International Review of Economics and Finance 27 (2013) 112–124

Contents lists available at SciVerse ScienceDirect

International Review of Economics and Finance

journal homepage: www.elsevier.com/locate/iref

Dividends, investment and cash flow uncertainty: Evidence from China

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ARTICLE INFO

Article history:
Received 8 May 2011
Received in revised form 9 September 2012
Accepted 11 September 2012
Available online 29 September 2012

JEL classification:
G31
G35

Keywords:
Dividend
Investment
Cash flow uncertainty

ABSTRACT

This paper investigates the relation between dividends and investment for Chinese listed firms in a condition of cash flow uncertainty. We find that facing cash flow uncertainty, Chinese firms neither cut dividends nor cut investment, but maintain extremely high level of investment. External financing is the only instrument that resolves cash flow uncertainty. We further find that there is an "N-shaped" nonlinear relation between dividends and investment given different levels of cash flow uncertainty. These results can be explained by China's special institutional settings in which firms have strong incentives to spend capital on both dividend payout and make investment.

1. Introduction

In the perfect world of Miller and Modigliani (1961), dividend and investment decisions are separable because firms can freely acquire the capital they need. However, in an imperfect capital market where firms cannot obtain unlimited capital for both investment and dividends, they must rely more on internally generated cash flow. Once such cash flow becomes uncertain (e.g., firms run out of cash or experience volatile cash flow), firms must decide to cut dividends, cut investment, adjust cash holdings or acquire external financing. In this study, we empirically investigate the relation between dividend and investment decisions by observing how firms resolve cash flow uncertainty within China's institutional settings, in which firms have strong incentives to spend capital on both dividends and investment.

Our research is motivated by the long-term debates over the association between dividends and investment. Following Miller and Modigliani's (1961) seminal study, a number of studies provide empirical evidence on how dividends interact with investment. Some of this research supports the irrelevance argument (e.g., Fama, 1974) while others provide contradictory results suggesting that dividends are interdependent with investment (e.g., Dhrymes & Kurz, 1967; Louton & Domian, 1995). Scholars also extend the dividends and investment framework by including other factors such as the cost of external capital (Pogue, 1969), financial constraints (Holt, 2003) and financial flexibility (Daniel, Denis, & Naveen, 2008).

Most previous research has an implied assumption that dividends are of second-order importance relative to investment decisions. However, some survey evidence shows that firms make dividend decisions first (Lintner, 1956) or address dividends and investment simultaneously (Brav, Graham, Harvey, & Michaely, 2005). Managers are reluctant to reduce dividends, and

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http://dx.doi.org/10.1016/j.iref.2012.09.005

maintaining dividends is at least as important as making investments (Brav et al., 2005). In this case, dividend and investment decisions are interdependent, but dividends are no longer of second-order importance, which contradicts the empirical results of previous studies.

In response to the abovementioned inconsistencies regarding the association between dividends and investment, we address the issue by observing dividend and investment decisions under the condition of uncertain cash flow. Firms with uncertain cash flow have more difficulty accessing external finance and face higher cost of capital because such uncertainty indicates higher risk to capital providers. In this case, firms are more financially constrained and must rely on internally generated cash flow, which affects both dividends (Chaya & Suh, 2009) and investment (Minton & Schrand, 1999). The condition of uncertain cash flow allows us to better understand how firms make dividend and investment decisions when they have difficulty acquiring internal and external capital.

China provides an excellent institutional setting for our investigation for several reasons. China's rapid growth has been driven by high investment rates (39% on average) (Song, Storesletten, & Zilibotti, 2011). Bayoumi, Tong, and Wei (2010) show that the corporate investment of Chinese firms ranks third among 51 countries around the world. Such high investment is motivated by local governments' desire to promote local economic growth and banks' preferences for large firms. In contrast, Chinese firms are more reluctant to cut dividends than firms in other markets because continuous dividend payment is one of the qualifications required by authorities for seasoned equity offerings. Given these institutional settings, the relation between dividends and investment and the financial decisions of Chinese listed firms could be significantly different from the decisions of firms in other markets.

Our empirical results provide evidence on the differences in the decision-making process for dividends, investment and financing as exercised by Chinese listed firms. We first employ a similar methodology to that used by Daniel et al. (2008) to investigate how Chinese firms resolve cash flow uncertainty, measured by cash flow shortfall and cash flow volatility. We find that, unlike US firms, when facing uncertain cash flow Chinese firms do not cut dividends or investment. Moreover, even with uncertain cash flow, they still maintain a high level of investment. To resolve cash flow uncertainty, they mainly raise capital from external financing and almost do not reduce the cash balance or increase non-operating cash to cover uncertain cash flow.

Based on the abovementioned primary results on dividends, investment and financing, we further investigate how the relation between dividends and investment changes with cash flow uncertainty. Our empirical results show that the investment–dividend sensitivity first increases, then decreases and increases again with increase of cash flow uncertainty. These sensitivity analyses reveal an “N-shaped” nonlinear relation between dividends and investment given different levels of cash flow uncertainty that is further confirmed by piecewise and cubic regressions. When we introduce interaction terms of dividend and cash flow uncertainty into the investment–dividend regression, we find that investment and dividends share a negative interdependent relation only at a certain level of cash flow uncertainty. The “N-shaped” nonlinear relation is also supported by a cubic regression with dividend, square and cube of cash flow uncertainty interaction terms.

Compared to previous research, our findings appear inconsistent with both empirical evidence (e.g., Daniel et al., 2008) and survey evidence (e.g., Brav et al., 2005; Lintner, 1956) from the developed market. Our new results on dividends, investment and financing provide additional evidence from the emerging market that can be applied to the traditional dividends and investment irrelevance debate. China's special institutional settings provide firms with strong incentives for both dividend payout and investment. These special institutions prompt firms to make different dividend, investment and financing decisions than those made by firms in developed or even in other emerging markets. Our results suggest that different institutions can drive firms to make different decisions that deviate from those predicted by traditional theories. We also provide new evidence of the nonlinear association between dividends and investment according to different levels of cash flow uncertainty that complements previous research, which has shown that dividends and investment are jointly determined, such that nonlinear linkages exist between the two decisions (Mougoue, 2008). We identify cash flow uncertainty as the factor that jointly determines dividend and investment decisions. We further find that an “N-shaped” nonlinear relation exists and that it changes according to different levels of cash flow uncertainty.

The rest of this paper is organized as follows. Section 2 briefly reviews the related literature and introduces China's institutional settings. Section 3 describes our data and methodology. Section 4 presents the primary results on how firms resolve cash flow uncertainty. Section 5 reports regression results on the relation between dividends and investment and Section 6 concludes the paper.

2. Research background

2.1. Related literature

Miller and Modigliani (1961) were the first to theoretically show that dividends and investment are independent in a perfect market. Since then, the association between these two important financial decisions has become a hotly debated issue within corporate finance literature. Dhrymes and Kurz (1967) provide the earliest empirical evidence of the relation between dividends and investment. Employing simultaneous-equation, they find that dividend and investment are interdependent and that a stable dividend policy hampers investment through the reduction of internal capital, whereas firms with residual dividend policy first cut dividends for investment needs. Using a similar methodology, Fama's (1974) contradictory results show that dividends and investment are independent regardless of whether the market is efficient. Evidence from Higgins's (1972) dividend-saving model suggests that dividends can be a function of profit and investment and that the variation in dividends is caused by profitability

and investment demands. Specifically, dividends are positively related to profit and negatively related to investment, but investment is not determined by dividends. Louton and Domian (1995) argue that the inconsistent results of previous research are caused by relatively short sample periods. They extend the sample periods for 212 US firms to 37 years and their Granger causality tests show that dividends relate to investment in 33% of the sample firms. Despite the research on US firms, much of the emerging literature from other markets (e.g., Bhaduri & Durai, 2006; McDonald, Jacquillat, & Nussenbaum, 1975; Morgan & Saint-Pierre, 1978; Wang, 2010) concur that under certain conditions, dividends and investment are interdependent, with the dividend decision being of second-order importance to the investment decision.

Inconsistent with the abovementioned theoretical and empirical research, some evidence from managers suggests that not every firm employs the residual dividend policy. Lintner's (1956) survey shows that firms decide on their dividend policy first and then determine their level of investment. When firms are short of cash, they reduce capital budget to maintain or even increase dividends. Minton and Schrand (1999) find that firms with cash flow shortages will give up investment opportunities rather than acquire external capital. The survey on CFOs by Brav et al. (2005) suggests that "maintaining the dividend level is a priority on par with investment decisions," and that managers are unwilling to cut dividends "except in extraordinary circumstances." However, their evidence further shows that dividend increases are secondary to investment decisions. This stream of literature indicates that dividends and investment are still not separable, but that in some degree, dividend decisions are at least as important as investment decisions.

2.2. China's institutional settings

High enterprise investment, ranging from 27% to 35% of China's GDP from 1990 to 2003, is one of the key factors that distinguishes China from other countries (Kuijis, 2005; Song et al., 2011). Bayoumi et al. (2010) find that China's corporate investment is significantly higher than the global average and its relative investment rate (condition on common sector, year fixed effects and firm size) ranks third among 51 investigated countries.

This strong incentive can be explained by China's special institutional settings. As a country shifting from a planned to a market economy, the behavior of Chinese listed firms is still strongly affected by the government. In the process of economic reformation, central government decentralizes the control rights to local governments, which obtain greater autonomy in economic policies and fiscal revenues. "China's federalism" motivates different levels of government to pursue economic growth, which is also the main index for evaluating government officials (Qian and Roland, 1998). Investing is one of the most important instruments used by governments to promote GDP growth (Song et al., 2011) and they can use instruments such as basic resource allocation, project approval and favorable policies to push Chinese firms, especially the state-owned enterprises (SOEs), to invest heavily in capital expenditure or diversification. Fan et al. (2007) find that, thusly affected by government, Chinese firms, especially SOEs, diversify into low-growth, low-profitability and unrelated industries. Chow, Song, and Wong (2010) find that higher state ownership is associated with lower investment–cash flow sensitivities, suggesting that SOEs are less financially constrained.

Another motivation behind a high level of investment originates in China's banking system. When issuing bank loans, Chinese banks reveal a preference for larger firms because in business environments with weak property rights protection and serious information asymmetry, banks can only evaluate debt risk using firm size. As bank loan is still the main source for raising capital for most Chinese firms (Allen, Qian, & Qian, 2005; Chan, Fung, & Thapa, 2007), firms have an incentive to overinvest as a way of building business empires to convince banks of their capacity to repay the loans. Considering the abovementioned institutions together, Chinese firms have stronger incentives to invest than firms in other countries.

Compared to firms in other countries, Chinese firms also have strong incentives to pay continuous dividends, which is a necessary qualification for equity refinancing. In 2001, the China Securities Regulatory Commission (CSRC) issued the "guidance for new share issuance," which requires that if firms do not pay continuous cash dividends in the previous three years and their boards do not provide reasonable explanations, firms' refinancing applications can be rejected. Later, the "guidance for IPO approval," initiated by CSRC, also emphasized the importance of continuous dividend payout in the previous three years when approving IPO applications.

According to these regulations, listed firms begin to significantly increase cash dividend payouts to obtain qualification for refinancing. Fig. 1 clearly shows the changes in dividend decisions for all Chinese listed firms from 1991 to 2010. Around 2001, the percentage of cash dividend payers in all listed firms jumped from less than 30% to more than 50%, and the percentage maintained stability throughout the subsequent years. In 2006, CSRC required listed firms applying for equity refinancing to pay cash dividends of no less than 20% of the distributable profit in the previous three years. In 2008, that figure increased to 30%. These regulations reflect the authorities' efforts to encourage listed firms to pay cash dividends. To obtain approval for equity refinancing, Chinese listed firms must maintain the level of dividends.

Keeping the abovementioned institutions in mind, we follow the traditional dividends and investment framework, but introduce cash flow uncertainty as a given condition. Cash flow has been well documented as the determinant for investment and dividends. Beginning with Fazzari, Hubbard, and Petersen (1988), a line of literature argues that firms rely more on internally generated capital when they are financially constrained. Greater cash flow uncertainty increases the risk of external capital providers, causing a higher cost of capital, which leaves firms more financially constrained to the extent that they must reduce investment due to limited capital (Minton & Schrand, 1999). Cash flow uncertainty also has been identified as an important determinant of dividend payout and has the most significant effect on other dividend determinants (Chaya & Suh, 2009). Bhaduri and Durai (2006) confirm the joint determination of financing and investment decisions in emerging markets. Mougoue (2008)

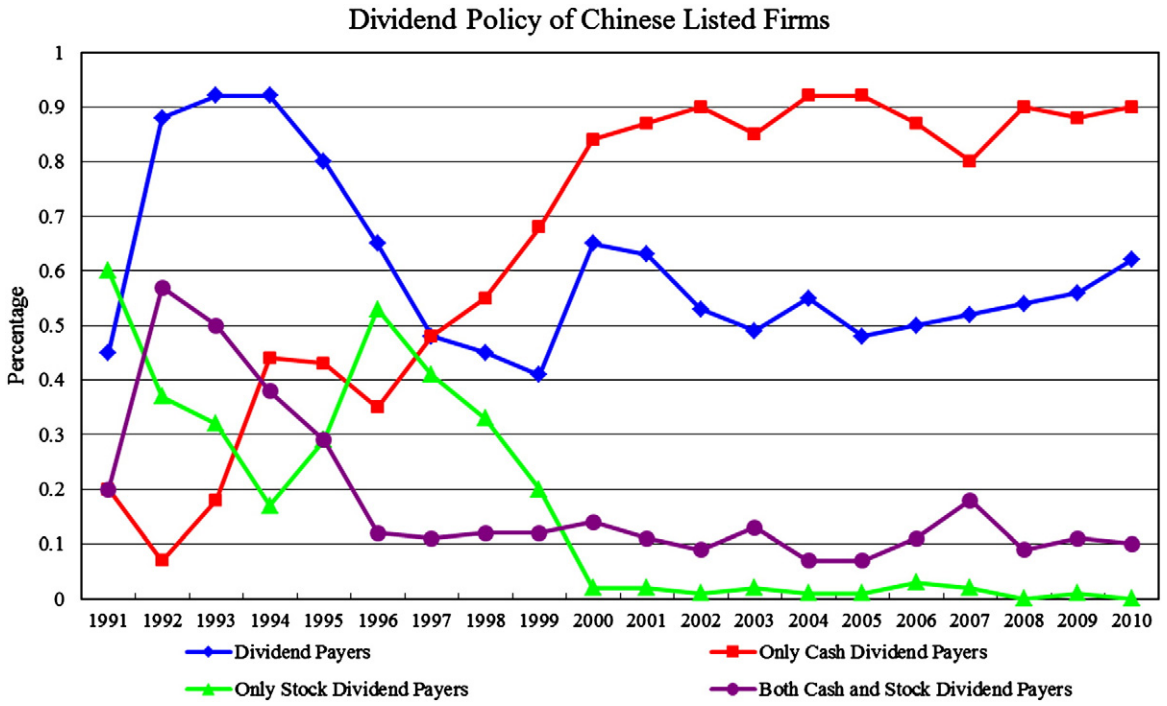

Fig. 1. Dividend policy of Chinese listed firms. This figure plots the percentage of firms which pay either cash or stock dividend, only cash dividend and only stock dividend to total listed firms. The blue line labeled as dividend payers is percentage of firms paying dividend. The red line labeled as cash dividend payer is percentage of firms only paying cash dividend as of the total listed payers. The green line labeled as stock dividend payer is percentage of firms paying stock dividend as of the total listed payers.

further uses a nonlinear causality test to show that dividends and investment are jointly determined, and that there is a bi-directional relationship between dividends and investment. Daniel et al. (2008) investigate the association between dividends, investment and cash flow shortfall in a study that is similar to ours. They mainly use descriptive evidence to show that when firms experience cash flow shortfall, they cut investment first rather than cut dividends and that the major way to cover shortfall is through debt financing.

Based on the literature, we adopt a methodology similar to that used by Daniel et al. (2008) to analyze the association between dividends and investment, given the joint determinant — cash flow uncertainty. Unlike Daniel et al. (2008), however, we not only use cash flow shortfall, but also cash flow volatility to measure cash flow uncertainty. Moreover, we show how the relation between dividends and investment changes according to cash flow uncertainty. We first provide descriptive evidence and provide a diagram that illustrates how investment–dividend sensitivity changes with cash flow uncertainty. We then provide evidence from piecewise and cubic regressions of how cash flow uncertainty jointly determines dividends and investment. In addition to these different methodologies, we obtain significantly different results with our Chinese data from those obtained by Daniel et al. (2008) using US data.

3. Data and methodology

Our sample is composed of Chinese firms listed from 2000 to 2010. We start in 2000 because the cash flow data for listed firms are only available after 2000. We exclude financial firms and firms with negative equity. We also require all firms to have complete financial data throughout the sample period. Outliers are winsorized by 1% on two sides. Our final sample includes 14,141 firm-year observations. Dividend data are from the China Stock Market Accounting Research (CSMAR) database and other financial data are from the China Center for Economic Research (CCER) database.

The most important variable in our research is cash flow uncertainty. The first measure for uncertainty is cash flow shortfall (*CashShort*) from Daniel et al. (2008). Cash flow shortfall is calculated as follows:

$$\textit{Cash flow shortfall} = \textit{Expected investment} + \textit{Expected dividend} - \textit{Available Cash Flow} \quad (1)$$

For expected dividend, we follow DeAngelo and DeAngelo (1990), DeAngelo, DeAngelo, and Skinner (1994) and Healy and Palepu (1990) and use dividend paid in the previous year.

For expected investment, we follow the methodology in Daniel et al. (2008). We first calculate the median of industry investment, which then is divided by industry lagged assets. We then multiply industry values by firms' lagged assets to get the firms' expected investment. Investment includes capital expenditure for fixed assets, intangible assets and other long-term assets.

Available cash flow is the net cash flow from operating activities. Because there are no preferred stocks and listed firms are not required to disclose R&D expenditures in China, we do not use adjusted cash flow as Daniel et al. (2008) do.

The second measure for uncertainty is cash flow volatility (*CFVol*). Following previous research (Chaya & Suh, 2009; Jayaraman, 2008), we use the standard deviation of the ratio of five years' operating cash flow to one-period lagged total assets.

Table 1 reports the descriptive statistics for main variables. Chinese firms show great variation in cash flow uncertainty. Cash flow shortfall has a mean of 38 million RMB with a standard deviation of 417 million RMB, ranging from −1835 to 2150 million. Cash flow volatility has a mean of 0.075 with a standard deviation of 0.062, ranging from 0.009 to 0.368. We also summarize the ways in which firms cope with cash flow uncertainty, specifically obtaining cash from non-operating cash flow, external finance and cash balance adjustments. Firms also display a large range of financing methods. One notable point is that non-operating cash and cash drawdown have negative means, which suggests that firms do not use these two methods to obtain additional capital. Only external cash has a positive value and it is much larger than that of non-operating cash and cash drawdown. This result indicates that firms mainly use external financing to raise capital.

To ensure that both cash flow shortfalls and cash flow volatility are relevant measures of cash flow uncertainty, we distribute the whole sample with different magnitudes of cash flow shortfalls and volatility in Table 2. We first divide all firms into five groups according to cash flow volatility. Within each group, we further divide the sample into five groups by cash flow shortfalls. A notable pattern is that with the increase of cash flow volatility, the magnitude of cash flow shortfalls also increases, which indicates a positive relation between cash flow volatility and cash flow shortfall. Correlation analysis shows that the two variables have a correlation coefficient of 0.665 that is significant at the 1% level.

4. Empirical results

4.1. How do firms resolve cash flow uncertainty?

We first investigate the dividend and investment decisions for firms with cash flow uncertainty by providing descriptive evidence of how firms resolve cash flow uncertainty. Throughout our analyses, we assume that firms only use five instruments to resolve cash flow uncertainty: cut dividends, cut investment, increase non-operating cash, obtain external financing and reduce cash balance. Given the aforementioned, the following equation holds:

$$\textit{Available cash} = \textit{Dividend cutback} + \textit{Investment cutback} + \textit{Non-operating cash} + \textit{External cash} + \textit{Cash drawdown} \quad (2)$$

Table 3 presents our results on cash flow uncertainty measured by cash flow shortfalls. In Panel A, we divide the sample into five groups by the level of shortfall. According to dividend and investment decisions, no matter whether cash flow shortfall is negative (groups 0 and 1) or positive (groups 2, 3 and 4), dividends stay negative and only slightly positive (1 million) in the last group in which firms have the largest cash flow shortfall. Across groups, investment has extremely large negative value that decreases with cash flow shortfall, but remains negative. These results imply that in the presence of cash flow shortfall, Chinese firms neither cut dividends nor cut investment, but even increase the expenditure on investment, which is much larger than the value of dividend payments. The imbalanced distribution of dividends and investment across groups also provides some evidence of the nonlinear effects of cash flow shortfall on investment.

Because dividends and investment are not methods used by Chinese firms to resolve cash flow uncertainty, we further look at how firms obtain cash to resolve such uncertainty. We identify three channel firms use to resolve cash flow uncertainty:

Table 1
Descriptive statistics. This table presents the descriptive statistics of the main variable used in this paper. Variables are defined in Appendix A. Real value variables are reported in million.

Variables	N	Mean	S.D.	Min	Max
Investment	14,141	270	680	0	4991
Dividend	14,141	108	233	0	1681
I_TA	14,141	0.072	0.081	0	0.418
Div	14,141	0.028	0.020	0	0.111
CashShort	14,141	38	417	−1835	2150
CashShort_TA	14,141	0.016	0.097	−0.318	0.333
CFVol	10,129	0.075	0.062	0.009	0.368
NonOpCash	14,141	−35	1041	−93526	24,614
ExternalCash	14,141	345	2230	−32113	11,0832
CashDrawdown	14,141	−114	1127	−53775	41,216
ExtCash_TA	14,141	0.061	0.137	−0.179	0.673

Table 2
Cash flow volatility and cash flow shortfall. This table presents sample distribution with different cash flow volatility and cash flow shortfall. Firms are sorted into five groups based on magnitude of cash flow volatility. Cash flow volatility is measured with standard deviation of five years' operating cash flow. Cash flow shortfall is estimated from model (1). In each group, the first row reports the value for cash flow shortfall, and the second row reports the number of observations.

		CashShort_Rank				
CFvol_Rank		Quintile1	Quintile2	Quintile3	Quintile4	Quintile5
Quintile 1	CashShort(M)	−1181	−98	86	169	235
	Firm-years	191	565	795	691	219
Quintile 2	CashShort(M)	−702	−77	95	278	304
	Firm-years	426	580	495	514	446
Quintile 3	CashShort(M)	−729	−64	79	212	309
	Firm-years	331	596	604	610	320
Quintile 4	CashShort(M)	−702	−118	96	232	684
	Firm-years	849	265	249	286	812
Quintile 5	CashShort(M)	−378	−65	81	174	376
	Firm-years	680	422	352	386	621
Sum	CashShort(M)	−3692	−423	437	1064	1908
	Firm-years	2477	2428	2495	2487	2418

non-operating cash flow (*NonopCash*), external financing (*ExternalCash*) and the adjustment of cash holdings (*CashDrawdown*), which are calculated as follows:

$$NonopCash = Cash\ received\ from\ sale\ of\ investment – Cash\ paid\ for\ PPE\ purchase – Cash\ paid\ for\ purchase\ or\ disposal\ subsidiaries + Cash\ received\ from\ investment\ revenue – Cash\ paid\ for\ investment\ in\ subsidiaries \tag{3}$$

$$ExternalCash = Cash\ received\ from\ equity\ investment – Cash\ paid\ for\ equity\ investment + Cash\ received\ from\ debt + Cash\ received\ from\ bond\ issuance – Cash\ paid\ for\ debt – Cash\ paid\ for\ dividend\ and\ interest – Cash\ paid\ for\ debt\ investment + Cash\ received\ from\ debt\ investment + Cash\ received\ from\ dividend \tag{4}$$

$$CashDrawdown = Change\ of\ cash\ and\ cash\ equivalents \tag{5}$$

Regarding these additional channels, the results in Panel A of Table 3 show that non-operating cash and cash drawdown have negative values in most groups, which suggests that firms also do not use these two channels to resolve cash flow shortfall. Only external cash has an extremely large positive value in all of the groups, even those in which firms do not have cash flow shortfall. These results show that Chinese firms mainly use cash from external financing to resolve cash flow shortfall.

The abovementioned results from our full sample analyses are further confirmed by our results from subsamples divided according to positive and negative cash flow shortfall as presented in Panels B and C of Table 3. Positive shortfall indicates that firms run out of cash and must obtain more cash from the abovementioned five channels. Our results show that firms with positive shortfall keep dividends almost unchanged, but still spend a lot on investment. Group 0, in which the included firms do not have serious cash flow shortfall, spent 122 million RMB or 291% of the shortfall on investment. Along with an increase in shortfall, firms reduce investment spending, but they never cut investment to cover shortfall. The results also provide some evidence of the relation between dividends and investment. Investment keeps decreasing with the increase in shortfall while dividends vary along with changes in shortfall, which suggests that the relation between these two decisions is not a simple linear one, given certain levels of cash flow uncertainty. Concerning the instruments to resolve uncertainty, we find that the only method firms use to cover shortfall is external financing. Although a firm's capacity for obtaining external cash flow is reduced by an increase in cash flow shortfall, external financing covers at least as much as all shortfall (104% in group 4). Non-operating cash and cash drawdown are much less important for covering shortfall, regardless of its level.

In Panel C of Table 3, we investigate the dividend, investment and financing decisions of firms with cash surplus, which is indicated by negative cash flow shortfall. The real value of investment increases with an increase in cash surplus, but the relative value keeps decreasing. Unlike investment patterns, dividends first decrease and then increase with changes in cash flow shortfall. Inconsistent patterns of change confirm a nonlinear relation between dividends and investment, given cash flow uncertainty. Our results also produce the interesting result that even when firms have plenty of cash, they still have a strong incentive to obtain capital from external financing. Even in the group in which firms have the largest cash surplus (group 0), they still obtain 59 million RMB from external financing. In addition to being used to pay dividends and invest, cash surplus is also used to increase non-operating cash and cash balance.

Noting that external cash is the major source for covering cash flow shortfall, we further investigate how firms obtain external cash in Table 4. We divide external cash into three categories: cash from equity financing, cash from debt financing and cash from other channels. The full sample in Panel A clearly illustrates that firms mainly acquire external capital from debt financing, which is consistent with some of the literature (e.g., Allen et al., 2005). Neither the value of debt financing nor the value of equity finance decreases with an increase in cash flow shortfall. The firms with positive cash flow shortfall in Panel B display a similar pattern in that they mainly cover cash flow shortfall with debt financing. The firms with cash surplus in Panel C still acquire a large amount

Table 3
How do firms resolve cash flow uncertainty? — Measure uncertainty with cash flow shortfall. This table presents how firms resolve cash flow uncertainty. Expected dividend is dividend paid in prior year. Cash flow uncertainty is measured with cash flow shortfall. Expected investment is industry median investment/lagged assets × firms' lagged assets. Available cash flow is net cash flow from operating activities. Cash flow shortfall equals Expected investment + Expected dividend — Available cash flow. Dividend cutback equals Expected dividend — Dividend. Investment cutback equals Expected investment — Investment. Non-operating cash is non-operating cash flow from statement of cash flow. External cash is cash flow from external financing, including equity and debt financing and cash from other channels. Cash drawdown is change of cash and cash equivalent. Panel A reports results for full samples. Panel B reports results for observations with positive cash flow shortfall. Panel C reports results for observations with negative cash flow shortfall. Numbers in each cell are the real value for each item, reported in million RMB. Percentage value is the percentage of certain item to total cash flow shortfall.

Cash short _Rank	Firm-year	Expected dividend	Expected investment	Available cash flow	Short fall	Dividend cutback	Investment cutback	Non-operating cash	External cash	Cash drawdown
Panel A Full sample										
0	2828	167	395	1202	−639	−45	−360	−117	97	−214
1	2828	149	294	545	−102	−14	−204	−30	244	−98
2	2829	146	276	327	95	−6	−139	−1	284	−41
3	2828	123	251	159	215	−5	−105	−10	334	1
4	2828	99	159	−198	456	1	−39	4	482	9
Panel B Positive cash flow shortfall										
0	1743	107	201	266	42	−13	−122	1	233	−56
						−32%	−291%	3%	554%	−132%
1	1743	176	335	356	155	1	−156	−15	333	−7
						0%	−101%	−10%	215%	−4%
2	1743	130	268	179	219	−2	−91	−6	325	−4
						−1%	−42%	−3%	148%	−2%
3	1743	104	196	25	274	−2	−67	−3	337	10
						−1%	−25%	−1%	123%	4%
4	1743	96	135	−323	554	1	−37	10	578	3
						0%	−7%	2%	104%	1%
Panel C Negative cash flow shortfall										
0	1085	110	198	1113	−805	−59	−327	−100	59	−377
						7%	41%	12%	−7%	47%
1	1085	212	553	1434	−669	−73	−550	−100	174	−119
						11%	82%	15%	−26%	18%
2	1086	232	535	1090	−323	8	−262	−119	213	−162
						−3%	81%	37%	−66%	50%
3	1085	113	222	438	−103	−19	−168	−34	202	−84
						19%	163%	34%	−196%	82%
4	1085	135	251	418	−33	−12	−136	−25	207	−68
						36%	418%	75%	−636%	208%

of capital from both debt and equity financing. These results also partially explain the reason that firms make significant investments. Because debt financing, largely from bank loans, is the major financing channel for Chinese firms, they must invest more to expand their firm size or on tangible assets to convince banks of their capacity to repay the loans. In addition, due to weak contract enforcement and legal effectiveness, banks use firm size or tangible pledges to lower the lending risk, which further motivates firms to invest (Tables 4).

We also measure cash flow uncertainty with cash flow volatility in Table 5. All of our observations are divided into five groups according to level of volatility. In Panel A, we find that similar to the results from cash flow shortfall, throughout all of the groups firms do not cut dividends or investment and only use external financing in the presence of cash flow uncertainty, such that the capital obtained from external financing increases with an increase in uncertainty. Firms also do not obtain cash from non-operating cash or cash balance, but increase even more in the two accounts when the uncertainty is the most serious (group 4).

In Panel B we also divide the external cash into three categories: cash from equity financing, cash from debt financing and cash from other channels. We discover a similar pattern in that firms mainly depend on debt financing to obtain cash and the capacity to obtain external capital does not decrease with an increase in cash flow uncertainty.

Taken as a whole, our results reveal a special relation between dividends and investment, given cash flow uncertainty, in Chinese listed firms that is quite different from what Daniel et al. (2008) observe in US firms. Measuring cash flow uncertainty using cash flow shortfall and volatility, we find that facing such uncertainty, Chinese firms neither cut dividends nor cut investment. On the one hand, these firms have volatile dividend payments that are indicated by positive and negative dividend cutback numbers. On the other hand, these firms maintain spending heavily on investment, which is indicated by decreasing but always negative investment cutback numbers. Although the level of investment decreases with an increase in uncertainty, even for firms with the greatest cash flow uncertainty, they still display negative investment cuts; that is, firms do not cut investment at all. Dividends and investment also reveal different patterns regarding changes in cash flow uncertainty, which suggests that there could be a nonlinear relation between the two decisions. The abovementioned results can be explained by China's particular institutional settings, in which firms pay continuous dividends to obtain qualification for equity refinancing and make large

Table 4
How do firms obtain external cash? — Measure uncertainty with cash flow shortfall. This table presents how firms obtain external cash. Expected dividend is dividend paid in prior year. Cash flow uncertainty is measured with cash flow shortfall. Expected investment is industry median investment/lagged assets × firms' lagged assets. Available cash flow is net cash flow from operating activities. Cash flow shortfall equals Expected investment + Expected dividend — Available cash flow. Dividend cutback equals Expected dividend — Dividend. Investment cutback equals Expected investment — Investment. Non-operating cash is non-operating cash flow from statement of cash flow. External cash is divided into three categories — cash flow from equity financing, cash flow from debt financing and cash flow from other channels. Cash drawdown is change of cash and cash equivalent. Panel A reports results for full samples. Panel B reports results for observations with positive cash flow shortfall. Panel C reports results for observations with negative cash flow shortfall. Numbers in each cell are the real value for each item, reported in million RMB. Percentage value is the percentage of certain item to total cash flow shortfall.

Cash Short _Rank	Firm-year	Expected dividend	Expected investment	Available cash flow	Short fall	Dividend cutback	Investment cutback	Non-operating cash	External cash			Cash drawdown
									Equity cash	Debt cash	Others	
Panel A Full sample												
0	2828	167	395	1202	−639	−45	−360	−117	94	448	−445	−214
1	2828	149	294	545	−102	−14	−204	−30	65	166	12	−98
2	2829	146	276	327	95	−6	−139	−1	83	202	−1	−41
3	2828	123	251	159	215	−5	−105	−10	79	251	5	1
4	2828	99	159	−198	456	1	−39	4	93	378	10	9
Panel B Positive cash flow shortfall												
0	1743	107	201	266	42	−13	−122	1	79	147	6	−56
						−32%	−291%	3%	188%	351%	15%	−132%
1	1743	176	335	356	155	1	−156	−15	80	262	−10	−7
						0%	−101%	−10%	52%	170%	−6%	−4%
2	1743	130	268	179	219	−2	−91	−6	82	233	10	−4
						−1%	−42%	−3%	38%	106%	4%	−2%
3	1743	104	196	25	274	−2	−67	−3	55	276	6	10
						−1%	−25%	−1%	20%	100%	2%	4%
4	1743	96	135	−323	554	1	−37	10	120	445	12	3
						0%	−7%	2%	22%	80%	2%	1%
Panel C Negative cash flow shortfall												
0	1085	110	198	1113	−805	−59	−327	−100	133	−94	20	−377
						7%	41%	12%	−17%	12%	−2%	47%
1	1085	212	553	1434	−669	−73	−550	−100	68	105	0	−119
						11%	82%	15%	−10%	−16%	0%	18%
2	1085	232	535	1090	−323	8	−262	−119	72	1318	−1177	−162
						−3%	81%	37%	−22%	−408%	364%	50%
3	1085	113	222	438	−103	−19	−168	−34	58	121	23	−84
						19%	163%	34%	−57%	−118%	−22%	82%
4	1085	135	251	418	−33	−12	−136	−25	77	124	6	−68
						36%	418%	75%	−236%	−381%	−20%	208%

investments driven by local governments and bank preferences, such that firms are reluctant to cut dividends and even more reluctant to cut investment.

Chinese firms also display special features for resolving cash flow uncertainty. Among the three channels, firms only use external financing as the major instrument to obtain cash, whereas non-operating cash and cash balance adjustment are rarely used. Among the channels to obtain external cash, Chinese firms mainly rely on debt financing, and then equity financing. The above results reveal the particularity of China's listed firm, which has been shown by prior literature (e.g. Allen et al., 2005; Deng, Li, & Wu, 2011; Wu & Wang, 2005).

4.2. The nonlinear relation between dividends and investment

Our primary results provide some indication of the relationship between dividends and investment. We find that dividends and investment change according to different patterns in relation to changes in cash flow uncertainty, which suggests a nonlinear relation between the two decisions that is consistent with the findings of Mougoue (2008). In this section, we take a detailed look at the relation between dividends and investment in Chinese listed firms.

We first plot the investment–dividend sensitivity, which is the coefficient of regressing investment on dividends, controlled for other variables, to the cash flow uncertainty to see how the relation between dividends and investment varies with uncertainty (Fig. 2). The horizontal axis represents the level of cash flow uncertainty, measured by cash flow shortfall and cash

Table 5
How do firms resolve cash flow uncertainty? — Measure uncertainty with cash flow volatility. This table presents how firms resolve cash flow uncertainty. Expected dividend is dividend paid in prior year. Cash flow uncertainty is measured with cash flow volatility. Cash flow volatility is standard deviation of five years' operating cash flow divided by lagged total assets. Expected investment is industry median investment/lagged assets × firms' lagged assets. Available cash flow is net cash flow from operating activities. Cash flow shortfall equals Expected investment + Expected dividend — Available cash flow. Dividend cutback equals Expected dividend — Dividend. Investment cutback equals Expected investment — Investment. Non-operating cash is non-operating cash flow from statement of cash flow. External cash is cash flow from external financing, including equity and debt financing and cash from other channels. In Panel B, External cash is divided into three categories — cash flow from equity financing, cash flow from debt financing and cash flow from else channels. Cash drawdown is change of cash and cash equivalent. Panel A reports results for full samples. Panel B reports results for observations with positive cash flow shortfall. Panel C reports results for observations with negative cash flow shortfall. Numbers in each cell are the real value for each item, reported in million RMB.

CFVol-rank	Firm-year	Expected dividend	Expected investment	Available cash flow	Shortfall	Dividend cutback	Investment cutback	Non-operating cash	External cash			Cash drawdown
									Equity cash	Loan cash	Others	
Panel A												
0	2025	136	277	381	31	−14	−142	−6		235		−41
1	2026	140	334	487	−13	−12	−147	−6		220		−67
2	2026	107	205	271	41	−12	−108	−21		252		−70
3	2026	117	213	339	−9	−15	−195	8		262		−69
4	2026	113	174	240	46	−24	−106	−39		394		−179
Panel B												
0	2461	140	311	469	−18	−24	−154	−21	68	475	−311	−51
1	2461	145	279	426	−1	−13	−183	−22	87	152	2	−24
2	2461	129	276	413	−7	−17	−151	−40	76	197	19	−90
3	2461	96	210	289	18	−10	−105	−3	83	131	1	−78
4	2461	109	175	276	7	−25	−176	−23	119	259	13	−158

flow volatility, and the vertical axis represents the coefficient of dividends from investment–dividend regression. The curve describing the relation between dividends and investment, given different levels of cash flow uncertainty, has an obvious "N-shape". When cash flow uncertainty is very low, dividends and investment have a negative association, but the sensitivity continues to increase with the increase in cash flow uncertainty. As the cash flow uncertainty continues to grow, the dividends and investment sensitivity shifts from negative to positive and begins to decrease after reaching the peak. When sensitivity approaches the bottom and cash flow uncertainty is high, it shifts again, this time from negative to positive, when the uncertainty is extremely high.

This "N-shaped" relation is further justified by the piecewise regression in Table 6. We distribute all observations, according to cash flow uncertainty, into ten groups, and introduce this cash flow uncertainty rank into the basic investment–dividend regression. We further introduce two dummies for the different cash flow uncertainty rankings. Dummy 1 (*Dum1*) equals 1 if the cash flow uncertainty rank is less than 4, and dummy 2 (*Dum2*) equals 1 if the cash flow uncertainty rank is between 4 and 7. In this way, the coefficient of the interaction term for dividends and the cash flow uncertainty rank can serve as a benchmark while the coefficients of the interaction term of dividends, the cash flow uncertainty ranks and the dummies reflect the incremental effects of different levels of cash flow uncertainty. We employ the following piecewise regression model to test the effects of cash flow uncertainty on the investment–dividend relation:

$$\begin{aligned} I\_TA = {} & \alpha_0 + \alpha_1 DIV + \alpha_2 Rank + \alpha_3 Dum1 + \alpha_4 Dum2 + DIV^*(\alpha_5 Rank + \alpha_6 Dum1 \\ & + \alpha_7 Dum2) + Rank^*(\alpha_8 Dum1 + \alpha_9 Dum2) + Div^* Rank^*(\alpha_{10} Dum1 + \alpha_{11} Dum2) \\ & + \alpha_{12} ExtCash + \alpha_{13} CF + \alpha_{14} Lag(I\_TA) + \alpha_{15} MB + \alpha_{16} Size + \alpha_{15} ROA + \alpha_{15} LEV + \alpha_{16} State + \varepsilon \end{aligned} \tag{6}$$

To support the "N-shaped" nonlinear relation, we expect $\alpha_{10}+\alpha_5>0, \alpha_{11}+\alpha_5<0, \alpha_5>0$. The regression results in Table 5 show that the coefficients of the interaction terms for the three variables are significantly negative, but the coefficient of *Dum 2* is smaller than that of *Dum 1*. The total effect of cash flow uncertainty on investment–dividend sensitivity can be calculated as the sum of the benchmark coefficient (α_5) and the incremental coefficient. When cash flow uncertainty is low, the incremental coefficient of *Dum 1* is negative, but smaller than the benchmark coefficient, such that the total effect ($\alpha_{10}+a_5$) is positive, which is indicated by the curve showing the increasing investment–dividend sensitivity when the cash flow rank is less than 4. Similarly, the total effect ($\alpha_{11}+a_5$) from the incremental coefficient of *Dum 2* is negative, which suggests that when cash flow uncertainty is moderate, the investment–dividend sensitivity is negative and has a decreasing trend.

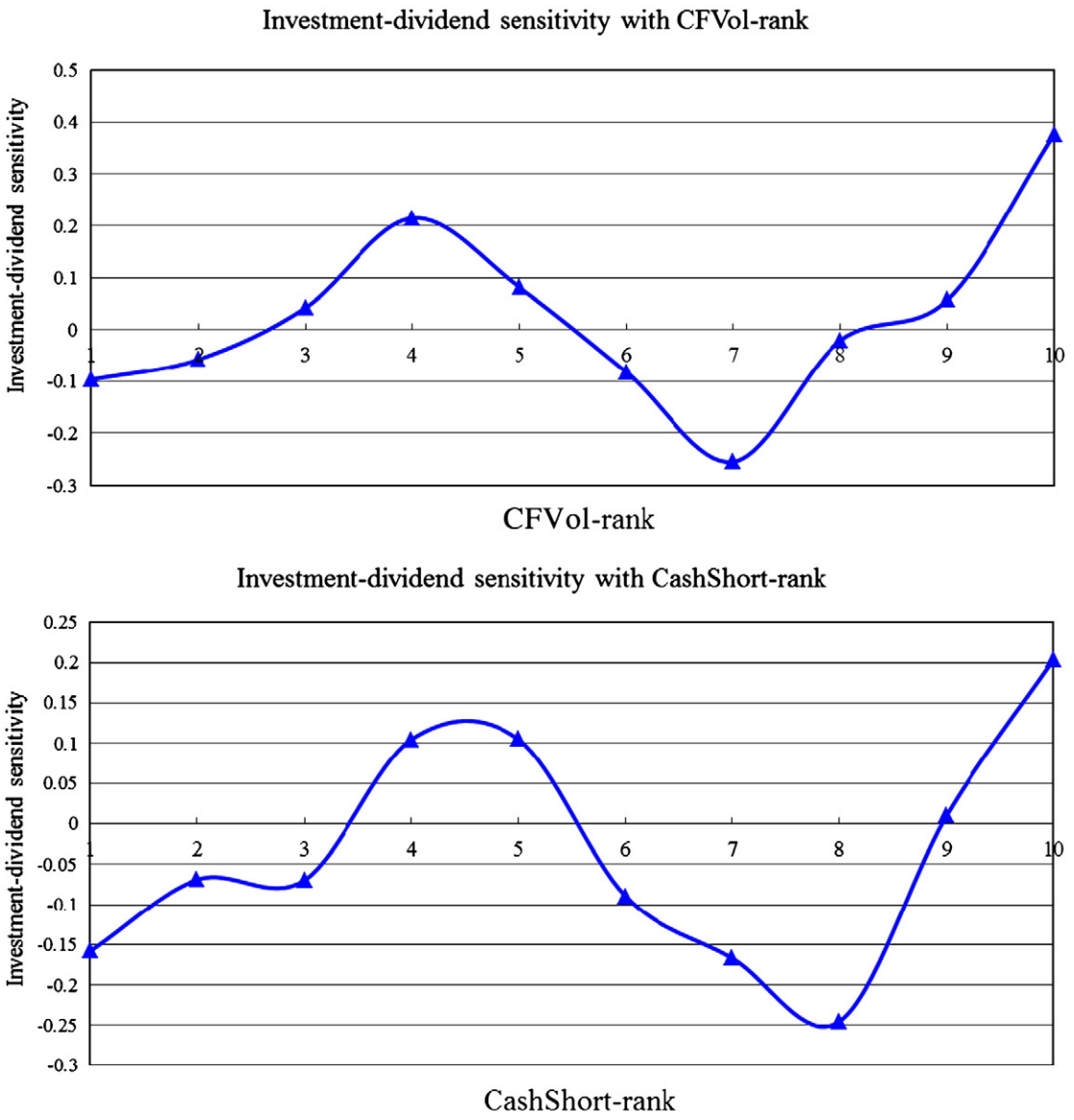

Fig. 2. Investment–dividend sensitivity with cash flow uncertainty. This figure describes how investment–dividend sensitivity, which is coefficient from regressing investment on dividend, controlled for other variables, changes with the change of cash flow uncertainty, measured by cash flow shortfall and cash flow volatility. The horizontal axis is the level of cash flow uncertainty, measured by cash flow shortfall and cash flow volatility, and the vertical axis is the coefficients of dividend from investment–dividend regression.

Because the investment–dividend has an "N-shaped" relation, we also introduce square and cubic terms for the cash flow uncertainty rank that interact with dividends in the following cubic regression model:

$$I\_TA = \beta_0 + \beta_1 DIV + \beta_2 Rank + \beta_3 Rank^2 + \beta_4 Rank^3 + DIV^*(\beta_5 Rank + \beta_6 Rank^2 + \beta_7 Rank^3) + \beta_8 ExtCash + \beta_9 CF + \beta_{10} Lag(I\_TA) + \beta_{11} MB + \beta_{12} Size + \beta_{13} ROA + \beta_{14} LEV + \beta_{15} State + \mu \quad (7)$$

We expect $\beta_5 > 0, \beta_6 < 0, \beta_7 > 0, \beta_1 < 0$ to justify the "N-shaped" nonlinear relation. The results in Table 7 confirm such a relation by showing that the coefficient of dividends and the square term is negative and the coefficient of dividends and the cubic term is positive, which confirms the "N-shaped" relation between dividends and investment, given cash flow uncertainty.

For both models, we introduce a dummy variable *State* that equals 1 if the firm is controlled by central or local government and 0 otherwise. In all regressions, this variable has a significantly positive coefficient, which suggests that SOEs invest more than non-SOEs. This result shed some light on why Chinese firms maintain such a high level of investment. We conjecture that investment

Table 6
Piecewise regression for nonlinear relation between dividend and investment. This table reports the piecewise regression results by regressing investment on dividend. All variables are defined in Appendix A. In two columns, cash flow uncertainty is measured with cash flow shortfall and cash flow volatility respectively. Robust t-value is reported in parentheses. ***, ** and * denote coefficients that are statistically significant at the 1%, 5% and 10% levels, respectively.

Dependent variable: Investment	Cash flow uncertainty measure	
	Cashshort	CFVol
DIV	−1.936***	−0.394***
	(−5.68)	(−3.18)
Rank	0.008***	−0.006
	(3.44)	(−0.90)
Dum1	0.093***	−0.058
	(4.63)	(−1.03)
Dum2	0.045*	−0.023
	(1.89)	(−0.39)
DIV × Rank	0.219***	0.212***
	(5.91)	(2.67)
DIV × Dum1	1.785***	0.19***
	(6.05)	(6.77)
DIV × Dum2	2.632***	1.206***
	(3.28)	(3.06)
Rank × Dum1	−0.025***	0.012*
	(−8.76)	(1.84)
Rank × Dum2	−0.006*	0.002
	(−1.73)	(0.24)
DIV × Rank × Dum1	−0.205***	−0.108**
	(−10.83)	(−2.16)
DIV × Rank × Dum2	−0.331***	−0.353**
	(−2.83)	(−2.09)
ExtCash	0.101***	0.090***
	(38.71)	(32.81)
CF	0.109***	0.114***
	(17.67)	(26.97)
Lag(I_TA)	0.153***	0.122***
	(25.74)	(18.82)
MB	0.001	0.003
	(0.09)	(0.28)
Size	0.007***	0.009***
	(10.62)	(11.10)
ROA	0.061***	0.057***
	(5.67)	(4.98)
LEV	−0.007**	−0.004
	(−2.24)	(−1.22)
State	0.005***	0.004***
	(4.08)	(3.37)
Intercept	−0.184***	−0.110*
	(−7.65)	(−1.87)
adj. R^2	0.538	0.531
N	13,224	10,340

has been the instrument through which government promotes economic growth, and government has more influence on SOEs. This indication that SOEs invest more confirms our argument that high investment is motivated by a governmental desire to promote economy (Table 7).

In summary, we use both descriptive and regression results to show that, given different levels of cash flow uncertainty, there is an "N-shaped" nonlinear relation between dividends and investment in Chinese listed firms. Combined with the results in the previous section, these findings illustrate that when cash flow uncertainty is low, there are strong incentives for firms to pay dividends and make investments without any reduction, which suggests that dividend and investment sensitivity is positive and increasing. When cash flow uncertainty is moderate, firms must maintain their level of investment while slightly cutting dividends, such that the sensitivity becomes negative and decreasing. When cash flow uncertainty is extremely high, firms must reduce both investment and dividends, which causes the sensitivity to become positive and increase again.

5. Conclusion

This study empirically examines the relation between dividends and investment with the condition of uncertain cash flow and explores how firms resolve cash flow uncertainty. Our research is conducted using the financial data of Chinese listed firms from

Table 7
Cubic regression for nonlinear relation between dividend and investment. This table reports the cubic regression results by regressing investment on dividend. All variables are defined in Appendix A. $Rank^2$ and $Rank^3$ are square and cubic items of cash flow uncertainty rankings. In two columns, cash flow uncertainty is measured with cash flow shortfall and cash flow volatility respectively. Robust t-value is reported in parentheses. ***, ** and * denote coefficients that are statistically significant at the 1%, 5% and 10% levels, respectively.

Dependent variable: Investment	Cash flow uncertainty measure	
	Cashshort	CFVol
DIV	−0.209***	−0.98***
	(−12.73)	(6.90)
Rank	−0.028***	0.017***
	(−9.38)	(4.20)
$Rank^2$	0.005***	−0.003***
	(5.96)	(−2.82)
$Rank^3$	−0.001***	0.001
	(−4.01)	(1.60)
DIV × Rank	0.613***	0.627***
	(9.02)	(5.74)
DIV × $Rank^2$	−0.112***	−0.097***
	(−5.10)	(3.34)
DIV × $Rank^3$	0.005***	0.008***
	(2.94)	(9.04)
ExtCash	0.101***	0.087***
	(38.68)	(32.00)
CF	0.109***	0.111***
	(17.53)	(26.27)
Lag(I_TA)	0.154***	0.124***
	(25.82)	(19.13)
MB	0.001	0.003
	(0.12)	(0.30)
Size	0.008***	0.010***
	(10.75)	(12.26)
ROA	0.062***	0.067***
	(5.78)	(5.90)
LEV	−0.007**	−0.004
	(−2.26)	(−1.09)
State	0.005***	0.005***
	(3.95)	(3.80)
Intercept	−0.090***	−0.189***
	(−5.92)	(−10.91)
adj. R^2	0.538	0.529
N	13,224	10,340

2000 to 2010, whose financial decisions are believed to be different from those of their counterparts in developed markets due to special institutional settings.

Measuring cash flow uncertainty with cash flow shortfall and cash flow volatility, we first provide descriptive evidence of how firms resolve uncertainty. Our results show that, in the presence of cash flow uncertainty, Chinese firms neither cut dividends nor cut investment, but rather maintain a very high level of investment. They use external financing as the major instrument for covering cash flow uncertainty and they do not use non-operating cash or adjust cash balance for this purpose. Our results can be explained by China's special institutional settings, in which firms pay continuous dividends to obtain equity refinancing qualification and require investment driven by a governmental desire to promote the economy and banks' preference for large firms.

Complementary to these descriptive results, we further show that there is an “N-shaped” relation between dividends and investment by plotting investment–dividend sensitivity and cash flow uncertainty. This nonlinear relation is further confirmed by piecewise and cubic regressions that introduce cash flow uncertainty rankings as interaction terms into investment–dividend regressions.

Acknowledgments

This work is partially supported by the Natural Science Foundation of China (No. 71073020; No. 71202014), Social Science Foundation of China (No. 12CGL032), Program for New Century Excellent Talents in University (NCET-10-0337), MOE (Ministry of Education in China) Project of Humanities and Social Sciences (No. 11YJC630037) and Program for Excellent Talents, UIBE.

Appendix A. Definition of variables

Variables	Definitions
Investment	Expenditures on fixed assets, intangible assets and other long-term assets scaled by total assets
I_TA	Investment divided by lagged total assets
Dividend	Dividend per share
Div	Dividend per share divided by lagged total assets per share
CashShort	Cash flow shortfall estimated from the equation, Cash flow shortfall = Dividend cutback + Investment cutback + Non-operating cash + External cash + Cash drawdown..
CashShort_TA	Cash flow shortfall divided by lagged total assets
CFVol	Standard deviation of five years' operating cash flow scaled by lagged total assets
NonOpCash	Non-operating cash flow from statement of cash flow
ExternalCash	Cash flow from external financing, including equity financing and debt financing
CashDrawdown	Change of cash and cash equivalent
ExtCash_TA	Cash flow from external financing divided by lagged total assets
Rank	Rankings of cash flow uncertainty. Cash flow uncertainty is measured with cash flow shortfall and cash flow volatility. Shortfall is ranked by CashShort_TA and volatility is ranked by CFVol. There are a total of 10 rankings.
Dum 1	Dummy variable is equal to 1 if rank is smaller than 4, to 0 otherwise.
Dum 2	Dummy variable is equal to 1 if rank is larger than 4 and smaller than 7, to 0 otherwise.
State	Dummy variable is equal to 1 if the firm is controlled by central or local government and 0 otherwise.
CF	Operating cash flow divided by lagged total assets
MB	Market to book ratio
Size	Nature logarithm of total assets
ROA	Net income scaled by total assets
Lev	Total debt scaled by total assets

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