the root cause of overcapacity (Jiang et al., 2012; Wang et al., 2014; Yu and Lv, 2015). Besides the government's will to grow the economy, another cause of overcapacity is the rent-seeking behavior of local governments. When rent-seeking behavior is added to the decision model, the optimal output decision of an enterprise decreases (He, 2006). Rent-seeking behavior causes the actual production capacity of a company to be lower than the designed production capacity, and the greater the weight of rent-seeking, the more serious the under-utilization of capacity.

Regarding the impact of overcapacity on enterprises, Wang and Bai (2017) found that institutional overcapacity drives enterprises to invest directly. The rationale is that, because overcapacity is due to oversupply on one hand and weak domestic demand on the other, expanding the market helps digest excess capacity. More attention needs to be paid to the other effects of overcapacity on corporate behavior. Among the questions in need of investigation is how companies facing overcapacity crises can improve their risk resilience. Although this can be a life or death question for enterprises in industries with excess capacity, it has not yet been answered in the literature. This study approaches this question from the perspective of controlling shareholders' financial support. Can a company in an industry facing overcapacity receive support from the internal capital market, and if so, what is the mechanism of action?

3.1.2. Internal capital markets

Internal capital markets have three types of positive effects. First, they have the advantage of information symmetry, which is conducive to reducing group financing costs and thus promoting group financing efficiency. Second, by selecting winners, internal capital markets help optimize the overall efficiency of business groups' resource allocation. Third, when a member company is in financial distress, the group's internal

capital market exerts a propping effect through cross-subsidies. This not only helps resolve crises facing member companies but also helps prevent local crises from spreading to the group level.

(1) Reducing information asymmetry and financing costs

The information asymmetry between enterprises and the external capital market is the root cause of internal capital markets (Richardson, 1960; Alchian, 1969; Williamson, 1975). Internal capital markets not only can reduce information asymmetry and transaction costs through internalization but also have an important role in concentrating funds and improving the overall financing environment of enterprises.

The effectiveness of internal capital markets has been proven by a large body of literature (Stiglitz and Weiss, 1981; Myers and Majluf, 1984; Greenwald et al., 1984; La Porta et al., 1998). In the presence of an incomplete external market, internal markets in business groups can replace missing parts of the external market, thereby increasing the value of enterprises (Leff, 1978; Khanna and Palepu, 2000). The established relationships between parties lead to lower information asymmetry and higher trust, which is helpful in reducing transaction costs (Jian and Wong, 2010). Gertner et al. (1994) pointed out that centralized financing arrangements and asset resetting by corporate headquarters have regulatory and information advantages and are more efficient (and involve less friction) than bank financing arrangements.

In emerging economies, there tends to be more serious information asymmetry between companies and capital providers (and higher transaction costs for companies) because of the lack of investor protection measures, the smaller number of financial intermediaries, and flaws in information disclosure. This leads to friction in the capital market. Bank financing tends to be inefficient and hard to secure, and it is more difficult for companies to obtain equity financing from the capital market. The high cost of obtaining external funds in emerging economies puts financing constraints on companies (Stiglitz and Weiss, 1981; Myers and Majluf, 1984; Greenwald et al., 1984; La Porta et al., 1998), which explains the large number of enterprise groups and widespread use of internal capital markets in such countries. By allocating capital among subsidiaries, internal capital markets bring economic benefits to enterprise groups (Wang and Zou, 2009).

(2) Improving the efficiency of group resource allocation through winner-picking

Corporate headquarters can secure more external funding sources through their centralized financing advantage and also engage in winner-picking by allocating funds to member companies with greater investment opportunities or by transferring funds from low-yield to high-yield projects. The analytical model of Stein (1997) showed that the internal capital market has both a more money effect and a smarter money effect; that is, corporate headquarters can not only secure more external funding sources due to their centralization advantage, but also engage in winner-picking activities to improve the efficiency of capital allocation.

(3) Resolving business crises of member companies through cross-subsidies

Friedman et al. (2003) argued that controlling shareholders do not always hollow out companies through tunneling; rather, they can also prop up companies. A listed company in financial distress or in need of financing can receive support from major shareholders in the form of related-party transactions (Jian and Wong, 2010; Jia et al., 2013). In their examination of Indian business groups, Gopalan et al. (2007) found that member companies in financial crisis can often be rescued by the group. Business groups use internal fund transfers to support poorly performing member companies to avoid default problems. During crises, large shareholders often have a strong sense of stewardship; the higher their shareholding ratio, the stronger their stewardship function is (Lian et al., 2012). Controlling shareholders can help ease financing constraints on listed companies by providing financial support, particularly during a company's growth phase or during the recovery period after a recession (Tan et al., 2018). Riyanto and Toolsema (2008) argued that controlling shareholders' support for a company represents an insurance mechanism for minority shareholders, and it is precisely because of this insurance mechanism that minority shareholders are willing to invest in the company.

When the crisis facing a company is not from within but rather from the external environment, such as industry overcapacity, does the internal capital market still play a propping role? If so, what is the mechanism?

This study empirically investigates these questions to identify the mechanism of controlling shareholders' propping actions.

3.2. Theoretical hypothesis

3.2.1. Overcapacity and financial support from controlling shareholders

The intuition behind this article is that, when an industry faces an overcapacity crisis, companies in that industry will receive support from controlling shareholders to help them weather the crisis. The rationale is as follows.

First, overcapacity exposes companies to higher operating risks. On one hand, market demand is lower than industry supply, which leads to more intense market competition and worsens the external operating environment of enterprises. On the other hand, oversupply causes product prices to fall and corporate profitability to be impaired, hurting business performance. Under the guidance of supply-side reforms, enterprises in industries facing overcapacity are subject to macro-control and industrial policies (e.g., the removal of excess capacity). At the same time, industries with excess capacity are undergoing restructuring, and merger and acquisition activities are high. Against this backdrop, companies can face severe competition. When an industry faces an overcapacity crisis, companies operating in that industry face a series of risks, such as poor sales, inventory backlogs, rising costs, and falling product prices. With fierce industry competition posing a serious threat to their operation and survival, listed companies need to seek financial support from controlling shareholders.

Second, controlling shareholders have natural attributes that lead to their provision of support to companies in crisis. The propping role of internal capital markets has been demonstrated by many studies (Gopalan et al., 2007; Lian et al., 2012; Almeida et al., 2015; Tan et al., 2018; Raffaele et al., 2020). When a company was trapped in industrial level crisis, business risk may stimulate the stewardship consciousness of large shareholders. This kind of consciousness is not only from the listed company, but also from the overall interest of the group. If the listed company could not survive from the crisis, the group would be negatively affected. This will damage the controlling shareholder's return. Financial support may help companies stop losses and benefit large shareholders in the longer term.

Third, the special status of listed companies makes support from internal capital markets a necessity. In the Chinese capital market, enterprise groups include both listed companies and nonlisted companies. Listed companies often have a pivotal position in business groups, being not only important financing platforms but also signboards of the group. Compared with nonlisted companies, listed companies often attract very high market attention; operating performances are keenly watched by small and medium shareholders, regulatory authorities, the media, and competitors. In addition, under the share issuance approval system, it is not easy for companies to qualify for listing. According to Gopalan et al. (2007), local risks facing a member company can easily escalate to the group level; for example, bankruptcy risks can spread from one member company to other member companies. Once a risk occurs, it may spread much more quickly among listed companies than among nonlisted companies. Therefore, in view of the special market position of listed companies and their risk aversion motive, controlling shareholders are likely to come to their aid. Therefore, we propose the following hypothesis.

H1. Compared with non-overcapacity industries, controlling shareholders provide more financial support to listed companies in industries facing overcapacity.

3.2.2. Nature of property rights, overcapacity, and financial support

Government intervention is an important cause of overcapacity (Geng et al., 2011; Jiang et al., 2012; Wang et al., 2014; Yu and Lv, 2015). Under the dual pressures of local economic competition and promotional activities of local officials, local governments tend to attract unlimited investments during periods of economic expansion. Such an unreasonable investment system, combined with the government's strong will to participate in industrial investment, leads to blind expansion of capacity. At a certain point, vicious investment competition leads to a continued increase in accumulated domestic production capacity and causes overcapacity in the national market (Zhou and Sheng, 2007; Zhang et al., 2010). For this reason, it is reasonable to assume

that state-owned enterprises may be more seriously affected by overcapacity than non-state-owned enterprises in the same industry. In addition, under the influence of supply-side reforms, state-owned enterprises have a stronger motivation to cooperate with macro adjustment measures. This drive is also because of the dual considerations of local competition and the promotional activities of officials. State-owned enterprises not only face more serious overcapacity problems but are under more pressure to reduce production capacity. Thus, compared with non-state-owned enterprises, state-owned enterprises are more likely to receive financial support from controlling shareholders. Therefore, we propose the following hypothesis.

H2. Compared with non-state-owned enterprises, state-owned enterprises in the same overcapacity industry receive more financial support from controlling shareholders.

3.2.3. Financial status, overcapacity, and financial support

Regardless of the reason for the formation of overcapacity, the external operating risks faced by enterprises in the same overcapacity industry are similar. External operating risks become internalized, having a negative impact on the financial status of enterprises. This forms the basis for controlling shareholders' decision to provide financial support. When an industry faces a crisis of overcapacity, companies operating in that industry also face a series of risks, such as poor sales, inventory backlogs, rising costs, and falling product prices. In addition, they may also face industry restructuring risks (e.g., mergers and acquisitions). With the cleanup of low-end production capacity, some companies will inevitably withdraw from the market because of the normal functioning of the survival-of-the-fittest mechanism. When the market exit risk increases, industry competition further intensifies. Studies have found that companies facing fierce market competition have stronger incentives to increase cash holdings, such as by obtaining commercial credit support (Chen, 2017; Wu et al., 2017) and seeking government subsidies (Kong et al., 2013). In view of this, controlling shareholders are more likely to provide financial support.

However, this raises an important question: in industries facing overcapacity, do controlling shareholders support companies with a higher exit risk or those with a lower exit risk? Answering this question requires us to return to the two main principles of resource allocation in internal capital markets. In the operation of internal capital markets, resources may be allocated to more efficient or less efficient departments. The former approach is called winner-picking. In winner-picking, corporate headquarters transfer funds from low-yield projects to high-yield projects, thereby improving the efficiency of capital allocation at the group level (Stein, 1997). The latter approach is an example of a cross-subsidy; under this method, enterprise groups use internal fund transfers to support poorly performing member companies to avoid default problems and prevent local risks from escalating into group risks.

When considering listed companies, it is reasonable to assume that controlling shareholders will provide more funding to companies with poor financial status. The rationale is that listed companies are a group of market winners that have been rigorously screened by the market. Although the quality of listed companies varies, their overall quality in the entire market is higher than the market average. Therefore, controlling shareholders may provide more financial support to listed companies with poor financial status. Based on this, we propose the following hypothesis.

H3. Controlling shareholders provide more financial support to companies in industries facing overcapacity when those companies have poor financial status.

3.2.4. Economic consequences of financial support from controlling shareholders

It seems that companies capable of withstanding overcapacity risks have a higher probability of increasing their corporate value. First, the survival-of-the-fittest mechanism created by overcapacity will gradually clear out relatively weak companies, leading to fewer competitors. Second, companies that demonstrate an ability to survive under such conditions are likely to have strong capabilities in general, with strong management and resilience. In addition, after enduring overcapacity and market restructuring, the industry in question may have better overall efficiency. Therefore, we propose the following hypothesis.

H4. When controlling shareholders provide financial assistance to listed companies operating in an industry with excess capacity, the assistance is conducive to enhancing the companies' corporate value.

4. Research design

4.1. Data and samples

Using the data of A-share listed companies from 2007 to 2019, an initial sample of 34,400 observations was obtained. The sample was then screened by deleting 688 observations from the financial industry and 2490 observations with missing data. In the empirical process, the dependent variable lags by one period. In the end, 27,180 company annual observations were obtained. All of the continuous variables were winsorized at the 1% levels.

All financial data were obtained from the China Stock Market & Accounting Research (CSMAR) and Wind databases.

4.2. Models and variables

To test H1, the following multivariate empirical analysis model (1) was established.

$$Prop_{i,t+1} = \beta_0 + \beta_1 Overcap_{i,t} + \sum Control_{i,t} + \varepsilon_{i,t} \quad (1)$$

The explained variable is the financial support from controlling shareholders ($Prop_{i,t+1}$).

Prop = (other payable to controlling shareholders + long-term payable to controlling shareholders) / total assets at the end of the period * 100%

In a robustness analysis, the short-term funding ($Sh\_Prop_{i,t+1}$) and net funding ($Net\_Prop_{i,t+1}$) of controlling shareholders were used.

Sh_Prop = other payable to controlling shareholders / total assets at the end of the period * 100%

Net_Prop = (other payable to controlling shareholders + long-term payable to controlling shareholders − other receivable from controlling shareholders − long-term receivable from controlling shareholders) / total assets at the end of the period * 100%

The explanatory variable is overcapacity ($Overcap_{i,t}$). Following Xi et al. (2017), the following overcapacity industries were identified: ferrous metals, non-ferrous metals, petrochemical coking, chemical raw materials, mineral products, chemical fibers and paper products, coal mining and washing, ferrous metal mining and processing, oil and natural gas extraction, non-metallic mining, non-ferrous metal mining, electric power, and heat production and supply. A dummy variable was used to identify whether a company operates in one of these overcapacity industries: if so, it was assigned a value of 1 and 0 otherwise.

In the empirical analysis model, this study controlled companies' financial characteristics, major shareholder characteristics, and corporate governance characteristics, including the nature of property rights ($Soe_{i,t}$), company size ($Size_{i,t}$), profitability ($Roe_{i,t}$), asset-liability ratio ($Lev_{i,t}$), cash flow level ($Cash_{i,t}$), enterprise age ($Age_{i,t}$), market to book ratio ($MB_{i,t}$), power of major shareholders ($Top1_{i,t}$), management power ($Dual_{i,t}$), international "big four" auditor ($Big4_{i,t}$), board governance ($Board_{i,t}$), proportion of independent directors ($Independ_{i,t}$), equity checks and balances ($Balance_{i,t}$), year fixed effects ($Year_{i,t}$), and industry fixed effects ($Industry_{i,t}$). The variable definitions and calculation processes are shown in Table 1.

If H1 is true, then β_1 should be positive. To eliminate possible heteroscedasticity problems, we conducted a robustness analysis, and time series dependence was corrected by company-level clustering.

Table 1
Variable definitions.

Variable	Abbreviation	Definition
Explained variable	*Prop*	(Other payable to controlling shareholders + long-term payable to controlling shareholders) / total assets at the end of the period *100%
	Net_Prop	(Other payable to controlling shareholders + long-term payable to controlling shareholders − other receivable from controlling shareholders − long-term receivable from controlling shareholders) / total assets at the end of the period * 100%
	Sh_Prop	Other payable to controlling shareholders / total assets at the end of the period * 100%
Explanatory variable	*Overcap*	Dummy variable; if the company is in an overcapacity industry, assign a value of 1, otherwise 0
Other variables	*Soe*	Dummy variable; if the company is a state-owned enterprise, assign a value of 1, otherwise 0
	Zscore	Financial status; the higher the Z-score index, the better the corporate financial status
	Size	Natural logarithm of total assets
	Roe	Return on equity
	Cash	Net cash flow at the end of the period / total assets at the end of the period
	Lev	Total liabilities / total assets
	Age	Accounting period – year of company establishment
	MB	Total market value / total assets
	Balance	The ratio between the shareholding ratios of the second to 10th largest shareholders and that of the largest shareholder
	Top1	Shareholding ratio of the largest shareholder
	Big4	Dummy variable; if the auditor is a big four international accounting firm, assign a value of 1, otherwise 0
	Board	Number of board members
	Year	Year fixed effect
	Industry	Industry fixed effect

Table 2
Descriptive statistics.

	Entire sample N = 27,180		Non-overcapacity N = 21,275	Overcapacity N = 5905	
Variable	Mean	SD	Mean	Mean	*T*-test
Prop	0.52	2.038	0.479	0.668	−0.189***
Sh_Prop	0.457	1.837	0.437	0.529	−0.092***
Net_Prop	0.506	2.03	0.466	0.649	−0.182***
Overcap	0.217	0.412	0	1	
Soe	0.404	0.491	0.363	0.55	−0.188***
Size	21.971	1.279	21.881	22.298	−0.418***
Roe	0.061	0.139	0.065	0.048	0.017***
Cash	0.042	0.074	0.039	0.054	−0.015***
Lev	0.433	0.21	0.422	0.473	−0.051***
Age	9.213	6.775	8.969	10.091	−1.122***
Top1	0.353	0.15	0.348	0.372	−0.024***
MB	4.017	3.657	4.161	3.497	0.664***
Balance	0.875	0.767	0.901	0.779	0.122***
Board	8.737	1.743	8.639	9.089	−0.450***
Dual	0.255	0.436	0.271	0.197	0.075***
Independ	0.372	0.052	0.373	0.367	0.006***
Big4	0.055	0.228	0.051	0.07	−0.019***

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

5. Empirical analysis results

5.1. Descriptive statistics

The descriptive statistics of the variables are shown in Table 2. For listed companies, the average value of financial support from controlling shareholders is 0.52%. In addition, companies in industries facing

Table 3
Correlation coefficient matrix.

	Prop	*Sh_Prop*	*Net_Prop*	*Overcap*	*Soe*	*Size*	*Roe*	*Cash*	*Lev*	*Age*	*Top1*	*MB*	*Balance*	*Board*	*Dual*	*Independ*	*Big4*
Prop	1																
Sh_Prop	0.9541*	1															
Net_Prop	0.9964*	0.9505*	1														
Overcap	0.0382*	0.0206*	0.0370*	1													
Soe	0.1203*	0.1083*	0.1182*	0.1577*	1												
Size	−0.0114	−0.0283*	−0.0136	0.1347*	0.3260*	1											
Roe	−0.1002*	−0.1070*	−0.0992*	−0.0516*	−0.0360*	0.1007*	1										
Cash	−0.0663*	−0.0786*	−0.0670*	0.0813*	0.0455*	0.0503*	0.2413*	1									
Lev	0.2180*	0.2171*	0.2164*	0.0998*	0.3116*	0.4708*	−0.1626*	−0.1377*	1								
Age	0.1386*	0.1345*	0.1364*	0.0683*	0.4073*	0.3472*	−0.0950*	−0.0202*	0.3795*	1							
Top1	0.0680*	0.0561*	0.0673*	0.0669*	0.2110*	0.2136*	0.1228*	0.0874*	0.0533*	−0.0879*	1						
MB	0.1533*	0.1632*	0.1544*	−0.0748*	−0.1395*	−0.3958*	−0.0633*	0.0098	0.0188*	−0.0604*	−0.0782*	1					
Balance	−0.1020*	−0.0972*	−0.1004*	−0.0658*	−0.2844*	−0.1192*	−0.0005	−0.0294*	−0.1734*	−0.1732*	−0.6852*	0.0630*	1				
Board	−0.0139	−0.0215*	−0.015	0.1066*	0.2921*	0.2617*	0.0288*	0.0608*	0.1693*	0.1040*	0.0300*	−0.1062*	−0.0076	1			
Dual	−0.0354*	−0.0290*	−0.0344*	−0.0705*	−0.3001*	−0.1696*	0.012	−0.0275*	−0.1677*	−0.2194*	−0.0508*	0.0710*	0.0818*	−0.1805*	1		
Independ	0.0019	0.0034	0.0019	−0.0508*	−0.0789*	0.0206*	−0.0179*	−0.0289*	−0.0230*	−0.0271*	0.0376*	0.0309*	−0.0180*	−0.4514*	0.1074*	1	
Big4	−0.0288*	−0.0325*	−0.0299*	0.0344*	0.1412*	0.3559*	0.0604*	0.0825*	0.1037*	0.0668*	0.1388*	−0.1036*	−0.0395*	0.1173*	−0.0709*	0.0259*	1

Note: * indicates statistical significance at the 1% level.

overcapacity account for 21.7% of the total sample. For industries facing overcapacity, the average value of financial support from controlling shareholders is 0.668%, which is significantly higher than the 0.479% seen in non-overcapacity companies. The results show that, compared with companies in non-overcapacity industries, companies in overcapacity industries received more financial support from controlling shareholders. There are also other significant differences between companies in overcapacity industries and companies in non-overcapacity industries; the former are usually larger in scale and have poorer profitability, higher asset-liability ratios, older age, and lower business growth.

5.2. Correlation coefficient matrix

Table 3 presents the correlation coefficient test results. The results show that without controlling for other factors, there is a positive correlation between industry overcapacity and corporate financial support from controlling shareholders, which is significant at the 1% level.

Table 4
Overcapacity and financial support.

	All	SOE	Non-SOE
	(1)	(2)	(3)
	$Prop_{t+1}$	$Prop_{t+1}$	$Prop_{t+1}$
Overcap $_t$	**0.145****	**0.433*****	**−0.049**
	(2.35)	**(3.40)**	**(−1.04)**
Soe $_t$	0.288***		
	(4.13)		
Size $_t$	−0.157***	−0.225***	−0.132***
	(−4.81)	(−3.70)	(−4.19)
Roe $_t$	−0.749***	−0.688**	−0.617***
	(−4.10)	(−2.43)	(−2.72)
Cash $_t$	−0.900***	−1.101**	−0.904***
	(−3.34)	(−2.16)	(−3.15)
Lev $_t$	1.716***	2.270***	1.318***
	(9.82)	(6.78)	(8.41)
Age $_t$	0.022***	0.024***	0.026***
	(5.15)	(3.25)	(5.16)
Top1 $_t$	1.261***	2.201***	0.513*
	(4.49)	(4.26)	(1.93)
MB $_t$	0.071***	0.091***	0.062***
	(5.74)	(3.14)	(5.92)
Balance $_t$	0.065*	0.167*	−0.011
	(1.65)	(1.76)	(−0.30)
Board $_t$	−0.049***	−0.079***	−0.009
	(−3.24)	(−3.33)	(−0.56)
Dual $_t$	0.056	0.104	0.050
	(1.30)	(0.78)	(1.23)
Independ $_t$	−0.298	0.237	−0.206
	(−0.66)	(0.26)	(−0.47)
Big4 $_t$	−0.208**	−0.187	−0.177***
	(−2.56)	(−1.45)	(−3.08)
Cons	2.522***	3.212***	2.399***
	(3.97)	(2.83)	(3.63)
Year	Control	Control	Control
Industry	Control	Control	Control
N	27,180	10,969	16,211
Adj. R-sq	0.096	0.104	0.079
Coefficient difference test (Chi2)		39.12***	
P Value		(0.000)	

Note: The values in brackets are robust T values, and time series dependence is corrected by company-level clustering. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

5.3. Empirical analysis results

Table 4 presents the basic empirical results. Columns (1) to (3) show the results for the full sample, for state-owned enterprises, and for non-state-owned enterprises, respectively. As shown in column (1), for companies in an industry facing overcapacity, controlling shareholders provided more financial support, a finding that is significant at the 5% level. H1 was verified.

In industries with excess capacity, the pressure to clean up low-end production capacity and complete upgrading is particularly large for state-owned enterprises. Therefore, we examined whether the basic empirical results are still valid when controlling for the nature of property rights. The results in columns (2) and (3)

Table 5
Mechanism analysis: Financial status.

	All (1) $Prop_{t+1}$	SOE (2) $Prop_{t+1}$	Non-SOE (3) $Prop_{t+1}$
$Overcap_t$	0.193**	0.502***	−0.079
	(2.45)	(3.33)	(−1.31)
$Zscore_t$	−0.003	−0.009	−0.005**
	(−1.22)	(−1.00)	(−2.07)
$\boldsymbol{Overcap_t * Zscore_t}$	**−0.006***	**−0.014**	**0.003**
	(−1.83)	**(−1.42)**	**(1.41)**
Soe_t	0.289***		
	(4.14)		
$Size_t$	−0.155***	−0.223***	−0.127***
	(−4.76)	(−3.67)	(−4.04)
Roe_t	−0.738***	−0.644**	−0.620***
	(−4.05)	(−2.28)	(−2.73)
$Cash_t$	−0.902***	−1.120**	−0.880***
	(−3.34)	(−2.19)	(−3.05)
Lev_t	1.567***	2.012***	1.153***
	(7.47)	(5.18)	(6.10)
Age_t	0.022***	0.024***	0.025***
	(5.14)	(3.16)	(5.15)
$Top1_t$	1.265***	2.190***	0.533**
	(4.50)	(4.24)	(2.00)
MB_t	0.076***	0.100***	0.067***
	(5.35)	(3.02)	(5.86)
$Balance_t$	0.067*	0.167*	−0.009
	(1.71)	(1.76)	(−0.23)
$Board_t$	−0.050***	−0.079***	−0.010
	(−3.28)	(−3.36)	(−0.63)
$Dual_t$	0.058	0.100	0.051
	(1.34)	(0.75)	(1.26)
$Independ_t$	−0.295	0.237	−0.222
	(−0.65)	(0.26)	(−0.50)
$Big4_t$	−0.208**	−0.190	−0.179***
	(−2.56)	(−1.48)	(−3.12)
Cons	2.551***	3.321***	2.363***
	(4.01)	(2.95)	(3.58)
Year	Control	Control	Control
Industry	Control	Control	Control
N	27,180	10,969	16,211
Adj. R-sq	0.096	0.104	0.079

Note: The values in brackets are robust T values, and time series dependence is corrected by company-level clustering. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

of Table 4 indicate that state-owned listed companies received more financial support from controlling shareholders. For non-state-owned enterprises, there is no similar discovery. Moreover, in between-group coefficient testing, this difference is significant at the 1% level. Thus, H2 was verified. State-owned enterprises in overcapacity industries can receive more financial support from controlling shareholders, possibly because they face more severe overcapacity problems, their business performance is more negatively affected, or they are under greater pressure to reduce capacity.

6. Further analysis

Why do controlling shareholders provide financial support to companies in industries with excess capacity? We analyzed the motivations from two perspectives: the starting point of support (i.e., corporate financial status) and the effect of support (i.e., the economic consequences).

6.1. Corporate financial status

Controlling shareholders are more likely to provide financial support to companies with poor financial status. Following Zheng et al. (2013), this study used the Z-score index (*Zscore*) to measure the financial status of a company. The larger the Z-score, the better the company's financial status. Table 5 presents the empirical results. The results show that, for an enterprise in an industry facing overcapacity, the worse the corporate financial situation, the more financial support provided by controlling shareholders. Thus, H3 was verified.

Table 6
Economic consequences.

	All	SOE	Non-SOE
	(1)	(2)	(3)
	Roa_{t+1}	Roa_{t+1}	Roa_{t+1}
$Prop_t$	−0.001***	−0.001**	−0.000
	(−2.65)	(−2.36)	(−0.96)
$Overcap_t$	−0.007***	−0.015***	−0.000
	(−4.13)	(−5.34)	(−0.15)
$Prop_t * Overcap_t$	**0.001****	**0.002*****	**0.002**
	(2.24)	**(2.92)**	**(1.50)**
$Size_t$	0.007***	0.007***	0.007***
	(10.24)	(7.96)	(8.13)
Lev_t	−0.093***	−0.097***	−0.088***
	(−25.49)	(−17.04)	(−17.97)
Age_t	−0.001***	−0.000	−0.001***
	(−5.93)	(−1.43)	(−5.12)
$Board_t$	0.000	−0.000	0.001**
	(0.85)	(−0.36)	(2.32)
$Independ_t$	−0.031***	−0.042***	−0.008
	(−2.67)	(−2.73)	(−0.49)
$Top1_t$	0.041***	0.024***	0.055***
	(9.59)	(3.79)	(9.13)
Cons	−0.089***	−0.097***	−0.115***
	(−6.61)	(−5.41)	(−5.73)
Year	Control	Control	Control
Industry	Control	Control	Control
N	27,180	10,969	16,211
Adj. R-sq	0.117	0.150	0.110

Note: The values in brackets are robust T values, and time series dependence was corrected by company-level clustering. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

6.2. Economic consequences

This study also explored the economic consequences of financial support from controlling shareholders, specifically whether such support enhanced the corporate value of listed companies. Following Huang et al. (2019), this study used return on assets (*Roa*) to measure corporate value. As shown in Table 6, the empirical results indicate that the financial support provided by controlling shareholders to enterprises facing overcapacity was conducive to improving operating performance. Thus, H4 was verified.

Based on this analysis, this study found that controlling shareholders provided financial support to enterprises facing overcapacity because of the nature of property rights and the financial status of the enterprise. Moreover, financial support from controlling shareholders enhanced the corporate value of enterprises.

6.3. Robustness checks

As the first robustness check, the financial support measurement method was adjusted. First, short-term financial support from controlling shareholders was considered. The specific formula is as follows: other

Table 7
Robustness analysis: Adjustment of financial support measurement method.

	(1)	(2)
	Net_Prop_{t+1}	Sh_Prop_{t+1}
Overcap $_t$	**0.147****	**0.113****
	(2.38)	**(2.06)**
Soe_t	0.292***	0.248***
	(4.19)	(3.92)
$Size_t$	−0.159***	−0.157***
	(−4.89)	(−5.56)
Roe_t	−0.706***	−0.691***
	(−3.88)	(−4.05)
$Cash_t$	−0.890***	−0.973***
	(−3.31)	(−4.02)
Lev_t	1.709***	1.587***
	(9.81)	(9.99)
Age_t	0.021***	0.019***
	(4.97)	(4.86)
$Top1_t$	1.261***	0.985***
	(4.50)	(3.89)
MB_t	0.071***	0.066***
	(5.74)	(5.80)
$Balance_t$	0.069*	0.043
	(1.76)	(1.19)
$Board_t$	−0.048***	−0.042***
	(−3.21)	(−3.10)
$Dual_t$	0.055	0.056
	(1.28)	(1.42)
$Independ_t$	−0.288	−0.242
	(−0.64)	(−0.62)
$Big4_t$	−0.210***	−0.160**
	(−2.60)	(−2.38)
Cons	2.530***	2.673***
	(4.01)	(4.88)
Year	Control	Control
Industry	Control	Control
N	27,180	27,180
Adj. R-sq	0.095	0.099

Note: The values in brackets are robust T values, and time series dependence was corrected by company-level clustering. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

payables to the parent company / total assets at the end of the period * 100%. Second, net support from controlling shareholders excluding the impact of tunneling was considered. The specific formula is as follows: (other payable to the parent company + long-term payable to the parent company – other receivables from the parent company-long-term receivables from the parent company) / period-end total assets * 100%. As shown in Table 7, the empirical results are largely consistent with the baseline results; controlling shareholders provided financial support to listed companies facing industry overcapacity crises. Thus, the empirical results are robust.

Second, Gopalan et al. (2007) found that when companies face bankruptcy risks, the internal capital market plays a propping role. Therefore, in consideration of the impact of extreme operating dilemmas, observations of companies receiving special treatment were excluded. As shown in Table 8, the empirical results remained largely unchanged; controlling shareholders provided financial support to listed companies facing industry overcapacity crises.

Finally, studies by Almeida et al. (2015) and Raffaele et al. (2020) found that macro-financial crises stimulate the propping role of internal capital markets. Therefore, in consideration of the impact of a deteriorating

Table 8
Robustness analysis: Excluding special-treatment companies.

	(1)	(2)	(3)
	$Prop_{t+1}$	Net_Prop_{t+1}	Sh_Prop_{t+1}
Overcap $_t$	**0.142*** **	**0.143*** **	**0.108** **
	(2.66)	**(2.69)**	**(2.35)**
Soe_t	0.251***	0.253***	0.218***
	(4.15)	(4.19)	(4.01)
$Size_t$	−0.102***	−0.106***	−0.105***
	(−3.62)	(−3.76)	(−4.45)
Roe_t	−0.962***	−0.908***	−0.878***
	(−5.54)	(−5.25)	(−5.51)
$Cash_t$	−0.584**	−0.587**	−0.648***
	(−2.40)	(−2.41)	(−2.98)
Lev_t	1.286***	1.283***	1.174***
	(8.76)	(8.78)	(8.94)
Age_t	0.018***	0.017***	0.015***
	(4.76)	(4.64)	(4.45)
$Top1_t$	1.140***	1.149***	0.885***
	(4.28)	(4.33)	(3.71)
MB_t	0.052***	0.051***	0.047***
	(5.11)	(5.10)	(5.17)
$Balance_t$	0.049	0.054	0.029
	(1.35)	(1.49)	(0.88)
$Board_t$	−0.045***	−0.044***	−0.039***
	(−3.16)	(−3.12)	(−3.08)
$Dual_t$	0.033	0.035	0.037
	(0.94)	(1.00)	(1.14)
$Independ_t$	−0.277	−0.257	−0.225
	(−0.68)	(−0.64)	(−0.66)
$Big4_t$	−0.259***	−0.261***	−0.211***
	(−3.61)	(−3.67)	(−3.84)
_cons	1.591***	1.610***	1.781***
	(2.96)	(3.02)	(4.02)
Year	Control	Control	Control
Industry	Control	Control	Control
N	26,053	26,053	26,053
Adj. R-sq	0.072	0.071	0.074

Note: The values in brackets are robust T values, and time series dependence was corrected by company-level clustering. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 9
Robustness analysis: Excluding observations during the financial crisis.

	(1) $Prop_{t+1}$	(2) Net_Prop_{t+1}	(3) Sh_Prop_{t+1}
Overcap $_t$	**0.120****	**0.117****	**0.092***
	(2.05)	**(2.01)**	**(1.82)**
Soe $_t$	0.322***	0.325***	0.285***
	(4.58)	(4.63)	(4.45)
Size $_t$	−0.124***	−0.129***	−0.127***
	(−3.97)	(−4.14)	(−4.65)
Roe $_t$	−0.628***	−0.597***	−0.533***
	(−2.95)	(−2.80)	(−2.71)
Cash $_t$	−1.102***	−1.088***	−1.138***
	(−3.62)	(−3.58)	(−4.11)
Lev $_t$	1.583***	1.583***	1.469***
	(9.48)	(9.50)	(9.57)
Age $_t$	0.018***	0.018***	0.016***
	(4.47)	(4.35)	(4.25)
Top1 $_t$	1.109***	1.123***	0.888***
	(4.19)	(4.25)	(3.75)
MB $_t$	0.089***	0.089***	0.082***
	(5.70)	(5.67)	(5.69)
Balance $_t$	0.061	0.066*	0.046
	(1.61)	(1.73)	(1.33)
Board $_t$	−0.053***	−0.053***	−0.046***
	(−3.25)	(−3.22)	(−3.14)
Dual $_t$	0.037	0.037	0.035
	(0.92)	(0.91)	(0.94)
Independ $_t$	−0.265	−0.243	−0.226
	(−0.59)	(−0.55)	(−0.60)
Big4 $_t$	−0.204**	−0.207**	−0.178**
	(−2.41)	(−2.44)	(−2.53)
Cons	1.949***	2.018***	2.126***
	(3.05)	(3.16)	(3.83)
Year	Control	Control	Control
Industry	Control	Control	Control
N	20,400	20,400	20,400
Adj. R-sq	0.106	0.105	0.109

Note: The values in brackets are robust T values, and time series dependence was corrected by company-level clustering. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

external operating environment, observed values during financial crisis periods (i.e., 2008, 2009, and 2015) were excluded. As shown in Table 9, the empirical results remain largely unchanged; controlling shareholders provided financial support to listed companies facing industry overcapacity crises. Thus, the empirical results of this article are robust.

7. Conclusion

Cleaning up surplus low-end production capacity is an inevitable trend and a prerequisite for healthy market development. However, solving the problem of overcapacity requires a long-term approach. To survive this process, enterprises must improve their ability to withstand risks. By analyzing the data for China's A-share listed companies from 2007 to 2019, this study found that companies in industries with overcapacity received more financial support from controlling shareholders compared with those in non-overcapacity industries. Analysis of the mechanism revealed that state-owned enterprises and companies with relatively poor financial status receive more financial support from controlling shareholders. This study also examined the economic consequences of such support and found that it is conducive to enhancing business performance. The above findings withstood a series of robustness tests.

This study has several important implications. First, the allocation of resources in internal capital markets can help improve the risk resistance of enterprises facing overcapacity. Inferior companies are highly likely to withdraw from the market due to the normal function of the survival-of-the-fittest mechanism, but high-quality companies are also subject to the negative impacts of industry risks. As such, strengthening enterprises' risk buffers is an important prerequisite for survival. Second, internal capital markets serve a propping role for enterprises facing overcapacity, which is conducive to a smooth economic transition. Fierce market competition due to overcapacity is a normal economic phenomenon, but violent market fluctuations can harm the real economy. Maintaining relative market stability is an important foundation for a stable economic transition. Third, in supply-side reforms, coordination between government regulations and business operations is not the only type of government-market synergy: the cooperation of corporate stakeholders is also crucial in this regard.

This study also has some limitations. First, it does not explore how the propping role of internal capital markets affects the macroeconomy, whether positively or negatively. Does controlling shareholders' provision of financial support to enterprises facing overcapacity promote or inhibit the process of cleaning up excess capacity? Second, this article analyzes the microeconomic consequences of overcapacity in terms of controlling shareholders' provision of financial support, but does not examine other important behaviors (e.g., of controlling shareholders and management) related to investment, financing, and strategy. Third, this study adopts a somewhat broad and unfocused research context; different industries have different overcapacity situations, and processes of reducing capacity may also vary. Such differences should lead to different effects on enterprises. This article does not focus on differences among overcapacity industries, but rather analyzes differences in controlling shareholder behavior between overcapacity industries and non-overcapacity industries. As such, the findings may have limited interpretability and applicability to real-world problems. These issues require further investigation in future research.

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Economic policy uncertainty and executive turnover

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ABSTRACT

This paper examines whether economic uncertainty increases executive turnover. The negative perception perspective and business change theory suggest that executives are more likely to leave their jobs during periods of corporate distress. However, the additive effects of internal and external risk are thought to prompt firms to carefully consider executive turnover, thereby reducing the likelihood of executive changes. Based on the literature, we propose a check-and-balance hypothesis for the relationship between external uncertainty and executive change, according to which the optimal superposition of the internal and external risks stemming from increased external uncertainty would be to avoid a wave of executive departures. Using a sample of Chinese A-share listed companies from 2010 to 2019 and the China economic policy uncertainty index of Baker et al. (2013), we examine the impact of economic policy uncertainty on executive turnover and our results support the check-and-balance hypothesis. Our findings enhance our understanding of how economic policy uncertainty affects executive turnover, and enrich the literature on corporate risk management and strategic management.

1. Introduction

Economic policy uncertainty refers to the inability of economic agents to predict with certainty if, when, and how a government will change its economic policies (Gulen and Ion, 2016). Since the financial crisis in 2008, there have been increasing external risks stemming from factors such as the intensification of the trade war between the U.S. and China and the sudden onset of the COVID-19 pandemic. Economic policy uncertainty, as an unavoidable systemic risk, has significant implications for China's political system, macroeconomic performance, and corporate environment. To cope with the changing global economic environment, the Chinese government has introduced numerous macroeconomic policies, such as the ''Four-trillion yuan

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economic stimulus plan," "Industry 4.0 version," "Supply-side reform," and the "Belt and road" initiative, and implemented various free trade zones, tax cuts, stock registration system reforms, and other major policy changes.

Changes in the external business environment make it more difficult to assess the future business environment and have a negative impact on short-term operations (Deng, 2019). However, it is often difficult to discern whether these effects are due to the unpredictable circumstances or to economic mismanagement. Corporate accountability and the reduced tolerance of shareholders and directors for poor economic performance reinforce the negative perceptions of such an economic environment, and thus increase the likelihood of corporate departures. Rao and Xu (2017) argue that increased economic policy uncertainty increases the risk of executive changes, and the combined internal and external risks can make companies more prudent when making executive turnover decisions. However, external uncertainties also increase the requirement for comprehensive capabilities of executives, which can increase the risk-taking of corporations (Liu et al., 2017) and the level of corporate innovation (Hao et al., 2016). Moreover, economic policy uncertainty requires firms to engage in strategic positioning and change (Mirza and Ahsan, 2020). In this regard, hiring a new CEO can provide an important opportunity for a company to realign its practices with the changing economic environment. Accordingly, in recent years, firms have been increasingly using executive change as a governance mechanism for corporate development and strategy implementation (Tan and Luo, 2017). However, as the level of policy uncertainty continues to rise, at least two opposing views have emerged on the reasons for changing senior executives, and whether firms should seek to counterbalance these reasons to avoid a wave of redundancies.

In this paper, we use a sample of Chinese A-share listed companies from 2010 to 2019 and the China economic policy uncertainty index developed by Baker et al. (2013) to study the impact of economic policy uncertainty on executive turnover. Our analyses generate a number of empirical findings. First, economic policy uncertainty serves as an overall positive shock that increases the rate of executive turnover. Second, risk-taking reduces the negative perception of uncertainty, and can thus act as a buffer against this positive shock. Third, executives who serve dual director-manager roles are better able to respond to risk and adapt to volatile environments. Thus, companies are more inclined to give weight to the internal consequences of replacing these executives, and tend to implement internal risk hedging measures. Fourth, further analyses reveal that the negative perception of executive turnover is stronger for firms facing high performance pressures, firms in declining industries, and non-SOEs. Thus, although there is a clearly negative perception of executive change, economic uncertainty generates greater executive turnover due to the greater incentives for firms to reposition themselves in the market. In terms of enterprise size, our analysis shows that small-scale enterprises are more likely to be risk-averse and large-scale enterprises are able to mitigate external shocks, whereas medium-sized enterprises tend to accept the risk of replacing senior managers for strategic repositioning purposes. Finally, we find that older and longer tenured executives are more likely to leave the company due to policy uncertainty, indicating a proactive response to the changing economic environment. Thus, the empirical results of this paper confirm our reasoning that although an environment marked by high external economic policy uncertainty will undoubtedly generate numerous shocks, the increasingly negative perceptions of executive turnovers and the strong incentives for reform within firms counterbalance the risk-avoidance effects. Thus, although economic policy uncertainty generates personnel fluctuations, it does not ultimately trigger a wave of executive departures.

The findings of this paper have several implications. First, previous studies of executive change mostly focus on internal and external corporate governance mechanisms, and pays less attention to the impact of the external economic environment. To address this gap, this paper incorporates the macroeconomic environment into the analytical framework to examine how the external environment affects executive turnover.

Second, previous studies have mainly examined executive change in terms of solving the agency problems of the constraint mechanism, and have ignored the fact the executive change decisions are also strategic decisions that can affect the future strategic positioning and development of an enterprise. This paper treats economic policy uncertainty as a risk-related shock to enterprises, and examines how the decision to change executives can serve as a way for enterprises to manage their reactions to the external shock and adjust their strategies to cope with the risk. Moreover, by objectively analyzing the impact of economic policy uncertainty on executive change and the subjective hiring decisions of enterprises, this paper adds to the literature on executive change by showing that economic policy uncertainty is an important factor in corporate executive turnover.

Third, studies have examined the effects of economic policy uncertainty on factors such as macroeconomic development, corporate investment, R&D spending, cash holdings, capital market risk, and the financial decisions of firms. In contrast, this paper examines whether economic policy uncertainty affects high-level personnel changes in enterprises, and finds that economic policy uncertainty influences the decisions to change senior executives, thus making an important contribution to this line of research.

2. Literature review and hypothesis development

2.1. Literature review

According to Gulen (2016), economic policy uncertainty refers to the inability of market participants to accurately predict whether a government will change economic policies or introduce new policies. Economic policy changes are usually implemented to counteract economic recessions caused by external shocks, such as financial crises or terrorist attacks (Bloom, 2009). During recessions, the levels of economic policy uncertainty can increase significantly as policy makers attempt to stabilize the economy and stimulate growth. In contrast, during boom periods, the economy does not require much adjustment or intervention (Pastor and Veronesi, 2013).

As a systemic risk to micro-enterprises, economic policy uncertainty poses general business risks and can have multifaceted effects on corporate decision making. The literature mainly focuses on firms' risk aversion and prospect expectations. With respect to risk aversion, increased economic policy uncertainty can discourage investment, increase the difficulty of raising capital (Ji et al., 2018), reduce the availability of debt financing (Ni and Dong, 2019), and lead firms to abandon investment opportunities to increase their cash holdings (Li et al., 2016). Based on the prospect expectations, economic policy uncertainty may provide an incentive for firms to increase their R&D activities to gain competitive advantage and capture markets (Meng and Shi, 2017; Gu et al., 2018), but it may also reduce the innovation efficiency of firms (Shen et al., 2019).

The literature on economic policy uncertainty focuses more on the investment and financing decisions of firms and less on the management decisions such as executive turnover. Management is the key to resolving firms' agency problems, for which executive motivation, discipline, and turnover serve as the most direct mechanisms of change. The literature focuses on the role of executive change in resolving agency problems. For example, as firms often judge their executives based on the company performance, performance is an important factor in executive change. In their pioneering work in this area, Coughlan and Schmidt (1985) discuss the relationship between executive turnover and a company's share price performance. Weisbach (1988) argues that the share price includes market expectations of the CEO, and the accounting metrics are thus more representative of the executive's personal behavior. Accordingly, he suggests using the return on assets (ROA) to indicate company performance, concluding that the ROA of companies with departing CEOs is significantly lower than the industry average. However, the accounting indicators of company performance are influenced by a variety of factors in addition to the individual efforts of executives such as the external business environment.

As executive turnover can also be constrained by corporate governance mechanisms, studies have also discussed how internal mechanisms, such as executive shareholding, institutional shareholding (Yue et al., 2011), director-manager duality (Miao, 2008), the size of the supervisory board (Hao and Ren, 2010), and the structure of the board of directors (Kang, 1995; Neumann and Voetmann, 2005), affect management change. Scholars have also begun to combine this perspective with research on firms' external governance mechanisms, such as the external controls of companies (Morck et al., 1989; Kato and Long, 2006) and the market competition for products (Achim, 2016). However, the personal traits of individual managers, such as an executive's political relationships (You et al., 2010) and the founder status of the CEO (Qu et al., 2012), can also influence firms' corporate governance mechanisms. Notably, such personal traits can serve as capital for constructing management trenches, weaken the supervisory and restrictive mechanisms of corporate governance, and reduce the likelihood of the CEO being replaced. However, scholars have focused on executive change as a mechanism for solving agency problems, and paid less attention to executive change as a form of strategic decision making.

2.2. Hypothesis development

This paper examines three possible ways in which economic policy uncertainty can affect executive turnover. First, we examine whether economic policy uncertainty affects the role of corporate governance mechanisms. As a social setting, the economic policy environment can affect the survival of all firms. For example, Deng (2019) finds that increased economic policy uncertainty has a negative impact on firms' short-term operations, and Yang et al. (2019) find that economic policy uncertainty is transmitted to capital markets, thus reducing the market value of firms. However, the external environment may also affect people psychologically and change their expectations. For example, when the overall economic situation declines and becomes unstable, enterprises may pay more attention to profit and loss. Moreover, The theory of attribution suggests that although we evaluate the behavior of others based on evidence, we also tend to underestimate the impact of external factors and overestimate the impact of internal or personal factors, and thus make basic attribution errors. Therefore, when the external environment is highly uncertain, the board of directors is likely to be less tolerant and to demand more accountability, and thus to blame management for the firm's distress. At the same time, increased economic policy uncertainty reduces the observability of management's diligence and makes it more difficult for shareholders to supervise management, leading to a greater degree of information asymmetry between shareholders and management (Liu and Han, 2010). Consistent with this argument, Jenter and Kannan (2015) find that when an industry as a whole is poorly run, executives are more likely to be fired, and this phenomenon is more pronounced during periods of macroeconomic downturn.

Second, we examine whether high economic policy uncertainty is more reflective of individual executives' capabilities. Executive ladder theory suggests that firm strategies are influenced by top management's perception of the economic situation, which means that a firm's performance can be predicted, in part, by the attributes of the firm's top managers. This effect is stronger in high-uncertainty environments, where managers who are better at processing information can more effectively manage the operational complexity and thus mitigate the adverse effects of the economic uncertainty (Herrmann and Datta, 2002; Hsu et al., 2013; Lester et al., 2006; Nielsen and Nielsen, 2011). In line with this, Chen et al. (2020) find that managers' abilities alleviate the effects of macro uncertainty on analysts' forecasts by reducing the negative impact of macro uncertainty on performance and improving the quality of information. Thus, it can be argued that greater macroeconomic policy uncertainty tests management's capabilities and can have a significant impact on management's overall performance. Alternatively, the greater the competency requirements, the more likely it is that less competent management will be eliminated.

Third, based on prospect expectation theory, we examine whether under high economic policy uncertainty, fluctuations in the economic environment force firms to improve their "hardware" to survive, and thus encourage the long-term development of enterprises (Deng, 2019). From an industrial organization perspective, studies suggest that the external socio-economic environment of a company can have a significant influence on its market position (Courtney, Kirkland, and Viguerie, 1997; Kaplan, 2008; Shen, Yu, and Wu, 2012). In terms of strategic management, companies always try to adapt their strategic design to the current operating or economic environment (Andrews, 1971; Porter, 1980; Scholes et al., 2000). Senior executive turnover provides important opportunities for companies to align with the changing environment and can help companies overcome their organizational inertia (Ocasio, 1994). The successor executives may implement strategic and organizational changes (Ocasio, 1994), initiate new strategic adjustment practices (Miller, 1993), and divest unprofitable units (Weisbach, 1995). Given the above dicussion, we propose the following hypothesis.

H1: The greater the economic policy uncertainty, the greater the likelihood of executive departures.

How an enterprise perceives external economic policy uncertainty is affected by the heterogeneity of individual characteristics, and how this uncertainty affects the enterprise also depends on the enterprise's attitude towards risk and its ability to resist risk. An enterprise's risk-taking reflects its risk appetite when making investment decisions, such that the higher the level of risk-taking, the more likely it is that the enterprise will take on risky investment projects (Yu et al., 2013). Therefore, risk taking represents an active willingness to bear risk under certain conditions, and emphasizes an enterprise's active embrace rather than passive acceptance of its own risk (Yu and Shan, 2015). However, risk-taking also depends on a firm's resource acquisition capacity, as risk-taking is a resource-consuming activity and can make a firm strongly resource dependent (Xin et al., 2013). For example, an enterprise's social network can help improve its ability to acquire resources, thus

increasing its level of risk taking. Therefore, an enterprise's level of risk taking also reflects the enterprise's ability to obtain resources.

In summary, corporate risk-taking reflects the willingness and ability of firms to take risks. Therefore, high economic policy uncertainty can reduce a firm's negative sensitivity to poor performance and thus lessen the censure of executives, while making the firm more resilient to external shocks. On this basis, we propose the following hypothesis.

H2: Corporate risk-taking can reduce the positive impact of economic policy uncertainty on executive turnover.

Director-manager duality is common in China's institutional setting. Director-manager duality can improve the risk coping ability and environmental adaptability of senior executives, and can thus increase the level of risk-taking of senior executives. Uncertain economic policies mean that enterprises face greater risks, and senior executives need to make quick judgments based on a good understanding of the future development of the enterprise and its capital arrangements and finances. Director-manager duality also gives directors greater autonomy, makes the board more tolerant of risk, and induces management to pay more attention to the long-term development and interests of the company. In addition, director-manager duality can help clarify a company's development goals, and increase the board's confidence in the company's long-term interests. More effective leadership and control can also facilitate the effective implementation of executive decisions, and thus enhance a firm's capacity to adapt to an uncertain environment. Director-manager duality is more common in large SOEs and family owned enterprises. In these enterprises, management has a greater internal aversion to the risks posed by external threats, and has more difficulty changing personnel. Furthermore, studies have shown that the agency problems associated with director-manager duality are more likely to emerge in mature markets, whereas director-manager duality is more conducive to business growth in emerging markets. On this basis, we propose our third hypothesis.

H3: Director-manager duality reduces the positive impact of economic policy uncertainty on senior executive turnover and enhances the protection of senior executives.

3. Empirical research design

3.1. Sample selection and data sources

Our research sample is comprised of A-share listed companies on the Shanghai and Shenzhen stock exchanges from 2010 to 2019, and excludes financial enterprises (690), cross-holdings (5855), firms with less than zero shareholder equity (593), and the special treatment samples (2531). All of the non-dummy variables are winsorized at the 1% and 99% levels to alleviate the potential effects of outliers. We obtain each firm's financial accounting information from the China Stock Market and Accounting Research database and construct an economic policy uncertainty index based on the uncertainty indices developed by Baker et al. (2013).

3.2. Definitions of main variables

TURN: Executive turnover. In accordance with the Chinese literature, we define executives as the chairman and general manager. Following Rao and Xu (2017), we do not distinguish between normal and mandatory executive departures. First, Chinese listed companies fully disclose the reasons for executive changes, but often record abnormal separations as normal changes. Second, in our setting, some executive departures may have occurred spontaneously, and this will not be reflected in the companies' disclosures of their reasons for leaving. If a company changes its chairman or managing director during the year, the explained variable takes the value of one, and zero otherwise. In cases where a company reports multiple changes in a year, we only retain the first change.

EPU: Economic policy uncertainty. Following the literature, we use the China economic policy uncertainty index constructed by Baker et al. (2013) to measure policy uncertainty. The index is based on the South China Morning Post, Hong Kong's largest English-language newspaper. The index is compiled based on keyword searches for terms such as "uncertain/uncertainty," "economic/economy," "policy," "tax," "spending," "regulation," "central bank," and "budget deficit." A monthly index is then complied by dividing the number of

articles identified in the keyword search each month by the total number of articles published in the South China Morning Post that month. Numerous domestic and international studies have used this economic policy uncertainty index to analyze the impact of economic policy uncertainty on the investments, innovation, and macroeconomic policies of enterprises. As the firm-level data used in this paper are annual, we convert the monthly averages to an annual indicator and use its logarithm as the final explanatory variable to obtain uniform data frequencies.

Risk: Enterprise risk taking. As higher risk-taking increases the uncertainty about the future cash flows of an enterprise, we follow He et al. (2019) and use the volatility of corporate earnings as a measure of risk-taking. The ROA volatility of a firm is used to measure the level of risk-taking, with greater volatility of earnings indicating a higher level of risk-taking and greater tolerance of performance volatility. Following Yu et al. (2013), we subtract the ROA from the annual industry mean to obtain the adjusted ROA, and use every five years as the observation period to calculate the standard deviation and range of the industry-adjusted ROA in a rolling manner. The standard deviation and range are also used to measure an enterprise's risk commitment. The paper uses the SEC's 2001 classification standard, and due to the large number of listed companies in China's manufacturing industry, the classification of manufacturing firms is broken down according to the secondary codes.

$$\mathrm{Risk1}_{i,t} = \sqrt{\frac{1}{N-1}\sum_{n=1}^{N}\left(adj\_ROA_{i,t} - \frac{1}{N}\sum_{n=1}^{N} adj\_ROA_{i,t}\right)^2} \tag{1}$$

$$\mathrm{Risk2}_{i,t} = \mathrm{Max}\left(adj_{ROAi}\right) - \mathrm{Min}\left(adj_{ROAi}\right) \tag{2}$$

where $N = 5$. *Risk1* is obtained by calculating the rolling standard deviation of the five-year *adj_ROA*, and *Risk2* is obtained by calculating the range of five-year *adj_ROA*.

Dual: Chairman of the board and general manager. If the chairman and the manager of the enterprise are the same person, the variable takes the value of 1, and 0 otherwise.

3.3. Model specification

To test the relationship between economic policy uncertainty and executive turnover, we construct a number of econometric regression models. As the explained variables are 0–1 dummy variables, the regressions are based on a binary choice model. The random error term of the probit model is subject to the standard normal distribution, whereas the logit model does not require strict assumptions and has a wider range of applications. Therefore, a panel logit model is used for the regressions. In addition, the panel logit model uses two-way fixed effects and controls for individual firm and year fixed effects. To alleviate concerns about the co-collinearity of the time dummy variable with *EPU*, we delete the 2010 dummy variable and construct the following measurement model.

$$TURN_{i,t} = \alpha_0 + \alpha_1 EPU_i + \Sigma Controls1_{i,t} + \varepsilon_{i,t} \tag{3}$$

$$TURN_{i,t} = \beta_0 + \beta_1 EPU_i + \beta_2 EPU_i * Risk_{i,t} + \beta_3 Risk_{i,t} + \Sigma Controls1_{i,t} + \varepsilon_{i,t} \tag{4}$$

$$TURN_{i,t} = \gamma_0 + \gamma_1 EPU_i + \Sigma Controls2_{i,t} + \varepsilon_{i,t} \tag{5}$$

where*TURN*is the executive change dummy variable, which takes the value of one if the firm has a change of chairman or general manager, and zero otherwise. *EPU* is economic policy uncertainty, which is calculated by averaging the economic policy uncertainty index into annual indicators on a monthly basis and then taking the logarithm. *Risk* is the level of corporate risk-taking, which is measured in two ways by Equations (1) and (2). Following Xu et al. (2012), we also control the following variables in Models (3) and (4): personal characteristics of the executive, including *duality, age,* and *tenure*; financial condition of the firm, including the *size* and *leverage ratio* of the firm; corporate governance characteristics, including *board size* and *board independence*; and equity characteristics, including *equity concentration* and *equity nature*. As the market indicators can be affected by policy changes and political events (Zong et al., 2013), we adjust the company's operating performance *ROA* by the industry averages. Similarly, we also control for individual *firm* and *year* fixed effects. The

Table 1
Variable definitions.

Dependent variable	Description
TURN	Executive turnover. Takes the value of one if a company changes its chairman or managing director during the year, and zero otherwise
Independent Variable	Description
EPU	The data are from http://www.policyuncertainty.com/. The variable is the logarithm of the annual targets, which are derived form the monthly averages.
Adjustment variables	Description
Risk1	Risk-taking, calculated by Model (1)
Risk2	Risk-taking, calculated by Model (2)
Dual	Director-manager duality. Takes the value of one if the chairman and the manager of the enterprise are the same person, and zero otherwise
Control variables	Description
ROA	Net profit divided by total assets and adjusted by the industry median
Size	Company size. Logarithm of the company's total assets at the end of the period
Debt	Asset-liability ratio. The ratio of a company's liabilities to its total assets
MB	Company growth. The ratio of total market value to the book equity value
Soe	Takes the value of one if the actual controller is a state-owned enterprise, and zero otherwise
Top1	Shareholding ratio of the largest shareholder
Board	Total number of directors
Independence	Percentage of the number of independent directors in the total number of directors
Dual	Director-manager duality. Takes the value of one if the chairman and the manager of the enterprise are the same person, and zero otherwise
Tenure	Executive tenure; missing values are replaced by the average company tenure
Age	Age of executive at departure; missing values are replaced by the average age of directors and supervisors

control variable in Model (5) removes the variable *duality*. Detailed definitions of the variables are provided in Table 1.

Model (3) can be used to validate H1. According to H1,α_1 should be significantly positive.

Model (4) can be used to validate H2 by adding the intersection term to examine the moderating role of the level of risk-taking by firms. Here, in the multiplication term, the value of the two variables are decentralized to avoid collinearity. According to H2,β_2 should be significantly negative.

Model (5) can be used to test H3 by dividing the sample into two subsamples according to whether the chairman of the board is also the manager. According to H3, γ_1 in the director-manager duality samples should be significantly smaller than γ_1 in the non– director-manager duality samples.

4. Empirical results

4.1. Descriptive statistics

Fig. 1 (in the attachment) shows the trend of the Chinese economic policy uncertainty index over the sample period. There are significant increases around 2011–2012 and in 2015. In 2011–2012, the central government implemented its "Four-trillion yuan" investment plan and the Eurozone debt crisis peaked; the increased uncertainty in the external environment was transmitted to China's economy. The index peaks again in 2015, when China experienced its lowest growth rate in 25 years, and the volatile stock and currency markets reinforced concerns about policy uncertainty. China was in severe economic recession during both periods, and the economic policy uncertainty intensified significantly, which is consistent with research showing that economic policy uncertainty increases substantially during recessions (Pastor and Veronesi, 2013).

Descriptive statistics of the variables are presented in Table 2. The results show that the mean value of the economic policy uncertainty index (before logarithm) is 332.75 and the standard deviation is 219.23, indicating relatively high and volatile economic policy uncertainty. The mean value of executive turnover (*TURN*) is 0.24, meaning that overall more than 20% of firms experience executive turnover.

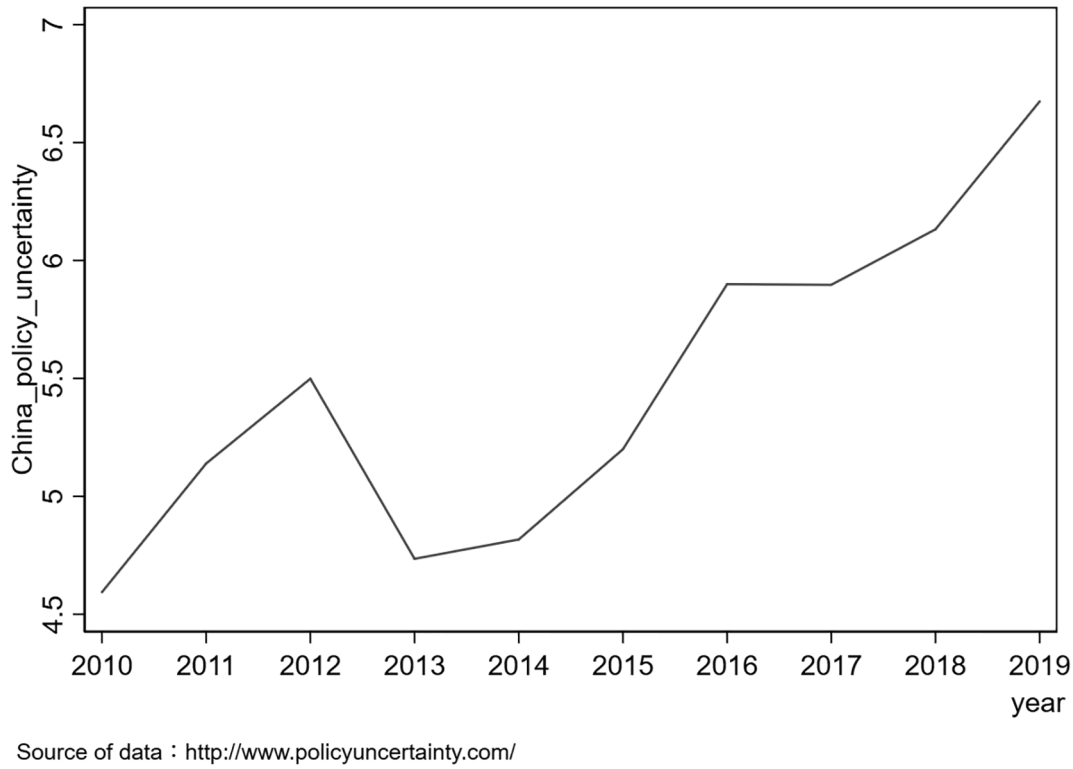

Fig. 1. The trend of China's economic policy uncertainty Index (after logarithmic transformation) from 2010 to 2019.

Table 2
Descriptive statistics.

Variables	Obs	Mean	Std	Min	P50	Max
EPU(Original Value)	10	268.71	167.85	98.89	181.29	791.87
EPU	10	5.42	0.58	4.60	5.21	6.68
TURN	18,255	0.26	0.44	0.00	0.00	1.00
Risk1	18,255	3.24	3.67	0.18	2.04	22.91
Risk2	18,255	7.30	8.29	0.28	4.60	51.52
Dual	18,255	0.24	0.42	0.00	0.00	1.00
ROA	18,255	0.00	0.06	−0.22	−0.00	0.17
Size	18,255	22. 13	1.22	19.57	22.01	25.70
Debt	18,255	0.44	0.21	0.05	0.43	0.89
MB	18,255	0.04	0.04	0.00	0.03	0.22
Soe	18,255	0.42	0.49	0.00	0.00	1.00
Top1	18,255	34.62	15.04	8.45	32.34	74.96
Board	18,255	8.69	1.73	0.00	9.00	18.00
Independence	18,255	0.37	0.05	0.33	0.33	0.57
Tenure	18,255	5.55	3.47	0.01	5.23	21.79
Age	18,255	51.65	6.48	21.00	51.00	69.00

4.2. Regression results

We first test for the presence of multicollinearity among the explanatory variables. Table 3 reports the variance inflation factor (VIF) for each variable. The results show that the VIF values for each explanatory variable are less than 5, indicating that multicollinearity is not a problem in the model.

The hypotheses are next tested and the regression results are presented in Table 4.

Table 3
Multicollinearity analysis.

Variables	VIF	1/VIF	VIF	1/VIF
EPU	1.13	0.88	1.14	0.87
Risk1	1.09	0.91		
Risk2			1.09	0.91
Dual	1.10	0.91	1.10	0.91
ROA	1.16	0.86	1.17	0.85
Size	3.32	0.30	3.53	0.28
Debt	2.10	0.48	2.14	0.46
MB	2.41	0.41	2.41	0.41
SOE	1.31	0.76	1.32	0.75
Top1	1.13	0.89	1.15	0.87
Board	1.45	0.69	1.47	0.68
Independence	1.31	0.76	1.31	0.76
Part	1.14	0.88	1.15	0.87
Age	1.17	0.86	1.17	0.86

In the test for Model (3), the first column of Table 4 includes no other control variables, while the second column adds all of the control variables. The regression results show that the coefficient on *EPU* is always significantly positive, which indicates that economic policy uncertainty is significantly positively related to executive change. That is, the greater the uncertainty in the economic policy environment, the greater the likelihood of executive departures, which supports hypothesis H1.

At the control variable level, there is a negative correlation between performance *ROA* and executive turnover, which is consistent with the findings in the literature, indicating that performance is an important criterion for evaluating executive capabilities. The results are not significant for company size (*Size*), debt ratio (*Debt*), and growth (*MB*). However, at the equity characteristics level, state-owned enterprises (*Soe*) significantly increase the probability of executive turnover. At the governance structure level, a large *Board* means the effectiveness of its decision-making is more likely to be affected, thus reducing the probability of turnover. At the executive characteristics level, *Tenure* enhances an executive's role in the firm's decision making, thus reducing the likelihood that such executives, and older (*Age*) executives, will leave the company.

The results of the test of Model (4) show that regardless of which measurement method is used, the interaction coefficients between *EPU* and *Risk1* and between *EPU* and *Risk2* are always significantly negative. Corporate risk-taking reduces the positive effect of economic policy uncertainty on executive departure rates, thus supporting H2, and indicating that corporate risk-taking can reduce the negative perception of a company's external environment.

In the subsample regression for Model (5), the coefficient on *EPU* is significantly negative in the *Duality* group, while the coefficient in the *Non-Duality* group is positive but not significant. In addition, the seemingly uncorrelated estimation test demonstrates that the *EPU* coefficients are significantly different between the two groups, indicating that director-manager duality reduces the positive impact of uncertainty on executive turnover, and even leads enterprises to introduce risk aversion measures to avoid fluctuations in personnel, thus supporting H3. These results demonstrate that director-manager duality can enhance a company's ability to resist risk and adapt to highly uncertain economic environments.

4.3. Robustness test

To ensure the reliability of the findings, the following robustness tests are conducted.

(1) Replace the measurement of the economic policy uncertainty index.

Dummy variables (*DummyEPU*) are used instead of continuous variables (*EPU*). *Dummy EPU* is divided into high uncertainty ($DummyEPU = 1$) and low uncertainty ($DummyEPU = 0$) subsamples according to whether the EPU is equal to or greater than the median *EDU*. The regression results are shown in Table 5. The regression coefficient for *DummyEPU* remains significantly positive and the coefficient for the interaction

Table 4
EPU, risk-taking, and executive turnover.

Variables	Dependent variable: *TURN*					
		Model(3)	Model(4)		Model(5)	
	Full sample	Full sample	Full sample	Full sample	Duality sample	Non-duality sample
EPU	0.204***	0.128**	0.110*	0.090	−0.525**	0.020
	(4.13)	(2.31)	(1.96)	(1.58)	(-2.57)	(0.32)
EPU Risk1*			−0.023***			
			(-2.73)			
Risk1			0.022***			
			(2.90)			
EPU Risk2*				−0.011***		
				(3.61)		
Risk2				0.010***		
				(3.08)		
ROA		−1.290***	−1.163***	−1.146***	1.714	−1.552***
		(-3.02)	(-2.71)	(-2.67)	(1.36)	(-3.12)
Size		0.070	0.079	0.081	−0.301*	0.053
		(1.39)	(1.54)	(1.58)	(-1.83)	(0.89)
Debt		0.024	0.012	0.003	1.377**	−0.295
		(0.12)	(0.06)	(0.02)	(2.12)	(-1.19)
MB		1.004	0.828	0.940	1.796	1.620
		(0.98)	(0.81)	(0.92)	(0.57)	(1.35)
Soe		0.195	0.180	0.183	0.322	0.170
		(1.31)	(1.21)	(1.23)	(0.51)	(0.98)
Top1		−0.003	−0.003	−0.003	−0.016	0.003
		(-0.94)	(-0.88)	(-0.85)	(-1.46)	(1.00)
Board		−0.077***	−0.077***	−0.076***	−0.103	−0.048*
		(-3.22)	(-3.22)	(-3.20)	(-1.16)	(-1.79)
Independence		0.954	0.938	0.931	−1.174	1.267*
		(1.52)	(1.50)	(1.48)	(-0.59)	(1.74)
Dual		−0.165***	−0.168***	−0.167***		
		(-2.66)	(-2.71)	(-2.68)		
Tenure		−0.134***	−0.133***	−0.133***	−0.137***	−0.133***
		(-14.54)	(-14.41)	(-14.41)	(-4.85)	(-12.90)
Age		0.007*	0.007*	0.007*	0.010	0.010**
		(1.81)	(1.79)	(1.80)	(0.98)	(2.12)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
N	15,451	15,451	15,451	15,451	1970	12,017
Pseudo R2	0.007	0.029	0.030	0.030	0.062	0.024
Chi2	94.382	370.184	382.916	384.577	84.157	243.759

Notes:
(1) This table shows the results of the panel Logit model regression in which the year and company fixed effects are controlled.
(2) z-values are reported in parentheses. * Statistical significance at the 10% level. ** Statistical significance at the 5% level. *** Statistical significance at the 1% level.
(3) As *Risk1* and *Risk2* are both continuous variables, the tests use the cross multiplication method, whereas the Dual variable is used for the test with the stratified regression. In addition, we conduct a seemingly uncorrelated estimation test for the stratified regression results; the test results are Chi2 = 5.78, P = 0.016, which pass the difference test.

EPU Risk* remains significantly negative, thus supporting the main findings. The control variables are similar to those in Table 4.

(2) Panel probit regression method.

The panel probit regression is further applied to regress the relationship between economic policy uncertainty and executive turnover. The regression results reported in Table 6 show that H1 and H2 are still verified.

Table 5
Alternate measurement of *EPU*.

Variables	Dependent variable: *TURN*				
	Model(3)	Model(4)		Model(5)	
	Full sample	Full sample	Full sample	Duality sample	Non-duality sample
DummyEPU	0.267**	0.290**	0.261**	−1.092**	0.042
	(2.31)	(2.39)	(2.16)	(−2.57)	(0.32)
EPU Risk1*		−0.021*			
		(−1.96)			
Risk1		0.031***			
		(3.00)			
EPU Risk2*			−0.010**		
			(−2.14)		
Risk2			0.015***		
			(3.12)		
Controls	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes
N	15,451	15,451	15,451	1970	12,017
Pseudo R2	0.029	0.029	0.030	0.062	0.024
Chi2	370.184	379.271	381.796	84.157	243.759

Notes:
(1) This table shows the results of the panel logit model regression in which the year and company fixed effects are controlled.
(2) z-values are reported in parentheses. * Statistical significance at the 10% level. ** Statistical significance at the 5% level. *** Statistical significance at the 1% level.

Table 6
Panel probit regression method.

Variables	Dependent variable: *TURN*				
	Model(3)	Model(4)		Model(5)	
	Full sample	Full sample	Full sample	Duality sample	Non-duality sample
EPU	0.090***	0.070**	0.008	0.112	0.076**
	(3.05)	(2.38)	(0.27)	(1.44)	(2.37)
EPU Risk1*		−0.005			
		(−1.12)			
Risk1		0.022***			
		(7.47)			
EPU Risk2*			−0.008**		
			(−2.57)		
Risk2			0.018***		
			(8.65)		
constant	−0.978***	−1.186***	−0.961***	−2.088**	−0.677*
	(−2.62)	(−3.19)	(−2.58)	(−2.05)	(−1.69)
Controls	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes
N	18,255	18,255	18,255	4299	13,956
Chi2	1317.252	1384.524	1403.067	320.082	878.859

Notes:
(1) This table shows the results of the panel probit model regression and the random effect model, which passed the random effect test.
(2) z-values are reported in parentheses. * Statistical significance at the 10% level. ** Statistical significance at the 5% level. *** Statistical significance at the 1% level.

However, H3, relative to director-manager separation, director-manager duality reduces the impact of uncertainty, but does not protect senior executives. The control variables are consistent with the results in Table 4 and do not change significantly (not reported).

(3) Endogeneity test.

Missing variables at the macro level can cause endogeneity problems. For example, macroeconomic changes can lead to changes in economic policy uncertainty and alter the frequency of executive changes. If the macroeconomic factors are not controlled, they can introduce an endogenous bias into the findings. To mitigate this endogeneity problem, we follow Gulen and Ion (2016) and Li and Yang (2015) and include *GDP growth* as a control variable in the regression model, and also control for *firms' boom index*. Controlling for the effects of these variables, the regression results remain robust and mitigate the endogeneity problem caused by the absence of macro-level variables.

An instrumental variables approach is also used to prevent the endogeneity problem arising from omitting variables that may change over time. Drawing on Wang and Song (2014), we use a lagged one-period index of U.S. economic policy uncertainty and include its logarithm as an instrumental variable for the Chinese economic policy uncertainty indicator in a two-stage ivprobit regression. The results are shown in Table 7. As can be seen from the regressions, hypotheses H1 and H2 are still confirmed. However, in the subsample regressions, director-manager duality does not play a role in mitigating the impact of economic policy uncertainty.

5. Further analysis

According to the preceding analysis, economic policy uncertainty can lead to increased executive turnover because the uncertainty affects the performance and strategic stability of enterprises. To further clarify the impact of economic policy uncertainty on executive turnover, in this section we focus on the impact of economic policy uncertainty on the performance and strategic stability of enterprises. Internal factors at the firm level, such as performance pressure, the nature of ownership, and the size of the firm, determine the extent of the shock to a firm. Executive traits are also analyzed to determine which executives are more likely to be fired in a highly uncertain environment.

Table 7
Second stage results of the instrumental regression.

Variables	Dependent variable: *TURN*				
	Model(3)	Model(4)		Model(5)	
	Full sample	Full sample	Full sample	Duality sample	Non-duality sample
EPU	0.340***	0.313***	0.239***	0.313***	0.301***
	(5.11)	(4.62)	(3.30)	(4.62)	(4.40)
EPU Risk1*	–	−0.016			
		(−0.68)			
Risk1	–	0.021***			
		(3.73)			
EPU Risk2*	–		−0.022**		
			(−2.13)		
Risk2	–		0.017***		
			(5.59)		
constant	−1.620***	−1.796***	−1.797***	−1.796***	−1.796***
	(−3.76)	(−4.18)	(−4.21)	(−4.18)	(−4.20)
Controls	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes
N	15,570	15,570	15,570	15,570	15,570
Chi2	1107.432	1148.272	1167.026	1148.272	1152.100

Notes:
(1) This table shows the results of the iv probit model regression in which the year and industry dummy variables are controlled.
(2) z-values are reported in parentheses. * Statistical significance at the 10% level. ** Statistical significance at the 5% level. *** Statistical significance at the 1% level.

5.1. What kinds of firms are more affected by the shock?

(1) Industry prosperity

The industry environment, as a *meso*-environment, can alter the impact of the macro-environment on micro-enterprises. Different industries are affected to different degrees by economic uncertainty, while the prosperity of an industry can also affect an enterprise's perception of the external macro environment. Jenter and Kannan (2015) find that when an industry as a whole is poorly managed, executives are more likely to be fired, and this phenomenon is more pronounced during recessions. Therefore, in a highly uncertain economic environment, if a company is operating in an industry that is not doing well, it will face more risk and have a greater need for internal consolidation and strategic adjustment. Following Deng and Zeng (2019), we use the sample firms' 2010–2019 annual ROA, and calculate the median value (MROA) for each year by industry, and then calculate the industry median value (MMROA). When an MROA of a firm's industry in year t is greater than the MMROA, this indicates the industry is operating well during that year. Thus, we divide the total sample into two subsamples consisting of higher and lower MROA values and test Model (3). The regression results are shown in Table 8. The coefficients of *EPU* are significantly and positively correlated at the 10% confidence level in the industry *depression* group, whereas the results for *EPU* in the industry *boom* group are not significant, which indicates that the industry prosperity affects the impact of economic policy uncertainty on executive turnover, with companies in recession industries being more likely to be affected by the uncertainty.

(2) Performance pressure

Modern enterprises usually implement executive compensation plans and job assessment mechanisms that are closely related to corporate profits, which thus reduces the personal income of managers when the company's profit declines and increases their performance pressure and even threatens their position. By increasing managers' performance pressure, uncertainty poses a further threat to business operations and makes it difficult for enterprises to meet their business performance targets. A declining share price due to substandard performance or failure to achieve a firm's equity incentive plans may result in executive dismissals or the voluntary departure of executives. Therefore, following, we use each firm's total profit plus the total asset impairment provision to obtain the "total profit adjusted for impairment." If a company's "total profit adjusted for impairment" for the current year is less than its total profit for the previous year, this indicates that managers are under pressure to perform in the current year. Accordingly, the total sample is divided into two groups of higher performance pressure and low performance pressure firms to test Model (3). The grouped regression results are shown in Table 8. The coefficient of *EPU* for the group with higher performance pressure is signif-

Table 8
Types of firms that are more affected by economic uncertainty.

Variables	Dependent variable: *TURN*								
	Depression	Boom	Higher pressure	Lower pressure	Non-SOEs	SOEs	Size: Small	Size: Median	Size: Large
EPU	0.304*	−0.042	0.677**	0.125*	0.190**	0.018	−0.069	0.375***	0.129
	(1.82)	(−0.34)	(2.17)	(1.88)	(2.12)	(0.24)	(−0.66)	(2.99)	(1.17)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	5328	6884	3201	9665	8065	7172	4425	4287	4927
Pseudo R2	0.017	0.042	0.035	0.031	0.036	0.028	0.039	0.023	0.030
Chi2	71.614	222.042	82.748	243.591	225.617	178.499	137.780	78.338	121.498
Test of the difference in the coefficients of EPU									
Chi2			2.81*		3.18*		2.33		8.20**
p-value			0.0935		0.0744		0.1271		0.0166

icantly higher than that for the group with lower performance pressure, which indicates that performance pressure leads to increased executive departures in uncertain economic environments.

(3) SOEs and non-SOEs

Enterprises with different property rights react differently to economic policy uncertainty. SOEs have better institutions, more stable bank loans, more government subsidies, and more social and economic incentives than non-SOEs. However, the appointment and dismissal of executives in SOEs are subject to government intervention (SASAC), which can weaken the impact of the changing market conditions on firms. Thus, different firms face different levels of economic policy uncertainty and respond in different ways, with SOEs being more resistant to external risks and more motivated to maintain business stability. Therefore, we divide the whole sample into SOEs and non-SOEs and perform a test on Model (3). The regression results show that *EPU* is significantly positive only for non-SOEs, indicating that non-SOEs have more difficulty bearing external risks.

(4) Size of the enterprise

In terms of risk resilience, large companies have well-developed development profiles and risk management mechanisms that enable them to deal with the changing economic environment, and thereby reduce the rate of executive turnover. With respect to resources and capabilities, the resources available to an enterprise can ensure a smooth strategic transformation and help companies to quickly adapt to the changing external environment. Zhou and Luo (2005) and Nie et al. (2008) find that while large-scale firms are more willing to proactively innovate, and are also more likely to proactively choose to replace executives in times of uncertainty, small-scale firms are more likely to survive in uncertain environments and are therefore more likely to avoid personnel changes. Accordingly, we compare the sizes of firms to the median size of the same industry in the same year, and divide the sample into three groups: small, medium, and large. The regression results for our test of Model (3) show that *EPU* is significantly positive for medium-sized firms, negative but not significant for small-sized firms, and positive but not significant among larger firms. In this case, smaller firms, being extremely sensitive to risk, are more likely to respond with risk-averse measures, whereas large-scale enterprises, while resilient to risk, may also need to implement strategic changes and proactively decide to change executives. Our findings indicate that only medium-sized firms have some need for change, and thus in an environment of uncertainty, such firms are more prone to executive turnover.

5.2. Types of executives that firms are more likely to fire

(1) Age

Li et al. (2015) argue that older executives are likely to have political capital and therefore have more bargaining power when negotiating pay contracts. However, research also suggests that older executives tend to be more conservative, less likely to engage in risk-taking (Li and Cao, 2020), and less able to adapt to the changing external environment. Thus, while age may enhance an executive's standing in the company and defensive capabilities, he or she may be more likely to leave the company because he or she cannot adapt to the changing external environment. (see Table 9)

Accordingly, we divide the executives into two subsamples based on their average age, namely those younger than 50 and those older than 50 but younger than 60 (retirement age). The regression results of a group test on Model (3) show that the coefficients and significance of *EPU* are greater in the older executive group than in the younger group, indicating that older executives who are less likely to be replaced are usually more affected by these shocks. This is consistent with studies showing that with increasing age, corporate executives become progressively less adaptable to changes in the external environment, possess inadequate analytical skills for making business decisions, and too often rely on past successes when making strategic business decisions. Thus, companies have greater incentives to replace older executives during periods of economic uncertainty.

Table 9
Types of executives that firms are more likely to fire.

Variables	Dependent variable: *TURN*			
	50 < Age < 60	Age<=50	Tenure: Long	Tenure: Short
EPU	0.473***	0.234**	1.059***	0.092
	(4.86)	(2.37)	(9.04)	(1.22)
Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes
N	6043	5566	6756	8077
Pseudo R2	0.070	0.049	0.119	0.063
Chi2	320.873	216.988	516.250	441.139
Test of the differences in the coefficients of EPU				
Chi 2		3.11*		41.93***
p-value		0.0776		0.000

(2) Tenure

The longer an executive's tenure, the more corporate experience and social resources he or she accumulates, and the more secure his or her position becomes. Moreover, the longer an executive remains in office, the more likely he or she will form interest groups and increase his or her control over the company, thereby reducing the likelihood that he or she will be replaced. However, longer tenure may also result in an executive becoming more averse to risk, less willing to implement strategic changes, and less likely to invest in technological innovation.

Accordingly, we divide the sample into two subsamples with longer tenure and shorter tenure based on the average tenure of executives to the industry median. The regression results of a group test of Model (3) show that *EPU* is significantly positive only for the long tenure group. Thus, longer tenure may generate an executive entrenchment effect. Nonetheless, in an uncertain environment, as longer tenure can delay or hinder a firm's pace of adapting to change, the firm is more likely to take the opportunity to engage in internal reorganization.

6. Conclusion

We use the Chinese economic policy uncertainty index of Baker et al. (2013) to examine the impact of economic policy uncertainty on executive turnover. Our results suggest that economic policy uncertainty can influence the turnover of senior executives, and that the extent and direction of the impact depends on whether firms can tolerate such shocks. The mechanism of non-inclusiveness is that economic policy uncertainty reinforces the negative perceptions of firms and encourages strategic corporate change, thus increasing the probability of executive departures. Thus, corporate risk-taking partly reduces the negative perceptions of external uncertainty and helps companies endure periods of economic difficulty. The mechanism of inclusiveness is that during periods of economic policy uncertainty, companies avoid internal and external risks and make more conservative turnover decisions, thereby reducing the rate of executive turnover. Therefore, dual director-manager executives are better able to adapt to volatile environments and reduce the impact of uncertainty by ensuring the tenure of executives. These mechanisms moderate the effect of uncertainty in triggering executive departures. Further analysis reveals that when facing industry downturns and performance pressure, non-SOEs and medium sized firms are more vulnerable to external uncertainty because their negative perceptions of the environment are stronger and they need to engage in strategic repositioning. Moreover, the analysis of executive traits shows that to adapt to the changing environment, enterprises are more likely to dismiss older senior executives and those with longer tenure. Our main implications are as follows.

First, by including economic policy uncertainty in the framework of executive change, we empirically demonstrate that executive turnover is indeed influenced by the external environment. Thus, we show that

the external environment is an important factor that cannot be ignored in analyses of business behavior and decision making.

Second, external uncertainty not only affects a company's social environment, but can also have psychological effects on employees, thereby increasing the need to strengthen firms' corporate performance evaluation systems and the consistency of their implementation.

Third, departing from the studies that treat executive turnover only as a constraint mechanism, we examine executive turnover as a strategic decision and show that it can profoundly affect the strategic positioning and transformation of companies. The departure of executives from their functions also gives companies opportunities to make strategic changes and the flexibility to adapt to changes in the environment. However, firms also need to pay attention to the impact of economic uncertainty on internal personnel arrangements, attach greater importance to the management of succeeding senior executives, and improve their emergency management systems to enhance their ability to cope with external changes.

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14/1 China Journal of Accounting Research Vol. 14/1 (2021) 1–100

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