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ORIGINAL RESEARCH

What does the timing of dividend reductions signal?

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Abstract
Dividend reduction theory suggests that during an economy-wide shock, a relatively early dividend reduction indicates that a firm reduces its cash outflows to pursue positive net present value projects, whereas a relatively late dividend reduction is due only to cash constraints rather than investment strategies. This paper directly tests the dividend reduction theory. Consistent with the theory, we find that during a recession, early-dividend reducers make 5% more firm investment than late-dividend reducers within the reduction year. Further, the investment levels are not significantly different between early and late reducers outside of recessions. The results also suggest that the signaling effect does not persist, implying that in a recession, the investment opportunities pursued by the early reducers are short-lived.

Keywords Dividend reduction · Recession · Timing · Investment

JEL Classification G35

1 Introduction

Whether dividend policies convey information about a firm's future profitability has long been debated. Under the assumptions of perfect capital market, rational behavior, and perfect uncertainty, Miller and Modigliani (1961) propose that a firm's value is independent of its payout policy and solely based on its earning power and investment. Yet, it has been well documented empirically that a change in dividends impacts market value (e.g., Asquith and Mullins 1983; Brickley 1983; Healy and Palepu 1988; Michaely et al. 1995). In an attempt to explain the relation between dividend policy and firm value, many studies have proposed

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dividends as a signal of future firm prospects (e.g., Bhattacharya 1979; John and Williams 1985; Miller and Rock 1985). These theories predict dividend increases (decreases) signal higher (lower) future earnings.[1] Intriguingly, Benartzi et al. (1997) show an increase in future earnings is reliably signaled by a dividend reduction instead of a dividend increase. Healy and Palepu (1988), DeAngelo et al. (1992), and Jensen and Johnson (1995) also consistently find that firms that reduced their dividends experienced a subsequent earnings increase. Finally, Grullon et al. (2005) show that dividend changes are negatively correlated with future earnings, implying that dividend cuts are expected to be followed by an earnings increase rather than a decrease.

One possible explanation for firms' earnings increase following dividend reductions is the increased subsequent investment. However, prior literature documents that dividend reductions are associated with a decrease in investment rather than an increase, which runs counter to the intuition that dividend-decreasing firms have more investment needs. For example, Jensen and Johnson (1995) show that firms tend to cut their capital expenditures and spending on research and development (R&D) after dividend reductions. Yoon and Starks (1995) also find that dividend reductions are associated with subsequent decreases in capital expenditures over the following 3 years. They conclude that dividend reductions do not convey information concerning managers' investment policies. Therefore, it is unclear whether the dividend reductions are due to firms' investment needs and whether the reduced dividends are used to fund firms' investment projects, which in turn lead to increased future earnings.

To help reconcile the above conflicts, Hull (2015) argues that the dividend reductions are a "noisy" signal that can be "deciphered" by accounting for their timing. He proposes a theoretical model in which the timing of dividend reductions conveys information about the firm value. Specifically, during an economy-wide shock when external financing is inaccessible or extraordinarily expensive, a relatively early dividend reduction is an indicator that a firm is reducing its cash outflows to pursue profitable investment opportunities, whereas a late reduction is merely due to the depletion of a firm's financial slack. By contrast, in an industry-wide shock, the timing of dividend reductions cannot be interpreted as a signal about a firm's investment because the more available access to capital markets allows a firm to fund its projects and maintain its usual dividend policies simultaneously. Hull's model suggests that early-dividend reducers make more investments than late reducers during a recession, whereas there should be no difference in investment levels between early reducers and late reducers outside of a recession. Hull (2013) finds that the timing of a dividend reduction impacts the firm's announcement and long-term returns. However, the underlying investment activities through which the timing signals value have not been empirically studied.

This paper aims to fill that gap by examining whether the early dividend reductions lead to more firm investment during a recession period. Unlike Fuller and Goldstein (2011) or Hull (2013) who rely on market reactions to infer the motivation behind a dividend reduction, we directly test the dividend reduction timing hypothesis by comparing the investment levels between early-dividend reducers and late-dividend reducers during a recession. To

[1] Empirical tests of dividend signaling have found conflicting results. Pettit (1972), Aharony and Swary (1980), Asquith and Mullins (1983), Richardson et al. (1986), Nissim and Ziv (2001), Best and Best (2001), Lee (2010), Liljeblom et al. (2015), and Huang et al. (2017) all find that dividends signal information to the market. Watts (1973), DeAngelo et al. (1996), Benartzi et al. (1997), and Grullon et al. (2005) find that the predictive value of dividend increases is minimal at best.

confirm that the timing of dividend reductions conveys information about a firm's investment within a recession only, we choose the dividend reductions during an industry contraction period as a control group and test whether the reduction timing-investment relation exists in this control group. For the purpose of disentangling the confounding effects of a recession on a contemporary industry contraction, we further divide the dividend reductions within industry contractions into two subsets: in the first, the reductions are made during a recession, and in the second, they are not made during a recession but purely within an industry contraction.

Utilizing dividend reductions from January 1965 through December 2014, we find evidence to support Hull's (2015) timing of dividend reductions theory. The results indicate that during a recession, the early-dividend reducers invest 5% more than the late-dividend reducers in the reduction year. In the out-of-recession periods, we do not find significant differences in investment levels between early and late reducers, implying that the timing of dividend reductions conveys information during the recessions only. The results also suggest that the impact of the timing of a dividend reduction has no persistence, implying that in a recession, the investment opportunities pursued by the early reducers are short-lived.

Our study focuses on the investment associated with early- and late-dividend reducers and attempts to reveal the mechanism through which the timing of dividend reductions signals firm value. To our knowledge, this paper is the first to offer empirical evidence linking the timing of dividend reductions to firm investment. Our empirical results suggest that the investment level of a dividend reducer is contingent on certain economic conditions and that firms' incentives to fund their investment projects by cutting dividends can be revealed after taking this timing into account. Thus, this paper provides a potential explanation as to why earnings increase after a dividend reduction. It also suggests that in response to an economy-wide recession, early dividend reducers cut dividends to grow their firms, implying that the timing signals future firm prospects. In general, this paper contributes to the dividend signaling literature by directly testing the information content conveyed by the timing of dividend reductions. Our empirical results provide strong evidence to support the arguments of Hull (2013, 2015) that the timing of dividend reductions is an additional signaling channel for firm value. This finding has implications for the question of whether dividend policy matters and suggests that dividends signal information.

In addition, our paper contributes to the broad question of why firms reduce dividends. Prior literature documents that firms reduce dividends for various reasons such as financial distress (DeAngelo and DeAngelo 1990), low investor preference toward dividends (Baker and Wurgler 2004a, b; Li and Lie 2006), growth opportunities (Che et al. 2018), financing constraints (Yang et al. 2000), and product market fluidity (Hoberg et al. 2014). Our paper shows that in economic recessions, investment needs and depletion of financial slacks are likely the reasons for dividend reductions among early reducers and late reducers, respectively.

2 Hypothesis development

According to Hull (2015), the timing of dividend reductions signals firm value. His theoretical model allows a firm's manager to rationally decide whether to implement a dividend cut in financial difficulty, and if so, when the dividend cut should be made. In his model, the financial difficulty is presented by either an economy-wide shock or an industry-wide shock. Specifically, the economy-wide shock destroys assets in place for a portion of the

entire economy, whereas the industry-wide shock destroys assets in place for a portion of the corresponding industry. After a shock, the cash reserve of the dividend-paying firms that have suffered losses can be used either to maintain their dividend policies or make investment to rebuild the assets in place. Managers also have an option to obtain external financing from capital markets in an industry-wide shock, whereas the external financing is inaccessible or unfavorably expensive in an economy-wide shock.

Outsiders have imperfect information about the firms' true state of nature, but they can discern the firm value via observing changes in dividend policies. In the setting of an economy-wide shock, the inaccessible external financing causes difficulties in investing in all positive net present value projects if managers strive to maintain their usual dividend policy. Therefore, firms with greater probabilities of investment success do not hesitate to reduce their dividends to fund their investment because the benefits from the investment outweigh the costs from the dividend cuts. The firms with lower probabilities of investment success do not have incentives to make an early dividend reduction because this would reveal their financial difficulties to outsiders. As a result, early dividend reductions indicate the firms that reduce cash outflows to make investment, and late dividend reductions are due merely to cash constraints. This leads to the main hypothesis in this paper:

H_{1a} In an economy-wide shock, early-dividend reducers have more firm investment than late-dividend reducers.

To confirm that the timing of dividend reductions can be interpreted as a signal about firm investment solely during an economy-wide shock, we use dividend reductions in an industry-wide shock as a control group.[2] In the setting of an industry-wide shock, firms have an option to obtain external financing from capital markets. Then firms with greater probabilities of investment success do not have incentives to reduce their dividends early. The reason is that firms can still fund their investment by obtaining external capital and avoiding the costs of dividend cuts. Therefore, both firms with greater success probabilities and firms with lower success probabilities are able to delay their dividend reductions until they have to do so. As a result, the timing of dividend reductions should not be driven by firm investment. This leads to the additional testable hypothesis:

H_{1b} In an industry-wide shock, the level of firm investment is not different between early-dividend reducers and late-dividend reducers.

3 Sample, variables, and summary statistics

3.1 Dividend reduction samples

The data for this study are obtained from the Compustat, Center for Research in Security Prices (CRSP), and National Bureau of Economic Research (NBER) databases from January 1965 through December 2014. We start our sample of all dividend-reducing firms from

[2] In the robustness checks, we also use the dividend reductions during a pseudo-recession period as another control group.

the CRSP database. Following Hull (2013), each dividend reduction observation should satisfy the following criteria:

1. The firm's data are available in both Compustat and CRSP databases.
2. The dividend distribution is a quarterly cash dividend (Distribution code 1232).
3. The dividend reduction is larger than 12.5%.[3]
4. The dividend reducer is not a financial firm (Standard Industrial Classification [SIC] code 6000–6999) or a utility firm (SIC code 4900–4999).
5. Each observation must come from an industry with at least 10 other quarterly dividend-paying firms.
6. The dividend reduction is not surrounded by stock splits, special dividends, or mergers.

We use the NBER recessions as a proxy for economy-wide shocks. Our sample includes seven recessions starting in 1969, 1973, 1980, 1981, 1990, 2001, and 2007.[4] Consistent with Hull (2013), the recession period is defined as the month of the recession peak to 1 month after the trough, based on the NBER recession data. The sample of dividend reductions in the recession (hereafter, recession sample) contains 530 observations. Utilizing the classification technique in Hull (2013) for a particular industry, the first dividend reduction and any reductions over the next two quarters from the end of the first industry dividend reduction are classified as early reductions, and all remaining dividend reductions are classified as late. Our recession sample includes 296 early dividend reductions and 234 late dividend reductions.

Following Mitchell and Mulherin (1996) and Hull (2013), we proxy for industry-wide shocks by industry contractions, which are represented by the large changes in the industry sales. Utilizing the Compustat quarterly data, we identify a significant drop in two consecutive quarters of industry sales, and specifically, this significant drop is represented by the 5th percentile return on two quarters of industry sales growth over the 1-year moving average. The sample of dividend reductions in the industry contraction (hereafter, industry contraction sample) contains 497 observations of dividend reductions, of which 318 occur outside of a recession period (named, out-of-recession subsample) and 179 occur in a recession period (named, in-recession subsample). According to the classification method of Hull (2013), for a particular industry, dividend reductions that are three or more quarters prior to the industry sales low point are classified as early reductions, and all remaining dividend reductions are classified as late reductions. Our industry contraction sample includes 232 early and 265 late dividend reductions. Our out-of-recession subsample consists of 175 early and 143 late dividend reductions, and our in-recession subsample consists of 57 early and 122 late dividend reductions.[5]

[3] As in Hull (2013) and Chemmanur and Tian (2014), the purpose for a dividend reduction to be greater than 12.5% is to ensure that the focus is on an economically significant dividend reduction. The empirical results are qualitatively the same with lower cutoffs.

[4] The peak to through for the seven recession periods is as follows: (1) December 1969–November 1970, (2) November 1973–March 1975, (3) January 1980–July 1980, (4) July 1981–November 1982, (5) July 1990–March 1991, (6) March 2001–November 2001, (7) December 2007–June 2009.

[5] The recession sample and the industry contraction sample in our study are both truncated at top 1% and bottom 1% level.

3.2 Firm-level variables

Following McLean and Zhao (2014), we measure firm investment as the sum of total asset growth and R&D spending, all scaled by lagged book value (BV) of total assets (i.e., $\text{Inv}_{i,t}$ = (Total $\text{Assets}_{i,t}$ − Total $\text{Assets}_{i,t-1}$ + $\text{R\&D}_{i,t}$)/BV of Total $\text{Assets}_{i,t-1}$). As is suggested by their study, this measure is the broadest possible measure of investment. In the robustness check section, we also experiment with other measures of investment including capital expenditure, total assets growth, and total noncash assets growth and obtain similar results. As is in Foucault and Fresard (2014), we calculate Tobin's Q as book value of total assets minus book value of equity plus market value (MV) of equity, all scaled by book value of total assets (i.e., $\text{Q}_{i,t}$ = (BV of Total $\text{Assets}_{i,t}$ − BV of $\text{Equity}_{i,t}$ + MV of $\text{Equity}_{i,t}$)/BV of Total $\text{Assets}_{i,t}$). Consistent with Foucault and Fresard (2014), we calculate cash flow as income before extraordinary items plus depreciation, all scaled by book value of total assets [i.e., $\text{CF}_{i,t}$ = (Income before Extraordinary $\text{Items}_{i,t}$ + $\text{Depreciation}_{i,t}$)/BV of Total $\text{Assets}_{i,t}$] and measure firm size as the logarithm of the book value of total assets [i.e., $\text{Size}_{i,t}$ = log (BV of Total $\text{Assets}_{i,t}$)].

Following Hull (2013), we use two measures to gauge the timing of dividend reductions, and they are the variables of interest in our subsequent analysis. First, we set a dummy variable, $\text{Early\_Rec}_{i,t}$ ($\text{Early\_Con}_{i,t}$) equal to 1 for an early dividend reduction in a recession period (an industry contraction period) and 0 for a late dividend reduction. The advantage of this measure is that it provides a direct definition for early- and late-dividend reducers. The disadvantage of this measure is that the cutoff used in the classification may not be an appropriate dichotomous break. Second, we utilize a count variable totaling the number of quarters since the first dividend cut in a particular industry to measure a firm's dividend reduction timing ($\text{Qrts\_Rec}_{i,t}$ and $\text{Qrts\_Con}_{i,t}$ for a recession period and an industry contraction period, respectively). The advantage of this measure is that it avoids the inappropriate cutoffs. The disadvantage of this measure is that it does not provide us with a direct definition for early- and late-dividend reducers.

To control for the potential effects of reduction extent on firm investment, we follow Hull (2013) and include a variable that represents the percentage of a dividend reduction ($\text{Red\_Per}_{i,t}$).[6] As is reported by Foucault and Fresard (2014), peers' valuation has an impact on a firm's investment. Following these researchers' framework, we include peers' Tobin's Q ($\text{Peer\_Q}_{i,t}$), cash flow ($\text{Peer\_CF}_{i,t}$), and firm size ($\text{Peer\_Size}_{i,t}$) that are relevant to the investment to control for this peer effect. Consistent with Leary and Roberts (2014) and Foucault and Fresard (2014), we define a firm's peers as all the firms that belong to the firm's three-digit SIC industry. We compute the peers' average Tobin's Q, cash flow, and size as above. Finally, to control for industry- and time-specific factors, we assign dummy variables for industries (two-digit SIC code), recessions, and industry contractions to capture the associated fixed effects.

All of the variables above are detailed in Table 1.

3.3 Summary statistics and simple correlations

Table 2 provides the descriptive statistics of the recession sample. Panel A reports summary statistics for the preliminary variables used in this study, whereas Panel B reports

[6] The percentage of a dividend reduction is calculated as the dividend in the last quarter less the dividend in the current quarter, scaled by the dividend in the last quarter.

Table 1 Definitions of variables

Variable	Definition	Source
Inv	Corporate investment, measured as the sum of book value of total assets (at) growth and R&D (xrd) spending, all scaled by lagged book value of total assets (at) [i.e., $Inv_{i,t}$ = (Total $Assets_{i,t}$ − Total $Assets_{i,t-1}$ + $R\&D_{i,t}$)/BV of Total $Assets_{i,t-1}$]	Compustat
Early_Rec	A dummy variable that is equal to 1 for early dividend reductions during a recession period, and 0 otherwise. The recession period is defined as the month of the recession peak to 1 month after the trough, based on NBER recession data. For a particular industry, the first dividend reduction and any reductions over the next two quarters from the end of the first industry dividend reduction are classified as early reductions	CRSP; NBER
Qrts_Rec	Number of quarters since the first dividend reduction in a particular industry during a recession	CRSP; NBER
Early_Con	A dummy variable that is equal to 1 for early dividend reductions during an industry contraction period, and 0 otherwise. The industry contraction period is defined as six quarters prior to two quarters after the sales low point (a fifth percentile return on two quarters of industry sales growth over the 1-year moving average). For a particular industry, dividend reductions that are three or more quarters prior to the industry sales low point are classified as early reductions	CRSP; Compustat
Qrts_Con	Number of quarters since the first dividend reduction in a particular industry during a contraction period	CRSP; Compustat
Red_Per	Percentage of dividend reduction	CRSP
Q	Tobin's Q, measured as book value of total assets (at) minus book value of equity (ceq) plus market value of equity (number of shares outstanding (csho) × stock price (prcc_f)), all scaled by book value of total assets (at) [i.e., $Q_{i,t}$ = (BV of Total $Assets_{i,t}$ − BV of $Equity_{i,t}$ + MV of $Equity_{i,t}$)/BV of Total $Assets_{i,t}$]	Compustat
CF	Cash flow of firm *i* at year *t*, measured as income before extraordinary items (ib) plus depreciation (dp), all scaled by book value of total assets (at) [i.e., $CF_{i,t}$ = (Income before Extraordinary $Items_{i,t}$ + $Depreciation_{i,t}$)/BV of Total $Assets_{i,t}$]	Compustat
Size	Firm size, measured as the logarithm of the book value of total assets (at) [i.e., $Size_{i,t}$ = log (BV of Total $Assets_{i,t}$)]	Compustat
Peer_Q	Average Tobin's Q of peers (defined as all the firms that belong to a firm's three-digit SIC industry)	Compustat
Peer_CF	Average cash flow of peers (defined as all the firms that belong to a firm's three-digit SIC industry)	Compustat
Peer_Size	Average size of peers (defined as all the firms that belong to a firm's three-digit SIC industry)	Compustat

This table presents the definitions of the preliminary variables used in this study

Table 2 Descriptive statistics of recession sample

Variable name	Mean	Median	Min	Max	*SD*	1st Quartile	3rd Quartile	*N*		
Panel A: Summary statistics										
Inv	0.120	0.106	−0.340	0.859	0.177	−0.001	0.210	530		
Early_Rec	0.558	1.000	0.000	1.000	0.497	0.000	1.000	530		
Qrts_Rec	1.964	2.000	0.000	7.000	1.872	0.000	3.000	530		
Red_Per	0.418	0.435	0.125	0.931	0.173	0.300	0.500	530		
Q	1.537	1.183	0.564	7.096	1.007	0.916	1.781	530		
CF	0.113	0.110	−0.078	0.353	0.057	0.074	0.146	530		
Size	5.948	5.713	1.924	10.837	2.006	4.340	7.372	530		
Peer_Q	2.202	1.382	0.701	24.746	2.925	1.107	2.041	530		
Peer_CF	−0.053	0.073	−4.399	0.157	0.475	0.019	0.094	530		
Peer_Size	4.344	4.108	2.118	7.912	1.213	3.418	5.294	530		
Variable name	Inv	Early_Rec	Qrts_Rec	Red_Per	Q	CF	Size	Peer_Q	Peer_CF	Peer_Size
Panel B: Correlations										
Inv	1.000									
Early_Rec	0.246	1.000								
Qrts_Rec	−0.252	−0.819	1.000							
Red_Per	−0.235	−0.107	0.162	1.000						
Q	0.353	0.196	−0.193	−0.079	1.000					
CF	0.361	0.129	−0.132	−0.263	0.561	1.000				
Size	−0.141	0.025	0.029	0.188	0.048	−0.112	1.000			
Peer_Q	−0.092	0.108	−0.036	0.112	0.256	0.081	0.236	1.000		
Peer_CF	0.160	0.010	−0.065	−0.153	−0.114	0.048	−0.205	−0.774	1.000	
Peer_Size	−0.217	−0.094	0.104	0.228	−0.095	−0.176	0.411	0.039	−0.062	1.000

This table presents the descriptive statistics of the recession sample. Panel A reports summary statistics for the preliminary variables used in this study, whereas Panel B reports correlations among the variables. The data are obtained from Compustat, CRSP, and NBER databases from January 1965 through December 2014. The final recession sample contains 530 observations of dividend reductions in seven recession periods, starting in 1969, 1973, 1980, 1981, 1990, 2001, and 2007. Inv is investment, measured as the sum of book value of total assets growth and R&D spending, all scaled by lagged book value of total assets. Early_Rec is a dummy variable that is equal to 1 for early dividend reductions during a recession period, and 0 otherwise. For a particular industry, the first dividend reduction and any reductions over the next two quarters from the end of the first industry dividend reduction are classified as early reductions. Qrts_Rec is the number of quarters since the first dividend reduction in a particular industry during a recession. Red_Per is the percentage of dividend reduction. Q is Tobin's Q, measured as book value of total assets minus book value of equity plus market value of equity, all scaled by book value of total assets. CF is cash flow, measured as income before extraordinary items plus depreciation, all scaled by book value of assets. Size is the firm size, measured as the logarithm of the book value of total assets. Peer_Q, Peer_CF, and Peer_Size are the average Tobin's Q, cash flow, and size of peers (defined as all the firms that belong to a firm's three-digit SIC industry), respectively

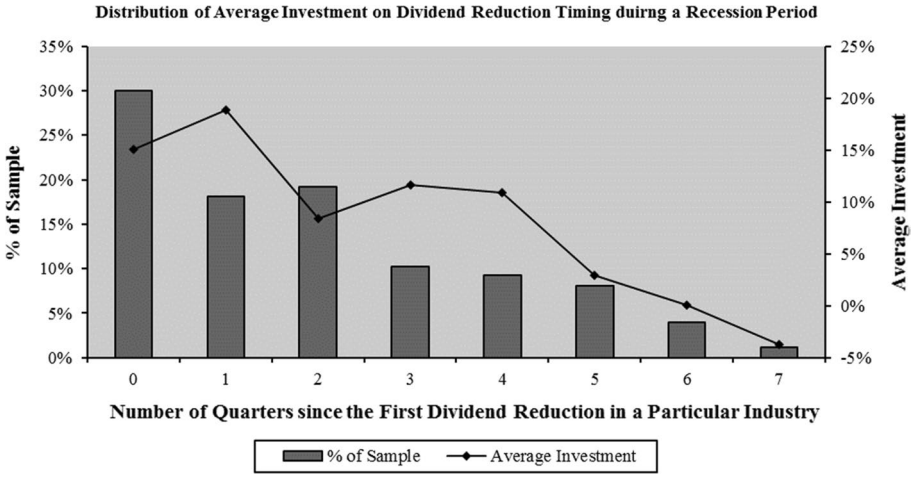

Fig. 1 Distribution of investment on the timing of dividend reductions during a recession period. This figure depicts the distribution of average investment on the timing of dividend reductions during a recession period. We determine the timing of a dividend reduction by observing the number of quarters since the first dividend reduction in a particular industry (defined by two-digit SIC code) within a recession. The recession period is defined as the month of the recession peak to 1 month after the trough, based on NBER recession data. The final recession sample contains 530 observations of dividend reductions in seven recession periods, starting in 1969, 1973, 1980, 1981, 1990, 2001, and 2007

correlations among those variables. In Panel A, it can be seen that there is a large heterogeneity in investment in our sample: It ranges from −0.340 to 0.859 with a mean of 0.120 and a median of 0.106. Even though there are negative values for the investment measure, we do not exclude these observations because they represent the firms that do not restore their assets in place via investment and removing them could potentially bias our results. In Panel B, the dummy measure for early dividend reductions is positively correlated with the investment, indicating that an early-dividend reducer coincides with a higher level of firm investment. The alternative count measure for the reduction timing is negatively correlated with the investment, implying that firms that delay their dividend cuts have less investment than the firms that do not. Figure 1 complements our descriptive statistics by showing the distribution of investment on the timing of dividend reductions in recessions. It shows a decreasing trend over time, implying that the earlier a firm reduces its dividend, the more investment it makes.

Table 3 provides the descriptive statistics in the industry contraction sample. Similarly, we find that the early reduction dummy measure is positively correlated with the investment, and the count measure is negatively correlated with the investment. However, the magnitude of the correlations is much less than that in the recession sample. Recall that the entire industry contraction sample contains dividend reductions both in a recession period and outside of a recession period. Therefore, we need to disentangle the confounding effects in the subsequent analysis. In addition, note that correlations are just one of the univariate tests. Without controlling for other relevant covariates, correlations do not provide us with reliable conclusions. Panel A in Fig. 2 depicts the distribution of investment on the timing of dividend reductions in the industry contractions. Overall, it shows a trend that is slightly decreasing over time. Panels B and C in Fig. 2 display the distribution of investment in the out-of-recession subsample and in-recession subsample, respectively.

Table 3 Descriptive statistics of industry contraction sample

Variable name	Mean	Median	Min	Max	*SD*	1st Quartile	3rd Quartile	*N*		
Panel A: Summary statistics										
Inv	0.177	0.147	−0.272	1.046	0.193	0.050	0.258	497		
Early_Rec	0.467	0.000	0.000	1.000	0.499	0.000	1.000	497		
Qrts_Rec	3.189	3.000	0.000	8.000	2.344	1.000	5.000	497		
Red_Per	0.407	0.417	0.125	0.950	0.164	0.286	0.500	497		
Q	1.690	1.352	0.597	9.490	1.143	1.008	1.938	497		
CF	0.119	0.114	−0.021	0.360	0.052	0.085	0.146	497		
Size	5.660	5.320	1.937	10.560	1.917	4.174	6.964	497		
Peer_Q	2.374	1.550	0.765	39.246	3.310	1.175	2.271	497		
Peer_CF	−0.042	0.075	−5.095	0.177	0.501	0.019	0.099	497		
Peer_Size	4.138	3.876	2.058	8.515	1.212	3.322	4.705	497		
Variable name	Inv	Early_Rec	Qrts_Rec	Red_Per	Q	CF	Size	Peer_Q	Peer_CF	Peer_Size
Panel B: Correlations										
Inv	1.000									
Early_Rec	0.162	1.000								
Qrts_Rec	−0.096	−0.749	1.000							
Red_Per	−0.075	−0.036	0.099	1.000						
Q	0.355	0.186	−0.187	−0.048	1.000					
CF	0.368	0.072	−0.024	−0.183	0.506	1.000				
Size	−0.081	0.080	−0.109	0.111	−0.011	−0.124	1.000			
Peer_Q	0.003	0.013	0.000	0.170	0.132	0.009	0.167	1.000		
Peer_CF	0.009	0.033	−0.062	−0.173	−0.014	0.027	−0.111	−0.733	1.000	
Peer_Size	−0.126	−0.004	−0.171	0.072	−0.065	−0.094	0.356	0.003	−0.049	1.000

This table presents the descriptive statistics of the industry contraction sample. Panel A reports summary statistics for the preliminary variables used in this study, whereas Panel B reports correlations among the variables. The data are obtained from Compustat, CRSP, and NBER databases from January 1965 through December 2014. The final industry contraction data sample contains 497 observations of dividend reductions during the industry contraction periods. Inv is investment, measured as the sum of book value of total assets growth and R&D spending, all scaled by lagged book value of total assets. Early_Con is a dummy variable that is equal to 1 for early dividend reductions during an industry contraction period, and 0 otherwise. The industry contraction period is defined as six quarters prior to two quarters after the sales low point (a 5th percentile return on two quarters of industry sales growth over the 1-year moving average). For a particular industry, dividend reductions that are three or more quarters prior to the industry sales low point are classified as early reductions. Qrts_Rec is the number of quarters since the first dividend reduction in a particular industry during a contraction period. Red_Per is the percentage of dividend reduction. Q is Tobin's Q, measured as book value of total assets minus book value of equity plus market value of equity, all scaled by book value of total assets. CF is cash flow, measured as income before extraordinary items plus depreciation, all scaled by book value of assets. Size is the firm size, measured as the logarithm of the book value of total assets. Peer_Q, Peer_CF, and Peer_Size are the average Tobin's Q, cash flow, and size of peers, respectively

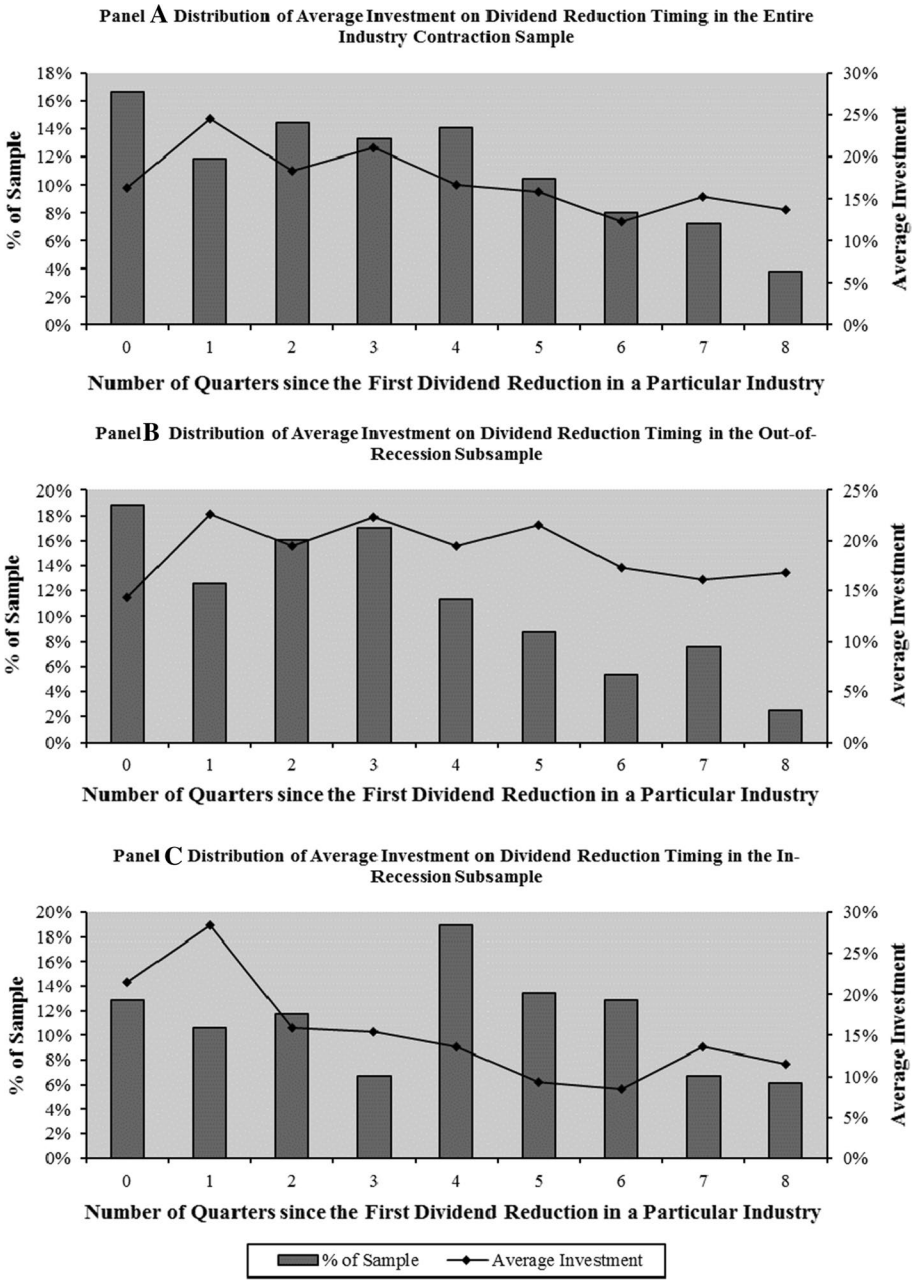

Fig. 2 Distribution of investment on the timing of dividend reductions during an industry contraction period. This figure depicts the distribution of average investment on the timing of dividend reductions during an industry contraction period. The industry contraction period is defined as six quarters prior to two quarters after the sales low point (a 5th percentile return on two quarters of industry sales growth over the 1-year moving average). For a particular industry, dividend reductions that are three or more quarters prior to the industry sales low point are classified as early reductions. The final industry contraction sample contains 497 observations of dividend reductions in industry contraction periods. Panel **A** presents the distribution of average investment on dividend reduction timing in the entire industry contraction sample. Panel **B** presents the distribution in the out-of-recession subsample. Panel **C** presents the distribution in the in-recession subsample

Panel B shows that there is no significant declining trend in the investment associated with the timing of dividend reductions when they are made outside of recession periods, whereas Panel C exhibits that early-dividend reducers make larger firm investment than late-dividend reducers, and the investment level decreases along with the time of dividend reductions. Therefore, the signaling effect of dividend reduction timing is likely to exist during recession periods only.

4 Empirical method

In this section of the paper, we develop our empirical analysis framework in the recession sample and industry contraction sample.

4.1 Regression in the recession sample

To estimate the covariation between a firm's investment and the timing of dividend reductions in a recession period, we include the timing variable in a standard linear investment equation. Consider a cross-sectional and yearly regression of firm investment scaled by lagged assets on lagged firms' and peers' characteristics:

$$\begin{aligned} Inv_{i,t} = {} & \alpha_d + \delta_c + \beta_0 + \beta_1 Early\_Rec_{i,t} + \beta_2 Red\_Per_{i,t} + \beta_3 Q_{i,t-1} + \beta_4 CF_{i,t-1} \\ & + \beta_5 Size_{i,t-1} + \beta_6 Peer\_Q_{i,t-1} + \beta_7 Peer\_CF_{i,t-1} + \beta_8 Peer\_Size_{i,t-1} + \varepsilon_{i,t} \end{aligned} \quad (1)$$

where the firm subscript i denotes the dividend reducer, the time subscript t denotes the dividend reduction year, the industry subscript d denotes the specific industry that a firm belongs to, and the cycle subscript c denotes the recession period. We account for time-invariant industry heterogeneity by including industry (two-digit SIC code) fixed effects (α_d) and time-specific effects by including recession period fixed effects (δ_c). The coefficient β_1 therefore measures how the firm investment is related to the timing of dividend reductions. Based on $\mathbf{H_{1a}}$, we expect β_1 to be positive and significant. Following common practice (e.g., Kaplan and Zingales 1997; Foucault and Fresard 2014; McLean and Zhao 2014), we impose a lag of 1 year between the measurement of investment and the control variables. We allow the error term ($\varepsilon_{i,t}$) to be correlated within industries. Thus, the heteroskedasticity-corrected robust standard errors are clustered on industry.

Equation (1) is the baseline specification in our recession sample. Additionally, to test whether the effect of dividend reduction timing has any persistence, we replace the dependent variable $Inv_{i,t}$ with $Inv_{i,t+1}$, which is the investment level in the year following the dividend reduction year. Thus, the significance of β_1 in the following year can be interpreted as the persistence of the effect. As mentioned in Sect. 3.3, even though we have defined a cutoff for early and late reducers, it may not be appropriate to state such a dichotomous break. Therefore, to examine whether the relation between timing of dividend reductions and investment is robust to a more general timing measure, we replace the dummy measure of dividend reduction timing $Early\_Rec_{i,t}$ with $Qrts\_Rec_{i,t}$, which is the count measure totaling the number of quarters since the first dividend reduction in a particular industry. Therefore, β_1 can be interpreted as how much the investment level will change when a firm cuts its dividend one quarter later, holding other covariates constant. Based on $\mathbf{H_{1b}}$, we expect β_1 on $Qrts\_Rec_{i,t}$ to be negative and significant.

4.2 Regression in the industry contraction sample

For the purpose of confirming that the signaling effect exists in the recession periods only, we choose the dividend reductions during industry contractions as our control group. To test the relation between dividend reduction timing and firm investment in an industry reduction period, the specification for the baseline regression is as follows:

$$\begin{aligned} Inv_{i,t} = {} & \alpha_i + \delta_c + \beta_0 + \beta_1 Early\_Con_{i,t} + \beta_2 Red\_Per_{i,t} + \beta_3 Q_{i,t-1} + \beta_4 CF_{i,t-1} \\ & + \beta_5 Size_{i,t-1} + \beta_6 Peer\_Q_{i,t-1} + \beta_7 Peer\_CF_{i,t-1} + \beta_8 Peer\_Size_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{2}$$

where the firm subscript i denotes the dividend reducer, the time subscript t denotes the dividend reduction year, the industry subscript d denotes the specific industry that a firm belongs to, and the cycle subscript c denotes the industry contraction period. Early_Con$_{i,t}$ is a dummy variable that is equal to 1 for early dividend reductions during an industry contraction period, and 0 otherwise. The other variables and estimation techniques are described in Sect. 4.1. We conduct this regression in the out-of-recession subsample and the in-recession subsample, respectively, so as to disentangle the confounding effects of recession periods. Based on $\mathbf{H_{1a}}$ and $\mathbf{H_{1b}}$, we expect β_1 to be positive and significant solely in the in-recession subsample and insignificant in the out-of-recession subsample.

Additionally, we implement a regression framework in the entire industry contraction sample, utilizing an interaction term between recession and early dividend reduction. In this case, the baseline regression is as follows:

$$\begin{aligned} Inv_{i,t} = {} & \alpha_i + \delta_c + \beta_0 + \beta_1 Early\_Con_{i,t} + \beta_2 Early\_Con_{i,t} \times Recession_t + \beta_3 Recession_t + \beta_4 Red\_Per_{i,t} \\ & + \beta_5 Q_{i,t-1} + \beta_6 CF_{i,t-1} + \beta_7 Size_{i,t-1} + \beta_8 Peer\_Q_{i,t-1} + \beta_9 Peer\_CF_{i,t-1} + \beta_{10} Peer\_Size_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{3}$$

where the firm subscript i denotes the dividend reducer, the time subscript t denotes the dividend reduction year, the industry subscript d denotes the specific industry that a firm belongs to, and the cycle subscript c denotes the industry contraction period. Recession$_t$ is a dummy variable that is equal to 1 if the dividend reduction occurs within a recession period, and 0 otherwise. The other variables and estimation techniques are described in Sect. 4.1. The variables of interest in this regression are Early_Con$_{i,t}$ and the interaction term Early_Con$_{i,t}$×Recession$_t$. Based on $\mathbf{H_{1a}}$ and $\mathbf{H_{1b}}$, we expect β_2 to be positive and significant and β_1 to be insignificant.

Besides the baseline regressions, we also use alternative specifications as we do in the recession sample to test whether the relation holds when we use a count measure to represent the reduction timing and how persistent the effect is when we replace the dependent variable with the investment made at the year following the reduction year.

5 Empirical findings

5.1 Empirical results in the recession sample

Table 4 reports the empirical results from examining the effects of the dividend reduction timing during a recession. Panel A in Table 4 presents the results from the univariate analysis. Column (1) displays the mean and median of investment in both the dividend reduction year and the following year in the entire recession sample, whereas Columns (2)

Table 4 Relation between timing of dividend reductions and investment during a recession period

	(1) Entire sample	(2) Early reducer	(3) Late reducer	(4) = (2) − (3) Difference
Panel A: Univariate analysis				
$Inv_{i,t}$				
Mean	0.120	0.158	0.071	0.088***
Median	0.106	0.146	0.098	0.047***
$Inv_{i,t+1}$				
Mean	0.105	0.124	0.082	0.042***
Median	0.075	0.033	0.053	−0.021***
N	530	296	234	
	(5) $Inv_{i,t}$	(6) $Inv_{i,t+1}$	(7) $Inv_{i,t}$	(8) $Inv_{i,t+1}$
Panel B: Multivariate regression analysis				
Intercept	0.196***	0.132**	0.243***	0.132*
	(0.064)	(0.062)	(0.066)	(0.067)
$Early\_Rec_{i,t}$	0.053***	0.005		
	(0.018)	(0.013)		
$Qrts\_Rec_{i,t}$			−0.015***	−0.006
			(0.005)	(0.005)
$Red\_Per_{i,t}$	−0.070*	−0.046	−0.06	−0.038
	(0.041)	(0.053)	(0.037)	(0.050)
$Q_{i,t-1}$	0.061***	0.016*	0.060***	0.014
	(0.015)	(0.009)	(0.014)	(0.009)
$CF_{i,t-1}$	0.324	0.669***	0.343	0.679***
	(0.236)	(0.159)	(0.227)	(0.157)
$Size_{i,t-1}$	−0.001	−0.009***	−0.001	−0.009***
	(0.007)	(0.003)	(0.007)	(0.003)
$Peer\_Q_{i,t-1}$	−0.003	−0.005	−0.002	−0.006
	(0.004)	(0.007)	(0.004)	(0.007)
$Peer\_CF_{i,t-1}$	0.014	−0.045	0.016	−0.047
	(0.019)	(0.048)	(0.020)	(0.048)
$Peer\_Size_{i,t-1}$	−0.001	−0.005	−0.002	−0.005
	(0.008)	(0.008)	(0.008)	(0.008)
Industry/recession FE	Yes	Yes	Yes	Yes
Adj. R^2	0.309	0.205	0.311	0.208
N	530	530	530	530

This table reports the results from estimating the effects of timing of dividend reductions on investment during a recession period. Panel A presents the results from the univariate analysis, whereas Panel B presents the results from the multivariate regression analysis. The firm subscript *i* denotes the dividend reducer, and the time subscript *t* denotes the dividend reduction year. Inv is investment, measured as the sum of book value of total assets growth and R&D spending, all scaled by lagged book value of total assets. Early_Rec is a dummy variable that is equal to 1 for early dividend reductions during a recession period, and 0 otherwise. The recession period is defined as the month of the recession peak to 1 month after the trough, based on NBER recession data. For a particular industry, the first dividend reduction and any reductions over the next two quarters from the end of the first industry dividend reduction are classified as early reductions. Qrts_Rec is the number of quarters since the first dividend reduction in a particular industry during a recession. Red_Per is the percentage of dividend reduction. Other variables are defined in Table 1. The final recession sample contains 530 observations of dividend reductions in seven recession periods, starting in 1969, 1973, 1980, 1981, 1990, 2001, and 2007. The significance levels of the means (medi-

Table 4 (continued)

ans) are based on a two-tailed *t* test (two-tailed Wilcoxon rank test). Industry fixed effects and recession period fixed effects are included in the multivariate regressions. Heteroskedasticity-corrected robust standard errors, clustered on industry (two-digit SIC code) are reported in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively

and (3) display the statistics of early-dividend reducers and late-dividend reducers, respectively. On average, the early-dividend reducers have an investment of 15.8% in the year of the dividend reduction, whereas the late-dividend reducers have an investment of 7.1%. The difference is 8.8%, which is significant at the 1% level based on a two-tailed *t* test. The median of investment shows a similar pattern, and a two-tailed Wilcoxon rank test indicates that the difference in median is also significant. In terms of the investment made in the year following the reduction, the early-dividend reducers have an investment of 12.4%, a 3.4% decrease relative to the level in the previous year, whereas the late-dividend reducers have an investment of 8.2%, relatively a 0.9% increase. The investment of early reducers is 4.2% higher than that of the late reducers, and the positive difference is still statistically significant. However, in terms of medians, it shows that the median of the investment made by early reducers is 2.1% less than that made by late reducers in the year following the dividend reduction year, implying that the relation possibly reverts.

Panel B reports the results from the multivariate regressions. Column (5) displays the coefficients in our baseline regression with the investment during the dividend reduction year as the dependent variable and the early reduction dummy as the variable of interest. The coefficient for the early reduction is 0.053, statistically significant at the 1% level. It suggests an economically meaningful 5.3% higher investment associated with early-dividend reducers versus late-dividend reducers during a recession. Similarly, the results in Column (7) show that each additional quarter after the first dividend reduction is associated with a 1.5% drop in firm investment. Therefore, our empirical analysis finds evidence that early-dividend reducers invest more than late-dividend reducers.

The above evidence demonstrates that the timing of dividend reductions has an impact on the investment, but how persistent is this effect? To investigate whether early reducers persistently make more investment than late reducers, we replace the dependent variable in Columns (5) and (7) with the investment made in the following year. The results from this regression are reported in Columns (6) and (8). Column (6) shows that the coefficient on the early reduction dummy variable is 0.005, and it is statistically insignificant. Recall that the effect of timing on the investment in the dividend reduction year is 5.3%. In the fiscal year after the reduction, the timing effect is completely gone. Hence, the results indicate that the effect of dividend reduction timing is not persistent, implying that the investment opportunity pursued by the early reducers is short-lived. Similarly, the coefficient on the count variable in Column (8) is not significant either, confirming the result exhibited in Column (6).

5.2 Empirical results in the industry contraction sample

This section tests $\mathbf{H_{1b}}$, which states that an industry-wide shock leads early-dividend reducers to invest differently than late-dividend reducers. Table 5 reports the results from the univariate test. As is discussed in Sect. 3.1, we partition the industry contraction sample into a subsample of dividend reductions during a recession and a subsample of dividend reductions outside of a recession for comparison purpose. Panel A displays the statistics

Table 5 Comparison between early reducers and late reducers in industry contraction sample

	(1) Entire sample	(2) Early reducer	(3) Late reducer	(4) = (2) − (3) Difference
Panel A: Out-of-recession subsample				
$Inv_{i,t}$				
Mean	0.191	0.201	0.180	0.022
Median	0.157	0.172	0.139	0.033
$Inv_{i,t+1}$				
Mean	0.158	0.164	0.151	0.013*
Median	0.124	0.124	0.123	0.001
N	318	175	143	
Panel B: In-recession subsample				
$Inv_{i,t}$				
Mean	0.152	0.241	0.111	0.130***
Median	0.139	0.228	0.097	0.131***
$Inv_{i,t+1}$				
Mean	0.137	0.195	0.110	0.085***
Median	0.095	0.173	0.073	0.100***
N	179	57	122	
Panel C: Entire industry contraction sample				
$Inv_{i,t}$				
Mean	0.177	0.211	0.148	0.063***
Median	0.147	0.178	0.122	0.055***
$Inv_{i,t+1}$				
Mean	0.151	0.172	0.132	0.040**
Median	0.115	0.126	0.100	0.026***
N	497	232	265	

This table presents the results from the univariate analysis that compares the corporate investment between early-dividend reducers and late-dividend reducers in the industry contraction sample. Panel A focuses on the dividend reductions in the industry contraction periods but outside of recession periods, whereas Panel B focuses on the dividend reductions during the industry contraction periods and also within the recession periods. Panel C provides an overview of the dividend reductions that occur in the industry contraction periods. The firm subscript *i* denotes the dividend reducer, and the time subscript *t* denotes the dividend reduction year. Inv is investment, measured as the sum of book value of total assets growth and R&D spending, all scaled by lagged book value of total assets. The industry contraction period is defined as six quarters prior to two quarters after the sales low point (a 5th percentile return on two quarters of industry sales growth over the 1-year moving average). For a particular industry, dividend reductions that are three or more quarters prior to the industry sales low point are classified as early reductions. The final industry contraction sample contains 497 observations of dividend reductions during the industry contraction periods. The significance levels of the means (medians) are based on a two-tailed *t*-test (two-tailed Wilcoxon rank test). ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively

for the out-of-recession subsample. It shows that the investment between early reducers and late reducers in the dividend reduction year is not significant in terms of either mean or median, implying that the timing of dividend reductions is not associated with investment outside of a recession. When we compare the investment following the reduction year, we find that the early reducers have a significantly higher mean of investment than late

reducers, but the magnitude of the difference is small, 1.3%, compared to the difference in the recession period.

Panel B reports the statistics for the in-recession subsample. It shows that the difference in investment between early reducers and late reducers is significant and positive, indicating that early-dividend reducers indeed have higher investment than late reducers, confirming the results in Sect. 5.1. Also, compared to the difference in the recession sample (8.8% in mean and 4.7% in median), the difference between early-dividend reducers and late-dividend reducers is even larger when they are in an industry contraction. This suggests that the depletion of financial slack is more severe when firms are in both an industry contraction and a recession at the same time, and therefore reducing the dividend payment is more imperative for firms to take their desired investment. Panel C reports the results of the univariate test in the entire industry contraction sample. It is shown that the difference in investment between early reducers and late reducers is still positive but not as large as in the in-recession subsample. Therefore, in the industry contraction, we find that the effect of the dividend reduction timing is primarily driven by the dividend reductions also contemporaneously during a recession period.

Table 6 reports the results from the multivariate regressions. Columns (1) to (4) display the regression results in the out-of-recession sample. Consistent with our univariate test, none of the coefficients on early dividend reduction dummy measure or the number of quarters count measure is significant, no matter the investment in the dividend reduction year or the year following the reduction is used as the dependent variable. Columns (5) to (8) display the regression results in the out-of-recession sample. In Column (5), when investment in the dividend reduction year is used as the dependent variable, the coefficient on the early dividend reduction dummy is 0.104, and it is statistically significant, indicating that the early-dividend reducers have, on average, 10.4% more investment than the late-dividend reducers. In Column (7), the coefficient on the number of quarters count variable is −0.025, suggesting that each additional quarter after the first dividend reduction is associated with a 2.5% drop in firm investment. Recall the coefficients of the regressions conducted for the recession sample (0.053 on the early reduction dummy variable and −0.015 on the number of quarters count variable). The difference is enlarged significantly in the industry contraction periods. Columns (6) and (8) examine the persistence of the effect by using the investment in the year following the dividend reduction as the dependent variable in the regressions. Consistent with what we have found in the recession sample, the effect of dividend reduction timing is not persistent.

To further confirm the results in the industry contraction sample, we run the regression in the entire industry contraction sample with the aid of an interaction term (Early_$\text{Con}_{i,t}$ × Recession_t). Table 7 presents the results from the regressions. In Column (1), the coefficient on the early reduction dummy variable is 0.016 but not significant. The coefficient on the interaction term between early dividend reduction dummy variable and recession dummy variable is 0.086 and statistically significant. This positive and significant coefficient estimate suggests that the effect of dividend reduction timing in the industry contraction sample is driven by the dividend reductions during recessions rather than the dividend reductions outside of recessions. In other words, in the context of industry contractions, there is no difference in investment levels between early reducers and late reducers. Column (3) shows consistent results. Specifically, the coefficient on the number of quarters count variable is not significant, and the coefficient on the interaction term between the count measure and the recession dummy measure is negative and significant. In Columns (2) and (4), we also find evidence that the effect of dividend reduction timing is gone in the year following the reduction year.

Table 6 Relation between timing of dividend reductions and investment in the industry contraction subsamples

	Out-of-recession subsample				In-recession subsample			
	(1) $Inv_{i,t}$	(2) $Inv_{i,t+1}$	(3) $Inv_{i,t}$	(4) $Inv_{i,t+1}$	(5) $Inv_{i,t}$	(6) $Inv_{i,t+1}$	(7) $Inv_{i,t}$	(8) $Inv_{i,t+1}$
Intercept	0.075	0.194**	0.077	0.224**	0.071	0.125	0.043	0.124
	(0.066)	(0.092)	(0.071)	(0.091)	(0.166)	(0.115)	(0.156)	(0.114)
Early_Con$_{i,t}$	−0.002	0.030			0.104***	0.057		
	(0.029)	(0.039)			(0.024)	(0.053)		
Qrts_Con$_{i,t}$			−0.001	−0.007			−0.025***	−0.008
			(0.005)	(0.006)			(0.005)	(0.010)
Red_Per$_{i,t}$	−0.014	0.038	−0.012	0.046	−0.161	−0.041	−0.132	−0.042
	(0.061)	(0.053)	(0.063)	(0.054)	(0.142)	(0.134)	(0.140)	(0.133)
$Q_{i,t-1}$	0.072***	0.065***	0.071***	0.066***	0.018	0.007	0.018	0.01
	(0.014)	(0.017)	(0.014)	(0.018)	(0.016)	(0.016)	(0.013)	(0.015)
$CF_{i,t-1}$	0.715**	0.088	0.719**	0.072	0.904**	0.669*	0.904**	0.643*
	(0.307)	(0.435)	(0.289)	(0.429)	(0.352)	(0.342)	(0.354)	(0.356)
$Size_{i,t-1}$	−0.009	−0.01	−0.009	−0.01	−0.005	−0.020**	−0.002	−0.020**
	(0.006)	(0.008)	(0.006)	(0.007)	(0.015)	(0.009)	(0.014)	(0.009)
Peer_$Q_{i,t-1}$	0.000	0.001	0.000	0.001	0.030*	0.016	0.024	0.015
	(0.004)	(0.004)	(0.005)	(0.005)	(0.015)	(0.018)	(0.015)	(0.019)
Peer_$CF_{i,t-1}$	0.007	0.032***	0.008	0.033***	0.143**	0.028	0.127*	0.024
	(0.033)	(0.010)	(0.034)	(0.010)	(0.063)	(0.075)	(0.067)	(0.078)
Peer_$Size_{i,t-1}$	0.000	0.003	0.000	0.003	−0.005	−0.012	−0.004	−0.012
	(0.013)	(0.013)	(0.013)	(0.013)	(0.009)	(0.011)	(0.009)	(0.012)
Industry/contraction FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.188	0.077	0.188	0.076	0.241	0.123	0.26	0.114
N	318	318	318	318	179	179	179	179

This table presents the results from the multivariate regression analysis on the relation between timing of dividend reductions and investment in the out-of-recession and in-recession industry contraction subsamples. The firm subscript *i* denotes the dividend reducer, and the time subscript *t* denotes the dividend reduction year. Inv is investment, measured as the sum of book value of total assets growth and R&D spending, all scaled by lagged book value of total assets. Early_Con is a dummy variable that is equal to 1 for early dividend reductions during an industry contraction period, and 0 otherwise. The industry contraction period is defined as six quarters prior to two quarters after the sales low point (a 5th percentile return on two quarters of industry sales growth over the 1-year moving average). For a particular industry, dividend reductions that are three or more quarters prior to the industry sales low point are classified as early reductions. Qrts_Rec is the number of quarters since the first dividend reduction in a particular industry during a contraction period. Other variables are defined in Table 1. The final industry contraction sample contains 497 observations of dividend reductions during the industry contraction periods. Industry fixed effects and industry contraction period fixed effects are included in the multivariate regressions. Heteroskedasticity-corrected robust standard errors, clustered on industry (two-digit SIC code) are reported in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively

In sum, we find that during an economy-wide shock, early-dividend reducers have more firm investment than late reducers, whereas during an industry-wide shock, the level of firm investment is not significantly different between early-dividend reducers and late-dividend reducers. In addition, we find evidence that the signaling effect of dividend reduction

Table 7 Relation between timing of dividend reductions and investment in the entire industry contraction sample

	(1) $Inv_{i,t}$	(2) $Inv_{i,t+1}$	(3) $Inv_{i,t}$	(4) $Inv_{i,t+1}$
Intercept	0.060	0.260***	0.074	0.280***
	(0.076)	(0.080)	(0.074)	(0.084)
$Early\_Con_{i,t}$	0.016	0.028		
	(0.018)	(0.046)		
$Early\_Con_{i,t} \times Recession_t$	0.086***	0.042		
	(0.031)	(0.043)		
$Qrts\_Con_{i,t}$			−0.005	−0.004
			(0.003)	(0.008)
$Qrts\_Con_{i,t} \times Recession_t$			−0.020**	−0.007
			(0.009)	(0.009)
$Recession_t$	−0.051**	−0.008	0.058	0.027
	(0.022)	(0.032)	(0.047)	(0.057)
$Red\_Per_{i,t}$	−0.05	0.009	−0.035	0.015
	(0.055)	(0.057)	(0.051)	(0.052)
$Q_{i,t-1}$	0.036**	0.023**	0.035**	0.026***
	(0.015)	(0.009)	(0.013)	(0.009)
$CF_{i,t-1}$	0.919***	0.397*	0.911***	0.366*
	(0.135)	(0.223)	(0.136)	(0.209)
$Size_{i,t-1}$	−0.004	−0.010*	−0.003	−0.010*
	(0.006)	(0.006)	(0.006)	(0.006)
$Peer\_Q_{i,t-1}$	0.002	0.003	0.001	0.003
	(0.003)	(0.003)	(0.004)	(0.003)
$Peer\_CF_{i,t-1}$	0.013	0.022	0.015	0.023*
	(0.027)	(0.013)	(0.026)	(0.013)
$Peer\_Size_{i,t-1}$	−0.001	−0.005	−0.001	−0.005
	(0.009)	(0.012)	(0.008)	(0.012)
Industry/contraction FE	Yes	Yes	Yes	Yes
Adj. R^2	0.229	0.031	0.238	0.025
N	497	497	497	497

This table presents the results from the multivariate regression analysis on the relation between timing of dividend reductions and investment in the overall industry contraction sample. Inv is investment, measured as the sum of book value of total assets growth and R&D spending, all scaled by lagged book value of total assets. Early_Con is a dummy variable that is equal to 1 for early dividend reductions during an industry contraction period, and 0 otherwise. The industry contraction period is defined as six quarters prior to two quarters after the sales low point (a 5th percentile return on two quarters of industry sales growth over the 1-year moving average). For a particular industry, dividend reductions that are three or more quarters prior to the industry sales low point are classified as early reductions. Qrts_Rec is the number of quarters since the first dividend reduction in a particular industry during a contraction period. Recession is a dummy variable that is equal to 1 if the dividend reduction occurs within a recession period, and 0 otherwise. Red_Per is the percentage of dividend reduction. Q is Tobin's Q, measured as book value of total assets minus book value of equity plus market value of equity, all scaled by book value of total assets. CF is cash flow, measured as income before extraordinary items plus depreciation, all scaled by book value of assets. Size is the firm size, measured as the logarithm of the book value of total assets. Peer_Q, Peer_CF, and Peer_Size are the average Tobin's Q, cash flow, and size of peers (defined as all the firms that belong to a firm's three-digit SIC industry), respectively. The final industry contraction sample contains 497 observations of dividend reductions during the industry contraction periods. Industry fixed effects and industry contraction period fixed effects are included in the multivariate regressions. Heteroskedasticity-corrected robust standard errors, clustered on industry (two-digit SIC code) are reported in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively

timing is not persistent, indicating that the investment opportunity pursued by the early reducers is short-lived.

5.3 Signaling effect for large and small firms

Our previous empirical evidence indicates that the timing of dividend reductions within a recession signals a firm's investment. However, this signaling effect may vary across company size. Large firms are typically industry leaders that may have more sophisticated financial personnel, who provide better information pertaining to the macro-environment. These large firms act more swiftly changing their dividend policies in accordance with their actual investment needs. By contrast, small firms are likely laggards that are reluctant to signal their financial difficulties to outsiders and tend to wait for large firms to act first. As a result, their dividend cuts convey no information about their future investment and are merely due to financial constraints. Therefore, we expect that the difference in investment levels between early reducers and late reducers is less pronounced among large firms and more pronounced among small firms.

To test whether size matters, we perform our empirical analysis for subsamples of large and small firms. Firms in our full sample are divided into large and small firm subsamples based on one of three size measures: book value of total assets, market value of total assets, and market capitalization. Specifically, a firm is classified as a large (small) firm if its size is greater than or equal to (less than) the sample median. Table 8 reports the results of the subsample analysis when firms are classified by the book value of total assets. We find for the large firm subsample, the effect of dividend reduction timing is barely significant (10% level) only when the timing is measured by the count variable totaling the number of quarters since the first dividend cut in a particular industry during a recession ($\text{Qrts\_Rec}_{i,t}$). For the small firm subsample, the coefficient estimates on both the dummy variable for an early dividend reduction during a recession ($\text{Early\_Rec}_{i,t}$) and the count variable ($\text{Qrts\_Rec}_{i,t}$) are statistically significant. Further, we find that when the subsamples are formed using the market value of total assets or market capitalization for size, the effect of dividend reduction timing is significant only for the subsample of small firms, regardless of which measure of dividend reduction timing is employed.[7]

Additionally, we conduct multivariate analysis including an interaction term between the dividend reduction timing and the firm size. Table 9 reports the results. It shows that the coefficient estimate on $\text{Early\_Rec}_{i,t} \times \text{Size}_{i,t-1}$ is consistently positive and significant and that the coefficient estimate on $\text{Qrts\_Rec}_{i,t} \times \text{Size}_{i,t-1}$ is consistently negative and significant, indicating that the difference in investment levels between early reducers and late reducers is less pronounced among large firms and more pronounced among small firms. Again, we find qualitatively similar results when the firm size is measured by the market value of total assets or market capitalization.[8] Taken together, these results indicate that the signaling effect is stronger for small firms.

[7] Results are available upon request.
[8] Results are available upon request.

Table 8 Relation between timing of dividend reductions and investment during a recession period: subsample analysis based on book value of total assets

	(1) Subsample	(2) Early reducer	(3) Late reducer	(4) = (2) − (3) Difference	(5) Subsample	(6) Early reducer	(7) Late reducer	(8) = (6) − (7) Difference
	Large firms				Small firms			
Panel A: Univariate analysis								
$Inv_{i,t}$								
Mean	0.095	0.129	0.052	0.077***	0.144	0.187	0.090	0.097***
Median	0.082	0.128	0.028	0.100***	0.128	0.161	0.052	0.109***
$Inv_{i,t+1}$								
Mean	0.084	0.106	0.056	0.050***	0.126	0.141	0.108	0.033
Median	0.069	0.094	0.044	0.050***	0.091	0.109	0.066	0.043*
N	265	147	118		265	149	116	
	(9) $Inv_{i,t}$	(10) $Inv_{i,t+1}$	(11) $Inv_{i,t}$	(12) $Inv_{i,t+1}$	(13) $Inv_{i,t}$	(14) $Inv_{i,t+1}$	(15) $Inv_{i,t}$	(16) $Inv_{i,t+1}$
	Large firms				Small firms			
Panel B: Multivariate regression analysis								
Intercept	0.122	0.139*	0.142*	0.142*	0.049	0.121	0.108	0.130
	(0.078)	(0.080)	(0.077)	(0.084)	(0.103)	(0.080)	(0.105)	(0.090)
$Early\_Rec_{i,t}$	0.030	0.007			0.077***	0.000		
	(0.024)	(0.016)			(0.017)	(0.018)		
$Qrts\_Rec_{i,t}$			−0.013*	−0.006			−0.015**	−0.006
			(0.007)	(0.004)			(0.006)	(0.008)
$Red\_Per_{i,t}$	0.018	−0.029	0.032	−0.021	−0.180***	−0.095	−0.176***	−0.089
	(0.049)	(0.071)	(0.047)	(0.073)	(0.054)	(0.090)	(0.049)	(0.083)
$Q_{i,t-1}$	0.059***	0.014	0.057***	0.013	0.069***	0.022**	0.069***	0.020*
	(0.016)	(0.013)	(0.015)	(0.013)	(0.021)	(0.010)	(0.020)	(0.011)
$CF_{i,t-1}$	0.451**	0.399	0.478***	0.408	0.008	0.782***	0.019	0.790***
	(0.170)	(0.290)	(0.173)	(0.282)	(0.380)	(0.240)	(0.376)	(0.240)

Table 8 (continued)

	(9) $Inv_{i,t}$	(10) $Inv_{i,t+1}$	(11) $Inv_{i,t}$	(12) $Inv_{i,t+1}$	(13) $Inv_{i,t}$	(14) $Inv_{i,t+1}$	(15) $Inv_{i,t}$	(16) $Inv_{i,t+1}$
	Large firms				Small firms			
$Size_{i,t-1}$	0.016	0.000	0.016	0.000	−0.020	−0.024*	−0.017	−0.024*
	(0.012)	(0.007)	(0.012)	(0.007)	(0.014)	(0.014)	(0.014)	(0.014)
$Peer\_Q_{i,t-1}$	−0.009**	−0.002	−0.009**	−0.002	0.011	−0.013	0.012	−0.014
	(0.004)	(0.005)	(0.004)	(0.005)	(0.008)	(0.016)	(0.009)	(0.017)
$Peer\_CF_{i,t-1}$	−0.019	−0.030	−0.020	−0.031	0.091**	−0.077	0.091*	−0.078
	(0.021)	(0.025)	(0.021)	(0.026)	(0.039)	(0.117)	(0.045)	(0.119)
$Peer\_Size_{i,t-1}$	−0.009	−0.003	−0.009	−0.003	0.010	0.001	0.005	0.002
	(0.009)	(0.007)	(0.010)	(0.007)	(0.012)	(0.017)	(0.012)	(0.018)
Industry/recession FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.344	0.259	0.358	0.264	0.355	0.173	0.336	0.175
N	265	265	265	265	265	265	265	265

This table reports the results from estimating the effects of timing of dividend reductions on investment during a recession period in the subsamples of large and small firms. A firm is classified as a large (small) firm if its lagged book value of total assets is greater than or equal to (less than) the sample median. Panel A presents the results from the univariate analysis, whereas Panel B presents the results from the multivariate regression analysis. The firm subscript *i* denotes the dividend reducer, and the time subscript *t* denotes the dividend reduction year. Inv is investment, measured as the sum of book value of total assets growth and R&D spending, all scaled by lagged book value of total assets. Early_Rec is a dummy variable that is equal to 1 for early dividend reductions during a recession period, and 0 otherwise. The recession period is defined as the month of the recession peak to 1 month after the trough, based on NBER recession data. For a particular industry, the first dividend reduction and any reductions over the next two quarters from the end of the first industry dividend reduction are classified as early reductions. Qrts_Rec is the number of quarters since the first dividend reduction in a particular industry during a recession. Red_Per is the percentage of dividend reduction. Other variables are defined in Table 1. The final recession sample contains 530 observations of dividend reductions in seven recession periods, starting in 1969, 1973, 1980, 1981, 1990, 2001, and 2007. The large firm subsample and the small firm subsample each consist of 265 observations. The significance levels of the means (medians) are based on a two-tailed *t*-test (two-tailed Wilcoxon rank test). Industry fixed effects and recession period fixed effects are included in the multivariate regressions. Heteroskedasticity-corrected robust standard errors, clustered on industry (two-digit SIC code) are reported in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively

Table 9 Relation between timing of dividend reductions and investment during a recession period: interaction analysis based on book value of total assets

	(9) $Inv_{i,t}$	(10) $Inv_{i,t+1}$	(11) $Inv_{i,t}$	(12) $Inv_{i,t+1}$
Intercept	0.148**	0.157***	0.281***	0.131*
	(0.066)	(0.058)	(0.065)	(0.076)
$Early\_Rec_{i,t} \times Size_{i,t-1}$	−0.013***	0.007		
	(0.005)	(0.007)		
$Qrts\_Rec_{i,t} \times Size_{i,t-1}$			0.004***	0.000
			(0.001)	(0.002)
$Early\_Rec_{i,t}$	0.130***	−0.035		
	(0.025)	(0.047)		
$Qrts\_Rec_{i,t}$			−0.038***	−0.005
			(0.008)	(0.012)
$Red\_Per_{i,t}$	−0.070	−0.046	−0.057	−0.038
	(0.042)	(0.053)	(0.036)	(0.050)
$Q_{i,t-1}$	0.060***	0.017*	0.059***	0.014
	(0.015)	(0.009)	(0.014)	(0.009)
$CF_{i,t-1}$	0.355	0.653***	0.368	0.678***
	(0.245)	(0.153)	(0.228)	(0.153)
$Size_{i,t-1}$	0.006	−0.013***	−0.008	−0.009**
	(0.008)	(0.005)	(0.006)	(0.004)
$Peer\_Q_{i,t-1}$	−0.002	−0.006	−0.002	−0.006
	(0.004)	(0.007)	(0.004)	(0.007)
$Peer\_CF_{i,t-1}$	0.018	−0.047	0.019	−0.047
	(0.018)	(0.047)	(0.017)	(0.048)
$Peer\_Size_{i,t-1}$	0.000	−0.005	−0.002	−0.005
	(0.008)	(0.008)	(0.008)	(0.008)
Industry/recession FE	Yes	Yes	Yes	Yes
Adj. R^2	0.313	0.204	0.316	0.206
N	530	530	530	530

This table reports the results from estimating the effects of timing of dividend reductions on investment during a recession period with interaction between timing and firm size. Firm size is measured by the logarithm of the book value of total assets. The firm subscript *i* denotes the dividend reducer, and the time subscript *t* denotes the dividend reduction year. Inv is investment, measured as the sum of book value of total assets growth and R&D spending, all scaled by lagged book value of total assets. Early_Rec is a dummy variable that is equal to 1 for early dividend reductions during a recession period, and 0 otherwise. The recession period is defined as the month of the recession peak to 1 month after the trough, based on NBER recession data. For a particular industry, the first dividend reduction and any reductions over the next two quarters from the end of the first industry dividend reduction are classified as early reductions. Qrts_Rec is the number of quarters since the first dividend reduction in a particular industry during a recession. Red_Per is the percentage of dividend reduction. Other variables are defined in Table 1. The final recession sample contains 530 observations of dividend reductions in seven recession periods, starting in 1969, 1973, 1980, 1981, 1990, 2001, and 2007. The significance levels of the means (medians) are based on a two-tailed *t*-test (two-tailed Wilcoxon rank test). Industry fixed effects and recession period fixed effects are included in the multivariate regressions. Heteroskedasticity-corrected robust standard errors, clustered on industry (two-digit SIC code) are reported in parentheses. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively

6 Robustness checks

This section provides robustness checks on our above results, correcting potential selection bias, matching treatment and nontreatment groups, conducting out-of-sample tests, and specifying alternative measures of investment. These tables are available upon request.

6.1 Heckman model for selection bias

Firms enter into the sample only when they reduce their dividends. As is suggested by Hull (2013), there is potential selection bias because those firms that do not need to cut their dividends will not be included in our sample. It is expected that the dividend reducers have different firm characteristics from the nonreducers, and specifically, the firms of smaller size, low cash reserves, high leverage, or low earnings per share are more likely to cut their dividends in the face of recessions (Hull 2013). To tackle the selection bias, we utilize a Heckman (1979) selection model. Following Heckman (1979), we predict the likelihood of making dividend reductions in the first stage and then predict the investment as affected by the timing of dividend reductions after controlling for the selection bias in the second stage. In the first stage, we include the same control variables as in our above baseline regressions and two important instruments—the net financing change and the dividend paid in the last quarter—as is suggested by Hull (2013). The net financing change is measured as the economy's (nonfinancial and nonutility dividend-paying firms) year average of net debt plus net equity issuance minus the average the previous year, all scaled by the previous year's average firm equity. The rationale to use these two variables as our instruments is that the net financing change is expected to be correlated with the overall external financing availability, and the decision to make a dividend cut is dependent on the size of the last usual dividend payment. In unreported results, after correction for the potential selection bias, the relations are still robust and similar to what we find from the baseline regressions.

6.2 Propensity score matching tests

As is suggested by Hull (2013), the decision of dividend reduction timing is not completely exogenous, and it can depend on the firm-specific characteristics. Propensity score matching is a good approach to measure the treatment effects. In our context, the treatment group is the early-dividend reducers, and the control group is the late-dividend reducers. We make comparisons between the treatment group and the control group in the recession sample, out-of-recession industry contraction subsample, and in-recession industry contraction subsample. The matching process starts from estimating the propensity score by a probit regression using the control variables ($\text{Red\_Per}_{i,t}$, $Q_{i,t-1}$, $CF_{i,t-1}$, $\text{Size}_{i,t-1}$, $\text{Peer\_Q}_{i,t-1}$, $\text{Peer\_CF}_{i,t-1}$, and $\text{Peer\_Size}_{i,t-1}$) as our matching variables in our baseline regressions. We first match the early reducers to the late reducers in the same industry (two-digit SIC code) and the same recession period (or industry contraction period). Then we determine the matched pairs by the one-to-one nearest-neighbor's propensity score. The matching process is conducted without replacement.[9] For each sample, we conduct a univariate test, a simple

[9] When the matching is conducted with replacement, we get more matched pairs, and the results are still similar and consistent.

ordinary least squares (OLS) regression with early dividend reduction dummy variable, and a difference-in-differences regression. Again, our results still hold.

6.3 Pseudo-recession analysis

Our empirical results indicate that the timing of dividend reductions has an impact on investment only during the time of recessions because the recession is expected to be correlated with overall external availability of external financing in the market. Therefore, we would expect that outside of recessions, regardless of whether in an industry contraction period, there is no difference between early-dividend reducers and late-dividend reducers in investment. To examine whether the effects are driven by the recession only, we create numerous sets of pseudo-recessions by random (there is no overlapping between the pseudo-recessions and actual recessions) and run the above tests in each pseudo-recession sample. Overall, consistent with our expectation, the signaling effect of dividend reduction timing does not exist in the pseudo-recessions, implying that it inhabits only the actual recession periods.

6.4 Tests with alternative measures of investment

Titman and Wessels (1988) argue that there may be no unique representation of the attribute that we want to measure, and the temptation to select the variables that work best in terms of statistical goodness-of-fit could bias the interpretation. Therefore, our last robustness check is conducted with alternative measures of investment. Following McLean and Zhao (2014), we test the empirical results when the investment is measured as the capital expenditure, the total assets growth, and the total noncash assets growth. Overall, our results are qualitatively similar and robust to all alternative measures of investment.

7 Conclusion

This paper provides a direct test of whether the timing of dividend reductions signals firm investment based on the theoretical work of Hull (2015). In Hull's (2015) model, the external financing is inaccessible or unfavorably expensive in an economy-wide shock. The model suggests that during an economy-wide shock, a relatively early dividend reduction indicates that a firm reduces its cash outflows in order to pursue positive net present value projects. A relatively late dividend reduction is due only to the depletion of financial slacks rather than the investment needs. In addition, the theory argues that during an industry-wide shock, the timing of dividend reductions is not driven by investment needs because a firm can maintain its usual dividend policy by accessing external funds from the capital markets. Hence, we test two hypotheses: (1) In an economy-wide shock, early-dividend reducers have more firm investment than late-dividend reducers, and (2) In an industry-wide shock, the levels of firm investment are similar for early-dividend reducers and late-dividend reducers.

Through the empirical analysis, we find evidence to support Hull's (2015) timing of dividend reductions theory. The results indicate that during a recession period, the early-dividend reducers make 5% more firm investment than the late-dividend reducers in the reduction year. In addition, in the out-of-recession periods, the investment level of early-dividend reducers is not significantly different from that of late-dividend reducers, implying that the

timing of dividend reductions conveys information during the economy-wide shocks only. Last but not least, we test whether the effects associated with the timing of dividend reductions are persistent. The results show that the signaling effect of the dividend reduction timing has no persistence, implying that in a recession the investment opportunities pursued by the early reducers are short-lived.

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