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Three essays on an event-driven investment strategy: Dividend adjustments, share repurchases, and market timing

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Three essays on an event-driven investment strategy: Dividend adjustments, share repurchases, and market timing

by

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ABSTRACT

This dissertation consists of three individual chapters. Chapter 1 documents that market responds negatively to dividend cuts and positively to dividend increases. Chapter 2 finds that firms hierarchally cut dividends and repurchases to meet their investment, or capital expenditure needs. Based on the analysis of Chapters 1 and 2, Chapter 3 discusses the discrepancy between firms and the market when firms adjust dividends, and shows that firms take advantage of this discrepancy to buy back shares.

CHAPTER 1

MARKET RESPONSES TO DIVIDEND ADJUSTMENTS

1.1. Abstract

Literature has documented that market respond negatively to dividend cuts and positively to dividend increases, but most researchers examine this phenomena either at intraday level or at annual level. Our research analyzes the market responses to dividend adjustments at quarterly level, namely, from -4 to 4 quarters surrounding the quarter of adjustments. We find that at quarterly level, market responses are quantitatively consistent with the findings at intraday level and annual level: (1) market responds negatively to dividend cuts and positively to dividend increases; (2) small firms have more information asymmetry, and their share prices are more sensitive to dividend adjustments; (3) market responses are not symmetric to dividend cuts and increases. The findings are consistent with the literature. Our research is complimentary to the current literature, and lend supports to the findings of Xiang and Lence (2016).

1.2. Introduction

Stock market responds negatively to dividend cuts and positively to dividend increases. This phenomena has been extensively analyzed. Most researchers investigate the abnormal return in the short run, usually in a 2- or 3-day window (Dhillon and

Johnson 1994). Some researchers also examine the abnormal return in the long run, or price drifts, from one year to three years (Michaely, Thaler, and Womack 1995).

We investigate the price changes due to dividend adjustments in the middle run, from 2 to 9 quarters. We find that at quarterly level, market responses are quantitatively consistent with the findings at intraday level and annual level: (1) market responds negatively to dividend cuts and positively to dividend increases; (2) small firms have more information asymmetry, and their share prices are more sensitive to dividend adjustments; (3) market responses are not symmetric to dividend cuts and increases. The findings are consistent with the literature. Our research is complimentary to the exiting literature, and lends direct support to Xiang and Lence (2016) which assume that market responses to dividend adjustments are quantitatively consistent at intraday, quarterly, and annual level.

The rest of the paper is organized as follows. In section 2, we briefly review the literature about how market responses to the dividend adjustments, and the possible explanations. Section 3 describes the data, models, and methods. In section 4 we analyze the results. Finally, we draw conclusions in section 6.

1.3. Literature Review

Researchers have well documented how market responds to dividend adjustments. Most of them focus on the short term abnormal returns after a dividend adjustment. For example, Dhillon and Johnson (1994) show that the abnormal return is -2.01% for a dividend cut and 0.98% for a dividend increase in a two-day window. Grullon, Michaely, and Swaminathan (2002) find cumulative abnormal returns of -3.71% for a dividend cut and 1.34% for a dividend increase in a three-day window.

Some researchers examine this phenomena from a long time horizon. For example, Michaely and Womack (1995) document that the first year excess return is 7.5%, and the accumulated three year excess return is 24.8% after a dividend initiation (an extreme case of dividend increase). In addition, they find that the market response is not symmetric. The first year excess return is -11.0%, and the accumulated three year excess return is -15.3% after a dividend omission, which is different from the case of dividend initiation in the magnitude.

After the dividend adjustment, the evolution of prices in the long run is complex. Some researchers find evidence for overreaction or mean reversion in prices. For example, De Bondt and Thaler (1985, 1987) document that firms with the most extreme price performance over 3 to 5 years tend to exhibit a mean-reverting process in excess returns. Again, this phenomena is not symmetric: the losers show a stronger mean reverting pattern than the winners.

The literature provides various explanations for the price reactions to and evolutions after dividend adjustments. The signaling hypothesis states that information asymmetry exists between the market and firms. Dividend adjustments send signals to the market to mitigate the asymmetry (Nissim and Ziv 2001). The information contained can be past earnings (Koch and Sun 2004) and future earnings (Nissim and Ziv 2001, Liljeblom, Mollah, and Rotter 2015), but either way, the market responses are in the same direction of dividend adjustments.

Other explanations include the agency cost hypothesis and clientele hypothesis. The agency cost hypothesis postulates that an increase in dividends reduces the agency costs thus increases the firms' present value (DeAngelo, DeAngelo, and Skinner 2009). The clientele hypothesis (Kawano 2013) suggests that some clientele have a special preference to dividends such as institutional investors and retirees. Some institutional investors can only invest in dividend-issuing stocks because of the "Prudent rule", and the retirees prefer to receiving cash dividends periodically (Fracassi 2008). Although these explanation varies, they are all consistent with the observed facts: market responses and dividend adjustments co-move in the same direction. Therefore, firms may use steady dividends to establish better access to equity market (Gan and Wang 2014).

1.4. Data and methods

We use Compustat quarterly data from 1993 through 2012, for a total of 80 quarters. The variable construction is as same as Xiang and Lence (2016). Size is measured by assets (ATQ, item 44). Market-to-book ratio (MB) equals market assets

(ATQ-CEQQ+CSHOQ*PRCCQ, item 44-item 59+item 61*item 13) divided by lagged assets. Leverage ratio is debt (DLTTQ+DLCQ, item 51+item 45) divided by lagged assets. We follow the well-established approach used by Fama and French (1992), and group the stocks into 3x3 = 9 portfolios with the same number of observations according to lagged firm size and MB. The definitions of portfolios are as follows.

Low to high MB →

Small to large ↓

Small & low MB	Small & blend	Small & high
Mid & low MB	Mid & blend	Mid & high
Large & low MB	Large & blend	Large & high

To examine the market responses to dividend adjustments, we use two methods, namely, the benchmark method (Michaely, Thaler, and Womack, 1995) and the autoregressive method (Campbell and Ammer 1993).

1.4.1. The benchmark method

The benchmark method examines the excess returns of the stock. The definition of excess returns is as follows (Michaely, Thaler, and Womack, 1995).

$$r_t = \frac{div_t + price_t}{price_{t-1}}$$

$$excess\ return_{j,p,t} = r_{j,p,t} - r_{p,t}$$

where t = -4, ..., -1, 0, 1,…,4; r_{pt} is the equally-weighted portfolio return based on the size-MB grouping method (9 portfolios); $\text{excess return}_{j,p,t}$ denotes the excess return of stock j (belongs to portfolio p) at t quarters after the dividend adjustments. We use equally-weighted instead of value-weighted portfolio returns because we are interested in the behavior of individual stocks. By adopting equal weights, we avoid having portfolio returns dominated by the largest firms, as would be the case if weights were based on firm size.

1.4.2. The autoregression method

At stock level, returns usually follow an autoregressive process (Campbell and Ammer 1993, Lamoureuc and Lastrapes 1990). The model is as follows:

$$r_{i,t} = \alpha_i + \beta_i * r_{i,t-1} + \gamma_i * D\_div\_cut_{i,t} + \delta_i * D\_div\_inc_{i,t} + \epsilon_{i,t}$$

where $\text{D\_div\_cut}_{i,t}$ and $\text{D\_div\_cut}_{i,t}$ denote dummy variables of dividend cuts and increases respectively. Coefficients γ_i and δ_i measure the return shocks after dividend cuts and increases. The stock price is measured by the quarterly close price, which is after the dividend distribution. Therefore, $\text{return}_{t=0}$ is the return after dividend adjustments, and $\text{return}_{t=-1}$ is the return before the adjustments.

1.4.3. The return change method

Xiang and Lence (2016) find dividend adjustments affect firms' share repurchase decisions. For small, low-leverage, and low-MB firms, repurchases move with dividends in the same direction, while for large, high-leverage, and high-MB firms, repurchases move in the opposite direction of dividend adjustments. The rationale is that dividend adjustments lead to price fluctuations. To lend more direct support to Xiang and Lence (2016), we follow them and partition the sample into three groups with the same number of firms for each of the following firm characteristics: size, MB, and leverage ratio, and examine the return changes 4 quarters before and after dividend adjustments. Then we examine the return changes surrounding the dividend adjustments. The definition of return changes is as follows.

$$return\ change_k = return_{t=k} - return_{t=0}$$

where t=0 denotes the quarter when a dividend cut or increase occurs, and k=-4, …-1, 1,…4 denotes the quarters before and after the dividend adjustments.

1.5. Results

Table 1.1 presents the results of the benchmark method. In 7 out of the 9 cases, the average returns are significantly below the corresponding benchmark by 1.84% to 6.72% at the 1% significant level after a dividend cut (panel A) . In 7 out of the 9 cases, the average returns are significantly above the corresponding benchmark by 0.6% to 8.8% at the 1% or 5% significant level after a dividend increase (panel B).

We plot the results of table 1.1 in figures 1.1 to 1.6 to show the dynamics. Clearly, for dividend cuts (figures 1.1-1.3), the majority of bottoms occur at quarter 0, i.e., right after the dividend cuts; for dividend increases (figures 1.4-1.6), the majority of the peaks occur at quarter 0, i.e., right after the dividend increases. In addition, the curves become smoother as the stock style goes larger, which shows that small stocks are more sensitive to dividend adjustments. The reason is that small firms have more information asymmetry problems than the large firms, and the market relies more on the dividend adjustments to mitigate the asymmetry problems. We also find that low-MB (high-MB) stocks are more likely to show higher (lower) excess returns than their benchmarks before and after the dividend adjustments, but the reason is unclear.

Table 1.2 reports the results of autoregressive methods. To avoid the effect of outliers, we winsorize the estimated coefficients γ and δ. at 0.005 level. The results are similar to the benchmark method. The coefficients of d_div_cut are significantly negative (-2.19% to -6.18%) with $t>1.64$ in 6 out of the 9 cases, and the coefficients of d_div_inc are significant positive (1.29% to 4.34%) in 8 out of 9 cases. In addition, in 6 out of 9 pairs, the market is more sensitive to dividend cuts than to dividend increases. These stocks are small-low, small-high, mid-low, large-low, large-blend, and large high stocks. This is consistent with the findings of Michaely, Thaler, and Womack (1995): the market responses are not symmetric.

The results of the return change method are plotted in figures 1.7-1.12. Typically, the returns in the quarter of dividend cuts are at the bottom of the valley, especially for firms with more information asymmetry. For example, the average returns are at the lowest point for the small/cut category (figure 1.7). For firms with less information asymmetry, the returns at t=0 are (almost) at the bottom, but all their valleys show a flatter bottom. These flat bottoms indicate that the market is less sensitive to the cuts, but it is still a good time to buy shares as Xiang and Lence (2016) suggest.

The cases of dividend increases are similar. The curves of returns are bell-shaped, with the peaks at or almost at t=0, showing that it is not a good time to repurchase. Again, the bell curves with peaks at t=0 are more typical and significant for firms with more information asymmetry than for those with less information asymmetry.

The analysis above shows that assumption in Xiang and Lence (2016) is sound. Share prices decrease after a dividend cut and increase after a dividend increase, not only in a 2- or 3-day window, but also at a quarterly level. In addition, information asymmetry plays an important role to determine how sensitive the prices are.

1.6. Conclusion

We show that at quarterly level, market responses are quantitatively consistent with the findings at intraday level and annual level: (1) market responds negatively to dividend cuts and positively to dividend increases; (2) small firms have more information asymmetry, and their share prices are more sensitive to dividend adjustments; (3) market responses are not symmetric to dividend cuts and increases. They are more sensitive to cuts than to increases.

Literature have examined the stock performance after dividend adjustments in the short run (over a few days) and the long run (over a few years). Our research examines the stock performance in the middle run, i.e., at quarterly level, and is complementary to the literature. After immediate price shocks, the market responses at least several quarters. The initial market responses are insufficient, leaving room for later price drifts (Michaely, Thaler, and Womack 1995). But the price mean-reverting process in the long run indicates that market over responds to the dividend adjustments (De Bondt and Thaler 1987). The under reaction in the short run and the over reaction in the long run, combined with our findings, suggest that it might take several quarters for the market to reach its intrinsic values from the systematic mispricing, and then fluctuates around the intrinsic values. Finally, our research lend support to Xiang and Lence (2016) by providing some direct evidence in support of their assumptions.

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Appendix

Figures 1.1-1.3: Excess returns surrounding dividend cuts (benchmark method)

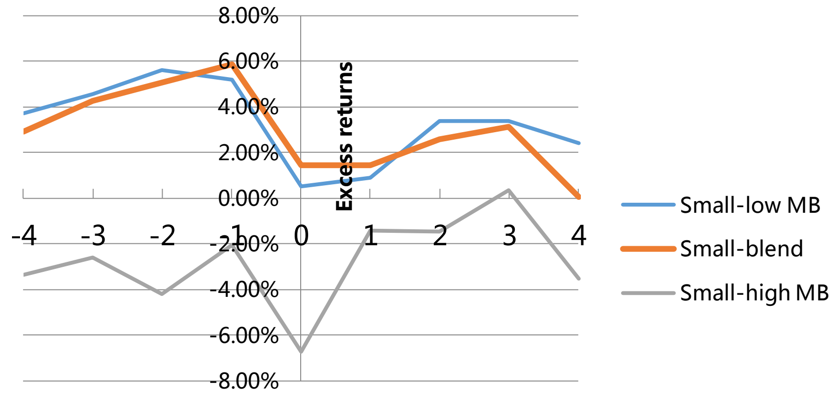

Figure 1.1: Dividend Cuts for Small Firms

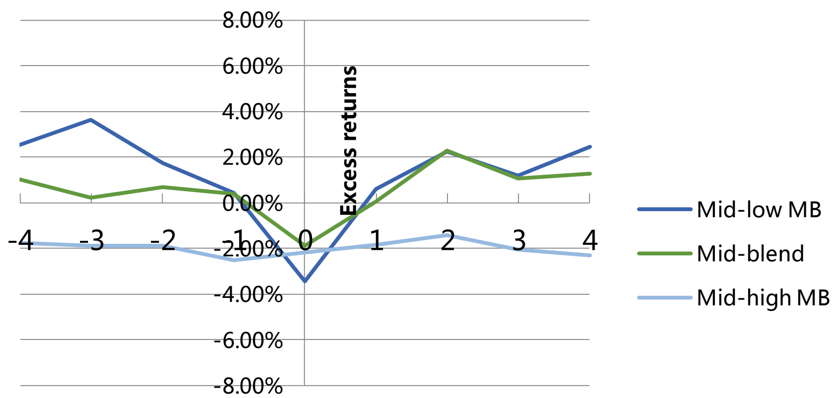

Figure 1.2: Dividend Cuts for Middle firms

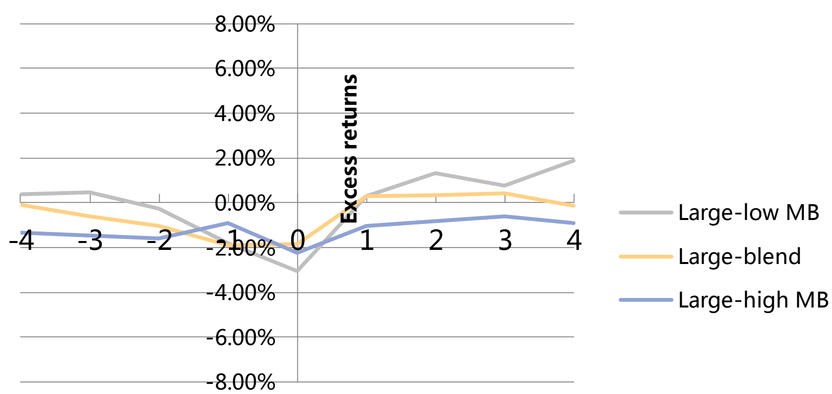

Figure 1.3: Dividend Cuts for Large Firms

Figures 1.4-1.6: Excess returns surrounding dividend increases (benchmark method)

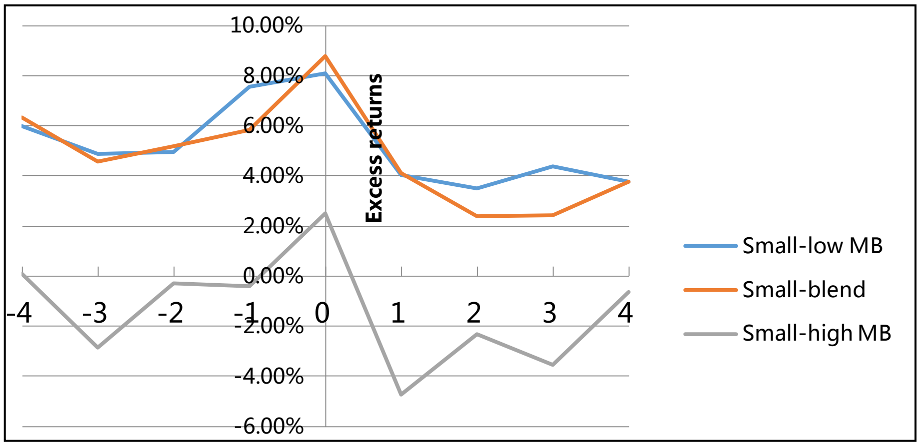

Figure 1.4: Dividend Increases for Small Firms

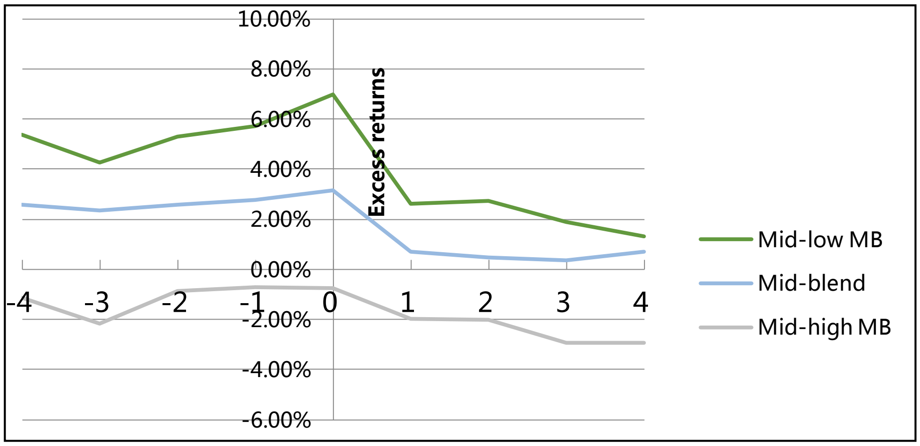

Figure 1.5: Dividend Increases for Middle Firms

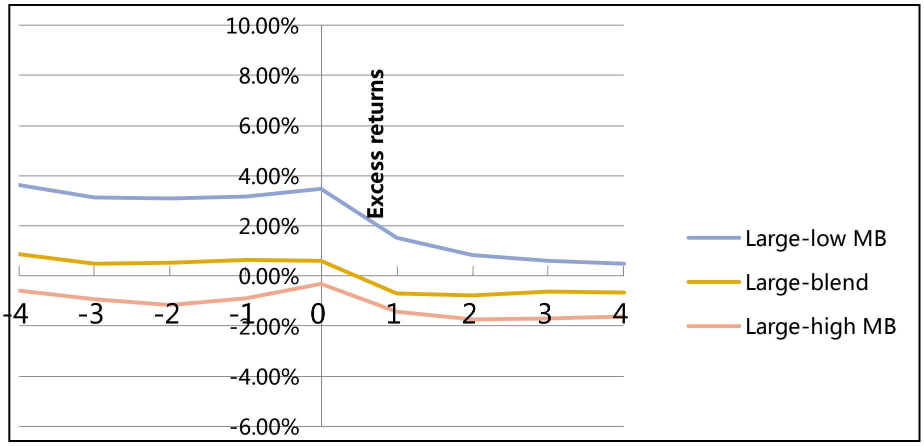

Figure 1.6: Dividend Increases for Large Firms

Figures 1.7-1.12: Returns Surrounding Dividend Cuts and Increases (the return change method)

Quarter 0 is the quarter that dividend cuts or increases occur.

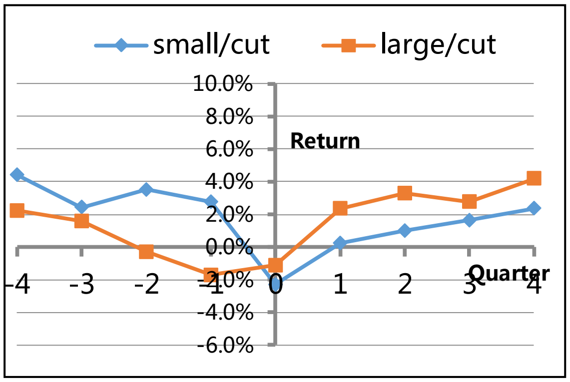

Figure 1.7
Returns Surrounding Dividend Cuts

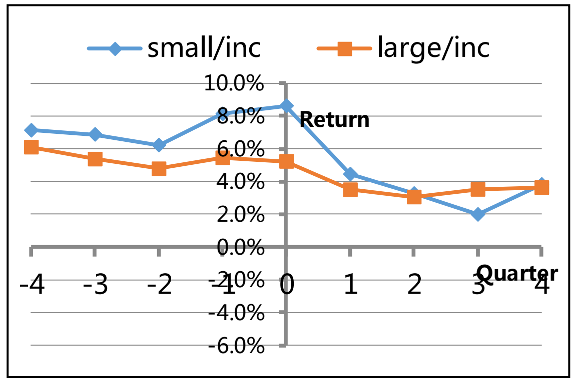

Figure 1.10
Returns Surrounding Dividend Increases

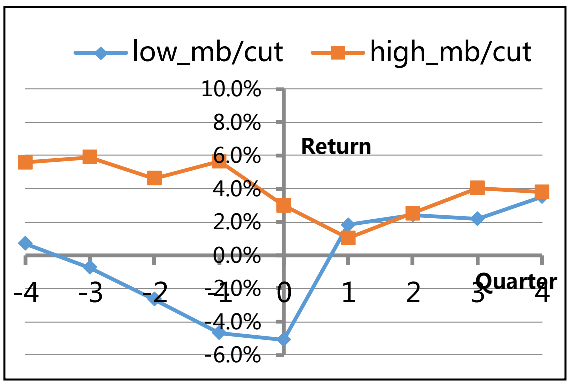

Figure 1.8
Returns Surrounding Dividend Cuts

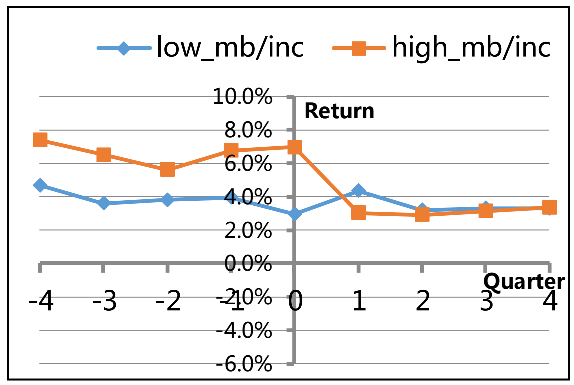

Figure 1.11
Returns Surrounding Dividend Increases

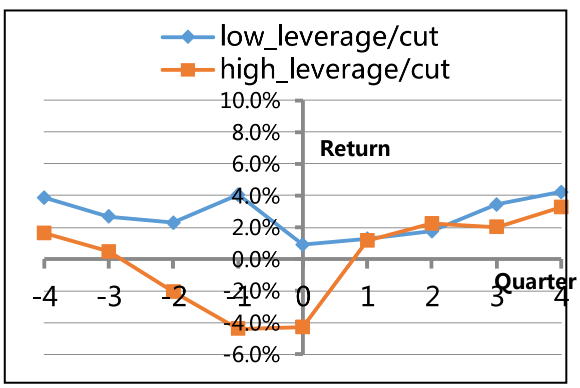

Figure 1.9
Returns Surrounding Dividend Cuts

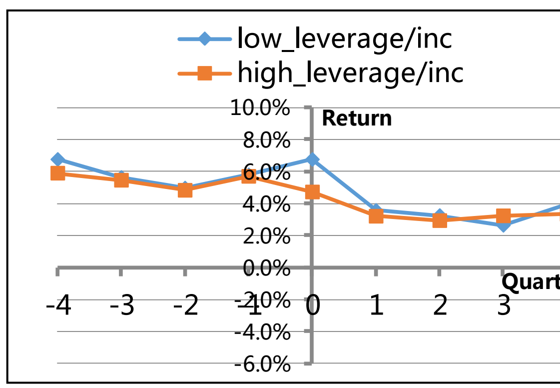

Figure 1.12
Returns Surrounding Dividend Increases

Table 1.1 Excess returns from t=-4 to t=4 (benchmark method)

Panel A — **Dividend Cuts**

	quarter -4	quarter -3	quarter -2	Quarter -1	Quarter 0	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Small-low MB	3.73%***	4.56%***	5.60%***	5.19%***	0.53%	0.91%	3.37%***	3.39%***	2.40%***
Small-blend	2.92%***	4.24%***	5.05%***	5.87%***	1.42%	1.42%	2.57%**	3.14%***	0.05%
Small-high MB	-3.37%**	-2.61%*	-4.18%***	-2.06%	-6.72%***	-1.41%	-1.45%	0.34%	-3.53%**
Mid-low MB	2.55%***	3.61%***	1.72%***	0.45%	-3.46%***	0.61%	2.25%***	1.17%**	2.43%***
Mid-blend	1.01%*	0.2%	0.68%	0.38%	-1.89%***	0.06%	2.28%***	1.07%*	1.28%**
Mid-high MB	-1.76%**	-1.88%**	-1.89%***	-2.53%***	-2.19%***	-1.86%**	-1.43%**	-2.05%***	-2.30%***
Large-low MB	0.37%	0.46%	-0.27%	-1.80%***	-3.05%***	0.28%	1.32%***	0.77%*	1.88%***
Large-blend	-0.08%	-0.61%	-1.01%**	-1.90%***	-1.84%***	0.31%	0.34%	0.43%	-0.11%
Large-high MB	-1.31%***	-1.47%***	-1.57%***	-0.92%**	-2.21%***	-1.01%**	-0.83%*	-0.61%	-0.90%**

Panel B — **Dividend Increases**

	quarter -4	quarter -3	quarter -2	Quarter -1	Quarter 0	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Small-low MB	6.00%***	4.87%***	4.96%***	7.57%***	8.11%***	4.04%***	3.50%***	4.37%***	3.76%***
Small-blend	6.32%***	4.59%***	5.17%***	5.82%***	8.80%***	4.12%***	2.39%***	2.43%***	3.76%***
Small-high MB	0.11%	-2.85%**	-0.31%	-0.42%	2.51%**	-4.75%***	-2.32%*	-3.56%***	-0.64%
Mid-low MB	5.38%***	4.27%***	5.29%***	5.72%***	7.00%***	2.60%***	2.72%***	1.90%***	1.33%***
Mid-blend	2.57%***	2.34%***	2.58%***	2.76%***	3.14%***	0.70%*	0.46%	0.37%	0.69%*
Mid-high MB	-1.14%***	-2.16%***	-0.86%**	-0.71%*	-0.74%*	-1.98%***	-2.01%***	-2.95%***	-2.95%***
Large-low MB	3.64%***	3.13%***	3.09%***	3.15%***	3.47%***	1.54%***	0.82%***	0.59%**	0.49%*
Large-blend	0.88%***	0.50%**	0.54%***	0.64%***	0.60%***	-0.69%***	-0.78%***	-0.61%***	-0.67%***
Large-high MB	-0.60%***	-0.94%***	-1.14%***	-0.88%***	-0.33%*	-1.44%***	-1.72%***	-1.69%***	-1.61%***

Table 1.2 Excess Returns at t=0 (auto regression method)

Panel A	Dividend Cuts				
Stock style	**Mean**	**Median**	**Sd.**	**N**	**t**
Small-low MB	-5.51%***	-4.40%	22.55%	211	**-3.55**
Small-blend	-1.60%	-2.02%	24.52%	237	-1.00
Small-high MB	-5.22%*	-3.36%	26.65%	79	**-1.74**
Mid-low MB	-6.18%***	-5.45%	22.31%	756	**-7.62**
Mid-blend	-1.76%	-1.79%	22.10%	364	-1.52
Mid-high MB	0.48%	-0.08%	20.26%	321	0.43
Large-low MB	-6.10%***	-5.30%	22.93%	704	**-7.05**
Large-blend	-4.49%***	-3.33%	20.98%	973	**-6.68**
Large-high MB	-2.19%**	-1.35%	18.87%	349	**-2.17**
Total	-4.14%***	-3.36%	21.97%	3994	**-11.91**

Panel B	Dividend Increases				
Stock style	**Mean**	**Median**	**Sd.**	**N**	**t**
Small-low MB	4.34%***	3.37%	20.12%	189	**2.97**
Small-blend	4.25%***	2.81%	24.07%	272	**2.91**
Small-high MB	-2.14%***	-0.48%	24.43%	102	-0.89
Mid-low MB	3.81%***	3.26%	19.24%	730	**5.35**
Mid-blend	1.68%*	1.03%	20.76%	563	**1.93**
Mid-high MB	1.33%*	0.63%	20.10%	628	**1.66**
Large-low MB	2.34%***	1.91%	17.64%	713	**3.55**
Large-blend	1.29%***	1.07%	15.33%	1526	**3.29**
Large-high MB	1.54%***	1.53%	15.03%	835	**2.96**
Total	2.02%***	1.53%	18.17%	5558	**8.30**

Table 1.3 Return changes at t=0 (return change method)

$$\text{Return change} = \text{return}_{t=0} - \text{return}_{t=-1}$$

$$\text{return}_t = \frac{\text{div}_t + \text{price}_t}{\text{price}_{t-1}}$$

t=0 when a dividend cut or a dividend increase occurs

	After dividend cuts				After dividend increases			
Groups	**Mean**	**Std.Dev**	**t_Statistics**	**Obs**	**Mean**	**Std.Dev**	**t_Statistics**	**Obs**
Small	-4.73%**	21.61%	**-3.17**	210	0.64%	22.52%	0.57	410
Large	0.68%	25.11%	1.03	1419	-0.10%	20.80%	-0.48	9861
Low MB	-0.23%	24.24%	-0.31	1092	-0.90%	21.15%	-1.88	1946
High MB	-2.57%*	24.23%	**-2.19**	427	0.28%	21.49%	0.92	5140
Low Leverage	-2.84%**	22.79%	**-3.15**	640	1.19%**	22.39%	**3.01**	3189
High Leverage	0.32%	26.07%	0.37	891	-0.91%*	20.85%	**-2.62**	3602
Aggregate	-0.40%	25.10%	-0.78	2404	-0.17%	21.33%	-0.92	12831

CHAPTER 2

EXTERNAL FINANCIAL RESTRICTIONS AND INTERNAL FINANCIAL FLEXIBILITY: HOW DO FIRMS CUT PAYOUTS TO FINANCE INVESTMENT

2.1. Abstract

This paper quantitatively analyzes how firms cut various payouts to finance their investments. Payouts have two different forms — dividends and repurchases. Repurchases are more flexible than dividends in terms of timing and dollar magnitudes. To undertake investments, firms show a hierarchy of payout cut behaviors: they are more likely to cut repurchases, and are not likely to cut dividends unless cutting repurchases does not meet their needs. Furthermore, firms' preference for payout cuts is affected by their accessibility to external financial sources. Small firms, high-leverage firms, and young firms have more difficulty accessing external finance sources. Therefore, they rely more on payout cuts to finance investments. These firms are more likely to cut repurchases or cut both repurchases and dividends. In contrast, large firms, low leverage-ratio firms and mature firms are less relient on payout cuts to finance investments. The results are robust to changes in the measurements of investments and repurchase cuts. In extreme circumstances, e.g., in the late 2000s crisis, firms rely more on all kinds of payout cuts to finance their investments.

2.2. Introduction

Investments and payouts are two major issues in corporate finance and have received intense scrutiny in the literature. Research on investments usually focuses on how firms make investment decisions, and how the investment is financed (e.g., Doms and Dunne 1998); studies on payouts mainly attempt to explain why, how, how much, and when firms pay out (DeAngelo et al., 2009). However, most research has examined the two activities separately, whereas firms may consider them simultaneously. In fact, investments and payouts interact with each other via the channel of budget constraints. In addition, when scholars examine the relationship between payouts and investments, they do not differentiate between the two forms of payout: They either focus on dividends, ignoring repurchases (for example, Danis et al., 2011), or add them together as a total payout (for example, Whited 2006).

Dividends and repurchases affect investment in different ways. In particular, dividends are sticky, whereas repurchases are much more flexible than dividends in both timing and dollar magnitudes(DeAngelo et at., 2009). Cutting dividends is not as easy as cutting repurchases. This situation can be even more complex when taking other factors into account. For example, when external finance opportunities are very limited, firms may be forced to cut both dividends and repurchases. In contrast, when the stock price is perceived to be significantly undervalued, which may be the case for small firms, firms may prefer to cut dividends over cutting repurchases. Therefore, treating repurchases in the same way as dividends may lead to biased conclusions. This bias maybe exaggerated when repurchases are more prominent, as they have become since the late 1990s (see figure 2.1)[1]. If regulators make decisions based on incorrect inference, they may not get desired results.

Analyzing the relationship between payout and investment by differentiating between repurchases and dividends is a brand-new research area. We rigorously examine, *for the first time*, how firms cut various payouts to finance their investments. Our research should help government regulators and firm managers make better decisions. Besides, it may help explain why sometimes firms' behaviors are consistent with the pecking order theory instead of the trade off theory. The pecking order theory states that firms prefer internal finance to external finance because the cost of internal funds is (always) lower than the cost of external funds. On the contrary, the trade off theory asserts that firms trade off between the benefits and costs of both external and internal finance, and choose the optimal financing method, usually a combination of both. Our research shows that small, young, and high-leverage firms' behaviors are more consistent with the pecking order theory because they have less external financial opportunities, leading to higher external financing cost.

Specifically, our paper find firms show a hierarchy of payout cut behaviors To undertake large lumpy investments. They are more likely to cut repurchases, and are not likely to cut dividends unless cutting repurchases does not meet their needs. Furthermore, firms' preference for payout cuts is affected by their accessibility to external financial sources. Small firms, high-leverage firms, and young firms have more difficulty accessing external finance sources. Therefore, they rely more on payout cuts to finance investments. These firms are more likely to cut repurchases or cut both repurchases and

[1] In the early 1980s, aggregate repurchase yield was only 1/10 of aggregate dividend yield, while in late 1990s, it began to exceed the aggregate dividend yield.

dividends. In contrast, large firms, low leverage-ratio firms and mature firms are less relient on payout cuts to finance investments. The result is robust to changes in the definition of repurchase cuts.

The rest of the paper is organized as follows. Section 2 provides a brief literature review on payouts and investments. Section 3 describes the data and variable construction. Section 4 proposes hypotheses. Section 5 discusses the regression results. We analyze how firms cut payouts when facing investment opportunities. More specifically, we explore the interactions between payout cut and firm size, leverage ratio, and age. We show how firms' payout cut strategies change over time. Section 6 tests the robustness after we change the measurement of investment and repurchase cut. Section 7 draws conclusions and discusses future research directions.

2.3. Literature Review

The literature regarding payout policies answers why, how much, how, and when firms pay out. As to the first question, earlier researchers (for example, Jensen 1986) believe that shareholders pressure managers to pay out because of agency costs. If shareholders allow internal cash to over-accumulate, managers will have opportunities to invest in projects that benefit themselves, e.g., pet programs. Payouts prevent this from happening by reducing the accumulated cash level. Recent research has found more reasons for firms to pay out. For example, firms pay out to signal to the market that they have good earnings. Whited (2006) finds that payout is a signal of fewer financial constraints. According to Brav et al. (2005) and Gan and Wang (2012), firms pay out to obtain better access to external equity markets.

The consequent question is how much should firms pay out. On the one hand, smaller payouts mean greater cash cushion to absorb unexpected earning shocks. On the other hand, smaller payouts indicates greater agency cost and more negative signals to the market. Firms tradeoff between the benefits and costs, and choose the optimal payout level (DeAngelo et al., 2009).

Another critical question is in what form (by dividends or by repurchases) firms pay out. In earlier years, firms were in favor of dividends, whereas nowadays firms prefer repurchases to dividends. The proportion of firms paying dividends was 66.5% in 1978, but dropped to 20.8% in 1999 (Fama and French, 2001). This change is partially due to the adoption of a series of rules and regulations. The first one is Rule 10b-18[2], which was adopted in 1982. Before 1982, large-scale repurchases might have been deemed as manipulating stock prices. Rule 10b-18 provided firms with a safe harbor to repurchase, and made large-scale repurchases feasible for the first time (see figure 2.1). The aggregate repurchase yield increased by a factor greater than three in the five years following 1982.

The second important rule change concerns the revision of the “prudent man rule” to the “prudent investor rule” in 1992. The prudent man rule requires trustees to invest as a prudent man — each investment is judged on its own merits. Under this rule, a stock that does not pay dividends is regarded as too risky to invest. Therefore, many firms pay dividends so that their stocks are not classified as “risky”. This situation changed when the “prudent investor rule” replaced the “prudent man rule” in 1992. Under the “prudent investor rule”, the risk is judged on the portfolio, not the individual investment. Therefore,

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[2] See U.S. Security and Exchange Commission (SEC) website for more details: http://www.sec.gov/divisions/marketreg/r10b18faq0504.htm#P15_1144

since 1992, the distribution of dividends has not been as critical as before, and repurchases have become more important.

The preference of repurchases over dividends is also due to some disadvantages of dividends. Dividends are much more rigid than repurchases. For firms paying dividends, the market expects them to pay continuously and maintain at least the same historical levels. If a firm reduces or omits the dividends, it receives a big market penalty. Denis and Osobov (2008) document that the stock price declines 6% on average over the three days after a firm announces a dividend cut. In contrast, the market does not expect firms to repurchase routinely. Firms can repurchase at any time and in any dollar amount. There is no significant market penalty for firms that reduce or omit repurchases.

There are other benefits of repurchases. For example, repurchases are subject to lower tax rates than dividends. In addition, in the late 1990s many firms began to use stock options to compensate their employees. Therefore, these firms might increase repurchases to mitigate the dilutive effect of increased stock shares(Ben, Venky, and Skinner, 2003). However, dividends are still an important form of payouts and are unlikely to disappear. Dividends convey a stronger signal to the market than repurchases. The stickiness of dividends implies that firms distributing dividends are much more confident in their future earnings than firms that repurchase. Therefore, some firms distribute dividends only, or payouts by means of dividends and repurchases at the same time.

Lastly, another question concerns the timing of payouts. Usually, dividends are paid periodically, e.g., quarterly, whereas repurchases can occur anytime. When firms believe their stock is undervalued by the market, they may repurchase it to increase its price. Or, when firms have high transitory cash flows, they may repurchase to prevent from over accumulating cash (DeAngelo et al., 2009).

Even though the payout literature is rich, research on the relationship between payouts and investments has been limited. Some researchers focus on the relationship between investments and dividends, ignoring repurchases. Daniel et al. (2007) show that when firms fall short of money, only 6% cut dividends whereas 68% cut investment. Bulan et al. (2008) suggest that firms may strategically omit dividends to explore investment opportunities. Other researchers examine the relationship between investments and total payouts, but treat repurchases and dividends in the same way. Whited (2006) finds that small firms[3] that distribute cash back capture more investment opportunities than small firms that do not, because cash to be paid out can provides internal financial resources for investment.

Sarig (2004) examines the causal-effect relationship between total payouts and investments. Using a vector auto regression (VAR) model and aggregate-level data, he finds that corporate investment decisions lead to payout decisions, and not the other way around. However, dividends are sticky, whereas repurchases are much more flexible than dividends in both timing and dollar values. Because timing and dollar magnitudes are two important aspects of investment opportunities, one dollar of repurchases is not equivalent to one dollar of dividends in terms of potential internal financial resources for investment. Grouping both of them into a single aggregate payout may lead to biased conclusions.

Brav et al. (2005) treat repurchases and dividends as different forms of payouts. They conduct a survey and find that most firms make dividend decisions before investment

[3] The sample in Whited (2006) distinguishes among "small firms", "very small firms" and "small segments of conglomerates". We ignore the difference and just name all of them "small firms".

decisions, but make repurchase decisions after investment decisions. However, a surveys may be subject to wishful-thinking bias (Forsythea and Rietza, 1999). Firms may wish to make dividend decisions before investment decisions, but they may actually make dividend decisions after investment decisions or simultaneously. In addition, the conclusions of Whited (2006) and Sarig (2004) are not completely consistent with each other. One possible reason is that they use different data and methods. Sarig (2004) uses aggregate data. At the aggregate level, the result is more likely to be dominated by the behavior of large firms. In contrast, Whited (2006) examines only small firms and uses data at the firm-year level.

Regarding measurments of investments, researchers use two methods. One method consist of using continuous investment data, whereas the other method focuses on discrete investments, i.e., investment spikes. Continuous measurement has some advantages: for example, it does not only provide more detailed information, but also helps address the cause-effect relationship between investments and payouts. To identify the cause-effect relationship, researchers typically use structural models and VAR models. For example, Gugler (2003) uses a structural model to analyze the relationships among dividends, R&D, and capital investment. Sarig (2004) estimates a VAR model to analyze the relationships among payouts, investments and earnings. All these models rely on continuous data.

Other researchers suggest that investments are more likely to be lumpy rather than continuous. Doms and Dunne (1998) find that on average more than 25% of a plant's accumulative investment over 17 years occurs within one year. They explain this phenomenon by non-convex adjustment costs. Furthermore, many modern corporate finance theories are interested in investment spikes. For example, a theoretical model usually assumes that an entrepreneur has an indivisible investment opportunity, or project. This assumption is typical in financial textbooks. Discrete investment spikes incorporate this idea.

Finally, observed payout cuts may have no cause-effect relationship with small investment fluctuations. It may well be the case that payout changes are induced by other factors. For example, a firm may cut repurchases because its stock is overvalued. At the same time, the firm uses a cash cushion to absorb the shocks of a small increase in investment. Therefore, a discrete method is plausible..

2.4. Data and Variable Construction

We use Compustat annual data from 1983 to 2011. Our data start in 1983 because large-scale repurchases became feasible only after Rule 10b-18 was passed in 1982. The variables we construct include firm characteristic variables, large investment variables, and payout cut variables. The details are as follows.

Firm characteristic variables include cash, cash flow, sales growth, debt leverage ratio, market-to-book ratio (MB), size, investment ratio, dividend yield, repurchase yield, age, and age squared. Cash is cash (CH, item 162) divided by asset (AT, item6). Cash flow is income before extraordinary items (IB, item18) plus depreciation and amortization (DPC, item125), divided by asset. Sales growth equals sales (SALE, item117) in the current year minus sales in the last year, divided by last year's sales. Debt leverage ratio is debt (LT+PSTKL-TXDITC-TXDITC-DCVT, item181+item10-item35 -item79) divided by asset. MB equals market assets (AT-CEQ+CSHO*PRCC, item6-item60+item25*item24) divided by asset. Size is logarithm of asset. Investment ratio is investment (CAPX, item145) divided by asset. Dividend yield equals dividends common/ordinary divided by asset (DVC/AT, item21/item6). Repurchase yield equals purchase of common and preferred stock (PRSTKC, item115) divided by asset. Age is the number of years that a firm has been listed on Compustat. For firms already listed in 1983, we go back 12 years (back to 1971) to calculate the age.

Utility firms and financial institutions (SIC 6000-6999, 4400-4999) are excluded from the sample because their operating is very different from other firms. To avoid results being seriously affected by a few outliers, we winsorize the data at the 0.5% level (not applicable to age). The final data set contains 493,741 firm-year observations. The descriptive statistics is shown in Panel A of table 2.1.

We partition the payout activities into four categories: no payout, dividends only, repurchases only, and both dividends and repurchases, as shown in Panel B of table 2.1. Both Panel A and Panel B show that repurchases are at least as important as dividends. Panel A shows that the mean repurchase yield is 1.01%, 36% larger than the mean dividend yield (0.7%). Panel B shows that the numbers of firm-year repurchases and dividends are comparable: 15.9% of firm years pay out by repurchases only, 13.7% of firm years pay out by dividends only, and 11.2% of firm years pay out by both. More than half (59.2%) of firm years have no payout.

To measure large investment activities, we use the discrete method for the reasons discussed before. We follow Whited (2006)'s definition of investment spike as follows: an investment spike occurs if investment ratio>2*median{the investment ratio of the firm}, and a dummy variable equals 1 if an investment spike occurs, and 0 other wise.

To describe payout cut activities, we define payout cut variables as follows. A dividend cut occurs when dividends in the current period are lower than dividends in the previous period. This definition is widely accepted by both academia and industry, because any cut in dividends leads to a significant market reaction. However, cut in repurchases has no clear definition. Repurchases are so flexible that a firm is not expected to repurchase as routinely as it is the case with distributing dividends. Therefore, it is assumed that only non-trivial reductions in repurchases are noticed by market. Following this idea, we define a repurchase cut as the repurchases at least 10% lower than in the previous year [4], which is similar to the definition of Bliss, Cheng, and Denis (2013).Hereafter, repurchase cut means “non-trivial decrease in repurchase”.

The cut of payouts have some preconditions. For example, for a firm to cut dividends, the precondition is that the firm must have distributed dividends in the previous year. We partition payout cuts into five categories: no payout cut, repurchase cut only, dividend cut only, combination of cutting both, and not applicable, each with its own preconditions. The details are as follows.

Table of payout cut and preconditions

Payout cut activities	**Preconditions**
1. No payout cut	lagged .repo>0 or l.div>0
2. Repurchases cut only	lagged.repo>0
3. Dividends cut only	lagged.div>0
4. Cut both	lagged.div>0 & lagged.repo>0
5. Not applicable	lagged.div=0 & lagged.repo=0

Table 2.2 describes unconditional payout cuts and payout cuts conditional on investment spikes. Unconditionally, firms are unwilling to cut dividends. Panel A shows that 37.9% of firm-year observations cut repurchases only, whereas 15.4% of firm-year observations cut dividends only, which is much smaller than the former. Conditionally on

[4] We try different criteria to define a non-trivial decrease in repurchases in the robustness test.

an investment spike, firms aggressively cut payout. The cut-both category increases from 60.6% to 81.3%. It is consistent with our hypothesis that firms cut payouts to undertake large investments. Panel C shows the economic significance of cutting payouts. In dollar values, the median of the dividends cut to investment ratio is roughly 8%, and the median of repurchase cut to investment ratio is 11%. Both are substantial. When we look at the mean, both ratios are around 50%, which are even higher.

2.5. Hypothesis and the Models

How does a firm optimize payout cuts to finance large investment in reality? In this section, we carry out a series of analyses to investigate this question by classifying payout-cut activities into different forms.

First, we discuss how firms take advantage of the internal financial flexibility provided by repurchase cuts. Second, we investigate how firms' payout cut strategies change under different external financial situations. There are at least four factors that may affect the external financing conditions: firm size, leverage ratio, age, and macro economic conditions. The first three are evaluated using cross sectional data, and the last one is examined using time series data. In the following, we discuss firms' payout cut strategies case by case.

2.5.1. Internal financing flexibility: repurchase cuts

Repurchases are flexible in terms of timing and dollar value. This internal financial flexibility makes it easy for firms to cut repurchases. Therefore, our main hypothesis is:

H1: All firms are more likely to cut repurchases than cut nothing when there is an investment spike. Firms are not more likely to cut dividends only.

Because both repurchase cuts and dividend cuts are discrete choices, we choose a discrete model to analyze firms' preferences. The advocated multinominal model (Greene 2012) is as follows:

$$prob(payout\_cut_{it} = j) = \frac{\exp(\alpha_j + \beta_j investment\_spike_{it} + \gamma_j X_{it} + \delta_j Y_{it} + \lambda_j D)}{\sum_{k=1}^{5} \exp(\alpha_j + \beta_j investment\_spike_{it} + \gamma_j X_{it} + \delta_j Y_{it} + \lambda_j D)} \qquad (1)$$

where j=1,2,…,5. *Payout_cut*=1, 2, 3, 4, or 5 if cut nothing, cut repurchases only, cut dividends only, cuts both, or falls in a category of "not applicable" i. X is a vector of predetermined firm characteristic variables, including repurchase yield, dividend yield, market to book ratio, debt leverage ratio, log asset, cash, cash flow, sales growth, age, and age squared. All explanatory variables are one year lagged except for age and age squared. Y is a vector of variables that describes the partition of 1-year lagged payout categories: paid out nothing, repurchased only, distributed dividends only, or paid out by both methods in period t-1 for firm i. If a firm did not pay anything in the previous year, the discussion of cutting payout becomes trivial. Therefore, we introduce Y so that the discussion of payout cut activities is under comparable preconditions5. D is a vector of year dummy variables and industry dummy variables at the two-digit SIC code level. We mitigate the endogenous problem of investment by an instrumental variable method

[5] An alternative is to limit firms to a subsample that paid by both dividends and repurchases in the previous year, but this method leads to sample selection bias. Besides, this method drops too many observations, resulting in a loss of efficiency. Therefore, we prefer our precondition-control method.

(IV). We use a fixed-effect model to compute the expected investment, which is then used to estimated the investment spikes. An estimated investment spike occurs when the estimated investment is at least two times larger than the firm's median. The model is as follow.

$$investment_{it} = \theta_1 + \theta_2 investment_{it-1} + \theta_3 X_{it-1} + \theta_4 D^* + \omega_i + v_{it}$$

where X is the vector of firm characteristics defined as before, D* is a vector of year dummy variables, ω is a fixed effect, and v is the error term.

2.5.2. Restricted external financing: firm size

We further investigate how firms' payout cut strategies change when external financing opportunities are restricted. Weinberg (1994) shows that it is harder for small firms to get external funding than for large firms, because the information asymmetry problem is more serious for them. Many other researchers support this point (for example, Beck etc., 2008; Martínez-Carrascal, 2010). As a result, cutting dividends and repurchases, or internal financing may be more important for small firms, but not for large firms. Following this idea, we form our sub-hypothesis A as follows.

H1-A: To finance large investment, small firms are more likely to cut repurchases than to cut nothing. They are also more likely to cut both repurchases and dividends. Large firms rely less on payout cuts.

To test this hypothesis, we examine the interaction between investment spikes and firm size. We partition the sample into three groups with the same number of observations by firm size in a year, namely, small, medium, and large firms. Then we interact the size group with investment spikes. The multilominal model is as follows:

$$prob(payout\_cut_{it} = j) = \frac{\exp(\alpha_j + \beta_j i.size\_grp_{it} * investment\_spike_{it} + \gamma_j X_{it} + \delta_j i.Y_{it} + \lambda_j D)}{\sum_{k=1}^{5} \exp(\alpha_j + \beta_j i.size\_grp_{it} * investment\_spike_{it} + \gamma_j X_{it} + \delta_j i.Y_{it} + \lambda_j D)} \quad (2)$$

where size_grp=1, 2, or 3 if the size of a firm is small, medium or large.

2.5.3. Restricted external financing: leverage ratio

Similarly, it is more difficult for high-leverage firms to access external finance resources than for low-leverage firms. The mechanism is as follows. External finance includes debt and equity. When a high-leverage firm finances by debt, it further increases its leverage ratio, while the market regards a high leverage ratio as a signal to high default risk. Marchica and Mura (1994) suggest that firms with high leverage ratio have less borrowing power. When the firm finances by issuing equity, the market tends to response negatively to the stock price of a high-leverage firm (Cai et. al., 2010). Therefore, a firm with high leverage ratio has to rely more on internal finance, which increases the possibility of a payout cut. In addition, high leverage firms have less internal financial flexibility, because of the higher interest burden. To seek more financial flexibility, they might also rely more on payout cuts. Hence, we form our sub-hypothesis B as:

H1-B: When there is an investment spike, high-leverage firms are more likely to cut repurchases than to cut nothing. They are also more likely to cut both repurchases and dividends. Low-leverage firms rely less on payout cuts.

To test this hypothesis, We partition the sample into three groups with the same number of observations by firm leverage in a year, namely, low, medium, and high leverage firms. Then we interact the leverage ratio group with investment spikes. The model is as follows (see next papge):

$$prob(payout\_cut_{it}=j)=\frac{\exp(\alpha_j+\beta_j i.lev\_grp_{it}*investment\_spike_{it}+\gamma_j X_{it}+\delta_j i.Y_{it}+\lambda_j D)}{\sum_{k=1}^{5}\exp(\alpha_j+\beta_j i.lev\_grp_{it}*investment\_spike_{it}+\gamma_j X_{it}+\delta_j i.Y_{it}+\lambda_j D)} \quad (3)$$

where lev_grp=1, 2, or 3 if the leverage ratio of a firm is low, medium or high.

2.5.4. Restricted external financing: age

Firm age also affects the accessibility to external financial market. Gonzalez, Lopez, and Saurina (2007) argue that mature firms have established more track records so that the lenders can evaluate. Therefore, mature firms have less restriction in external financial market, and might rely less on payout cut to finance their investment spike. Our sub-hypothesis C is as follows:

H1-C: When there is an investment spike, young firms are more likely to cut repurchases than cut nothing. They are also more likely to cut both repurchases and dividends. Mature firms are unwilling to cut payouts. Mature firms rely less on payout cuts.

To test this hypothesis, We partition the sample into three groups with the same number of observations by firm age in a year, namely, young, medium, and mature firms. Then we interact the age group with investment spikes. The model is as follows.

$$prob(payout\_cut_{it}=j)=\frac{\exp(\alpha_j+\beta_j i.age\_grp_{it}*investment\_spike_{it}+\gamma_j X_{it}+\delta_j i.Y_{it}+\lambda_j D)}{\sum_{k=1}^{5}\exp(\alpha_j+\beta_j i.age\_grp_{it}*investment\_spike_{it}+\gamma_j X_{it}+\delta_j i.Y_{it}+\lambda_j D)} \quad (4)$$

where age_grp=1, 2, or 3 if the age of a firm is young, medium or matured.

2.5.5. Restricted External financing: macro economic environment and the trend

The macroeconomic and policy environments are continuously evolving. This change affects firms' access to external financing sources. Therefore, firms' payout strategies change as well. We examine the trend of payout strategies when facing investment opportunities. We construct a year indicator variable and interact it with firm size and investment spikes. The model is as follows.

$$prob(payout\_cut_{it} = j) = \frac{\exp[\alpha_j + \beta_j i.(investment\_spike_{it} * size\_grp_{it} * year) + \gamma_j X_{it} + \delta_j i.Y_{it} + \lambda_j D]}{\sum_{k=1}^{5} \exp[\alpha_j + \beta_j i.(investment\_spike_{it} * size\_grp_{it} * year) + \gamma_j X_{it} + \delta_j i.Y_{it} + \lambda_j D]} \quad (5)$$

where year=1983,…,2011, and the base category is cut nothing as before. To get more intuitive information, we use a descriptive statistical method instead of hypothesis test as follows. We extract the relative risk ratio (RRR) coefficients in the categories of repurchase cut only and dividend cut only, organizing by size. Then we plot the bar charts and analyze the trend and characteristics in some special years.

2.6. Results

The regression results of model 1 show how firms cut payouts at the aggregate level, with the cut-nothing category as the base category. We present the results without and with IV side by side in table 2.3. The not-applicable category is dropped because Y_{it} predicts it perfectly. The RRR shows the likelihood that firms choose this category over the base category. The results of the regressions with and without IV are quantitatively the same and consistent with our hypotheses. Firms are 9%-12% more likely to cut repurchases only than to cut nothing when there is an investment spike. They are not more likely to cut dividends or cut both dividends and repurchases only at any significant level. In other words, firms take advantage of internal financing flexibility by cutting repurchases to undertake large investment. In the rest of our analysis for sub groups, we only report the results from the IV method.

Model 2 frames how payout cuts interact with firm size. The regression results (table 2.4) are very striking. When there is an investment spike, small firms are 17% more likely to cut repurchases only at a 1% significance level, and 39% more likely to cut both dividends and repurchases. They do not cut dividends alone. It shows a payout cut hierarchy for small firms. They may cut repurchases only, or cut both, but do not cut dividends without cutting repurchases. However, large firms show a different preference order. They are indifferent between cutting repurchases only and cutting nothing, and are 13% less likely to cut dividends only at a 5% significance level. It shows that small firms rely greatly on payout cuts to finance large investment, while large firms do not rely on payout cuts to finance large investment.

Model 3 depicts how firms' payout cuts interact with the leverage ratio. The regression results are shown in table 2.5. High leverage firms choose a more aggressive payout cut strategy. They are 44% more likely to cut both dividends and repurchases than to cut nothing at a 1% significance level. Similar to small firms, they are not more likely to cut dividends only and show a payout cut hierarchy. In contrast, low leverage firms are indifferent between these cutting methods. Their RRR coefficients of the three cut strategies are neither economically significant (0.97~1.07, close to 1) nor statistically significant. Succinctly, high leverage firms rely more on payout cuts to finance their large investments.

Model 4 explores the interaction between age and payout cut (table 2.6) when an investment spike occurs. Young firms are 21% more likely to cut repurchases only, and 34% more likely to cut both repurchases and dividends. In contrast, mature firms are only 9% more likely to cut repurchases. But they are not more likely to cut dividends only or cut both at any significant level. Therefore, young firms rely more on payout cut than mature firms.

We use model 5 to analyze payout cuts in some special years and the trend. The results are depicted in figures 2.2, 2.3, and 2.4. Figure 2.2 shows that small firms rely on payout cuts in most of the years: the majority columns are above 1. As to the preference between dividend cut and repurchase cut, small firms prefer the former before 1995, but the preference is reversed after 1995. Obviously, the cost of cutting dividends for small firms become higher than before, but the reason is unclear. This question is beyond the scope of our paper, and it is left for future research.

Large firms are less likely to cut dividends than to cut nothing over most years. Sometimes they may cut repurchases to finance large investment: in 14 out of 28 years, they prefer cut repurchases to cut nothing. This phenomenon is consistent with our conclusion in the previous discussion: repurchases are more flexible than dividends.

We notice that around 2007, all firms (small, medium and large) cut payouts, regardless of repurchases and dividends, to finance large investments. This phenomenon coincides with the starting of sub-prime crisis. Meanwhile, it is extremely difficult for all the firms to get external finance. Therefore, all the firms, regardless of their size, have to rely more on internal finance-cut repurchases and dividends. These findings are consistent with Bliss, Chen, and Denis (2013), and support the part of conclusion in the survey of Brav et al. (2005): in “extreme circumstances”, firms may cut dividends to undertake investment (See table 11 of Brav et. al. 2005). Of course, the market condition in 2007 can be viewed as “extreme”.

To sum up, we find that repurchase cuts provide internal financial flexibility. Firms are more likely to cut repurchases than to cut nothing to undertake large investments. Accessibility to external finance also plays a key role in the determination of payout cuts. If firms have difficulty accessing external financial resources, they will cut any payout, even dividends, to finance investment. But they will cut repurchases first, and dividends later.

2.7. Robustness Tests

In this section, we change the criteria of investment spikes and repurchase cuts. We find our results are robust.

In our previous analysis, an investment spike is defined as the investment at least 2 times larger than the firm median. We change the criteria from 2X to 1.5X, 2.5X, and 3X larger than the firm medium (1.5X, 2X, 2.5X, and 3X criteria). We also apply two different criteria[6] to repurchase cuts: (1) at least 20% lower than the previous year (20% criteria), and (2) at least 20% lower than the moving average of the previous three years (MA criteria). The precondition variable Y_{it}, which describes the lagged payout categories, is changed accordingly.

Firstly, we perform a robustness test at the aggregate level. Due to length limitations we only report the results after we change the criteria for investment spikes. Results are shown in table 2.3. Firms are 8%-12% more likely to cut repurchase only, but they are not more likely to cut dividends only at any significant level. An interesting phenomenon

[6] A better method is to examine the difference between announced repurchases and realized repurchases, but we do not have the data. The definition of investment spike is less controversial, because this criteria is used by some researchers (Whited 2006)

is that, after the criteria of investment spike are increased from 2X to 2.5X or 3X, firms are 26%-29% more likely to cut both dividends and repurchases (vs. insignificant under 2X criterion). The reason is that larger investment spikes require for more cash. Therefore, firms have to rely on more aggressive payout cuts.

We also run equation 2, 3, and 4 after changing the criteria for investment spikes and repurchase cuts[7]. We present the new results on the right side of the original regression results to make comparison more convenient. The results are still robust and consistent with our sub-hypothesis H1-A, H1-B, and H1-C (see tables 2.4, 2.5, and 2.6). For example (see table 2.4), small firms are significantly more likely to cut repurchase only under 10%, 20%, and MA criteria of repurchase cut. They are also more likely to do so under 2X and 2.5X criteria of investment spikes. Again, when we increase the threshold of investment spikes to 3X, we find that small firms rely more on aggressive payout cuts. They are 62% more likely to cut both, (vs. 39% under the 2X criteria of investment spike). At the same time, the RRR's of small firms in the repurchase cut only category is not statistically significant anymore. It shows that after increasing the criterion of investment spikes from 2X to 3X, repurchase cuts alone does not meet their demands for cash. In contrast, large firms do not rely too much on payout cuts. In the repurchase cut only category, none of the RRR's is significant. In the cut both category, 4 out of 5 results are not significant.

The situation is similar when we partition the firms by leverage ratio and age (table 2.5 and table 2.6). Firms with restrictions to external financial recourses, i.e., high leverage-ratio firms and young firms rely more on payout cut. For example, under the

[7] The results under 1.5X criteria are less prominent due to less cash shortage. We report them in the appendix A, table 1.

10%, 20% and MA criteria of repurchase cut, high leverage-ratio firms are 13%-24% more likely to cut repurchases (table 2.5), and young firms are 13%-21% more likely to cut repurchases (table 2.6). Under the 2.5X and 3X criteria for investment spikes, high leverage-ratio firms are 58%-60% more likely to cut both repurchases and dividends, and young firms are 59%-70% more likely to cut both repurchases and dividends. These results are both economically and statistically significant.

In our previous regressions, we use dummy variables to control the preconditions of payout cuts and regress on the pooled data. When firms that do not meet the precondition for payout cuts, the regressions result in probabilities that are numerically close to but not exactly zeros. To avoid this problem, we run logit regression on three subset of the data set seperately: (1) lagged repurchases>0 ; (2) lagged dividends>0; (3) lagged repurchases>0 & lagged dividends>0. The corresponding dependent variables are indicator variables of: (1) cut repurchases only; (2) cut dividends only; (3) cut both. The results are presented in tables 2.7, 2.8, and 2.9 (pairwise regression). For convenience, we stack the pairwise logit regression result to mimic the format of pooled multilogit regressons. We find that the results of both methods are quite similar. We have 3x3x3=27 (3 payout cut methods X 3 partition X 3 firm characteristics) relevant variables. 25 out of 27 coefficients are almost the same. For example, the coefficients corresponding to "repurchase cut only" for small, medium, and large firms are 1.17***, 1.13***, and 1.06 in the pooled regression vs. 1.14**, 1.12**, and 1.07 in the pairwise regression. Only two have some changes, but are still in the same direction: the coefficient of "cut both" for small firms is changed from 1.39** to 1.04, and the coefficient of cut both for high leverage ratio is changed from 1.44*** to 1.13, where * denotes significance level.

To sum up, the results in section 3 are robust after we change the criteria for investment spike and repurchase cut. Facing investment opportunities, firms with restrictions to access external financial sources rely more on internal funds. They cut payouts more aggressively, and exhibit a payout cut hierarchy. We also investigate 1.5X, 4X, and 5X criteria for investment spikes, finding similar results (the results under 1.5X criteria are reported in table 2.10, and the rest are unreported due to length limitations).

2.8. Conclusion

This paper examines the relationships between payout policies and investments. Dividends are sticky, because cutting dividends generally results in negative market responses. In contrast, repurchases are more flexible in terms of timing and dollar values. Therefore, firms are more likely to cut repurchases to undertake large investments. Firms that have difficulties accessing external financial markets rely more on internal finance. To undertake large investments, they have to aggressively cut payouts. For example, small firms, high leverage-ratio firms, and young firms are more likely to cut payouts when facing investment opportunities. Their payout cut behaviors also show a hierarchy, or a preference order. Usually, they prefer to cut repurchases rather than dividends. In contrast, large firms, low leverage firms, and mature firms do not rely too much on payout cuts to finance large investments. Our results are robust to changes in the measurement of repurchase cuts and investment spikes. In extreme circumstances, such as in the financial crisis of late 2000s, all firms rely more on internal finance when facing investment opportunities. They cut payouts aggressively to undertake large investments, regardless of dividends or repurchases.

Our research has some limitations. We do not address cause-effect relationships between payout cuts and investments. Previous researchers addressed this problem by employing a VAR model at the aggregate level, but did not differentiate between payout forms (see Sarig 2004). We follow their method, but differentiating between payout methods, and the results are inconsistent (unreported). A possible reason is that the preference order of firms' payout cuts is affected by firms' characteristics, whereas VAR models typically uses aggregate data, which assumes all firms have the same preference order. Furthermore, to identify cause-effect relationships, VAR models rely on Granger test. The logic is that, if X causes Y, then X in t-1 period affects Y in t period, and Y in t-1 period does not affect X in t. However, this argument is not applicable in our research[8]. Therefore, our paper does not use the VAR method. The causal-effect relation is reserved for future research.

Finally, our research fills a gap in the literature. We are the first to quantitatively examine the relationship between investments and payouts policies. Unlike previous researchers, we carefully differentiate between payout methods. Our findings help to explain the controversy between the pecking order theory and the trade off theory in corporate finance (Byoun, 2007). We show that firms with more difficulties to access external financial resources are more likely to cut payout, regardless of repurchases or dividends. Because payout cuts are potential sources of internal finance, their behaviors more consistent with the pecking order theory instead of the tradeoff theory.

[8] Consider the following ad-hoc example. Firms make dividend decisions first, investment decisions second, and repurchase decisions last. This is consistent with the basic framework: dividends are rigid, and repurchases are flexible. Then, dividends cause investment, and investments cause repurchases. By a Granger test argument, a repurchase cut in t-1 should lead to an investment change in t. However, this is not the case. A repurchase cut in t-1 is due to a large investment in t-1, and has nothing to do with investment in t.

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Appendix

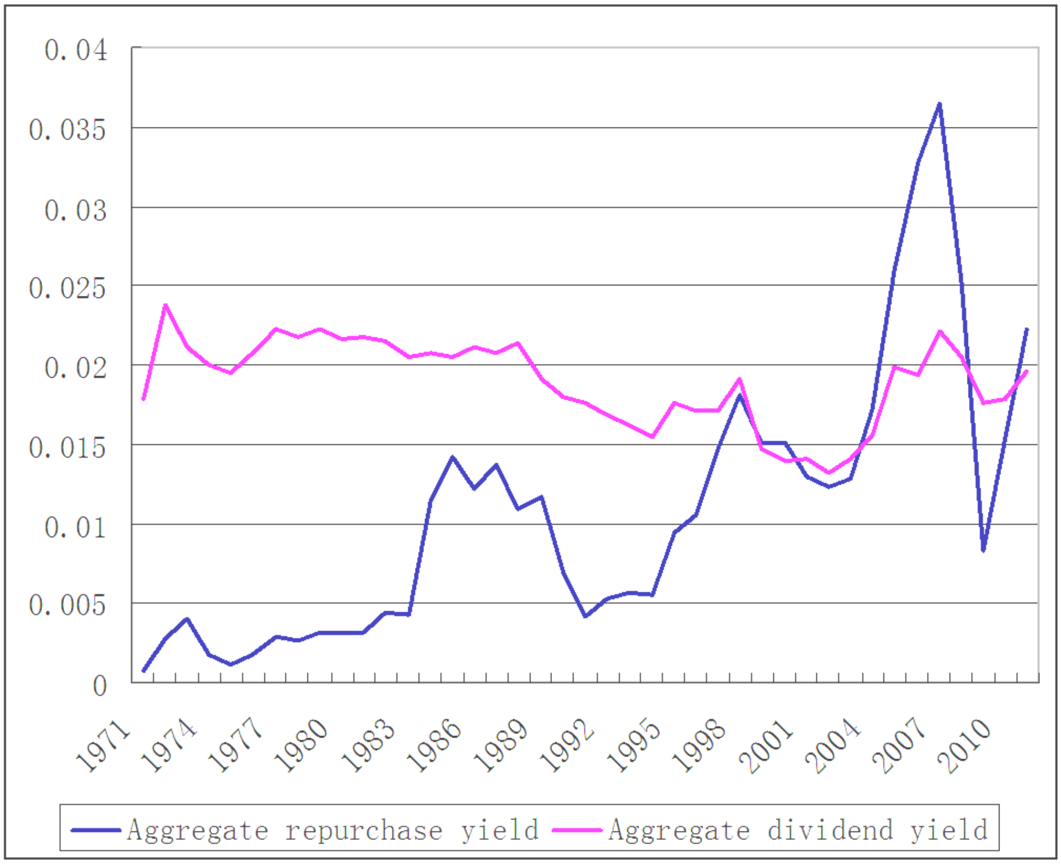

Figure 2.1 Aggregate Repurchase & Dividend Yield Trend: 1971-2011
Aggregate repurchase yield equals aggregate repurchase divided by aggregate asset.
Aggregate repurchase yield equals aggregate dividend divided by aggregate asset.
The data comes from compustat

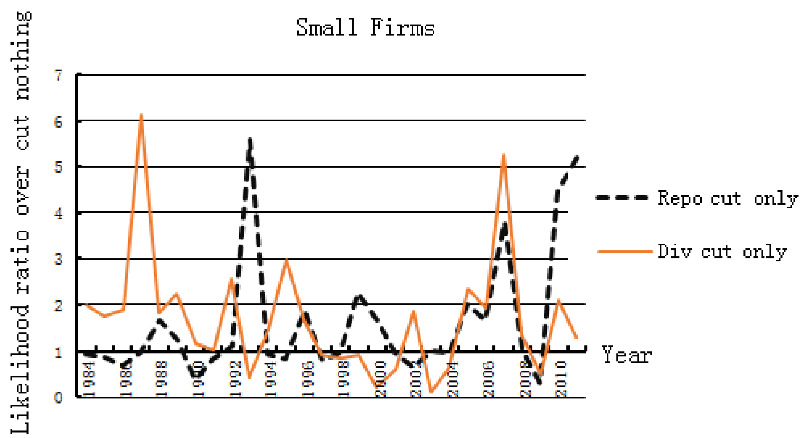

Figure 2.2 The trend for small firms

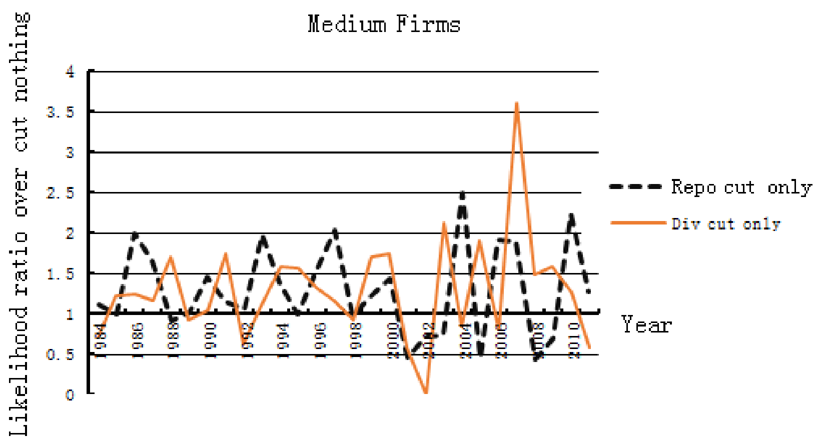

Figure 2.3 The trend for medium firms

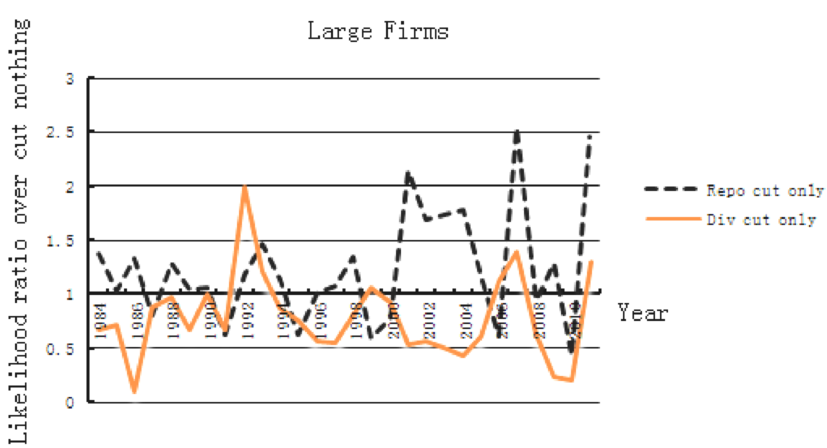

Figure 2.4 The trend for large firms

Table 2.1 Descriptive statistics

Panel A	**Firm characteristics**					
Variable	Obs	Mean	Std.Dev.	Min	Median	Max
repo_yield	173049	0.0101	0.0354	0	*0*	0.2880
dv_yield	173049	0.0074	0.0236	0	0	0.2066
investment_ratio	173049	0.0641	0.0827	0	0.038	0.5704
Asset (million $)	173049	1264.33	4831	0.037	70.45	42419
book_leverage_ratio	173049	0.8282	2.21	0	0.47	23.44
Cashflow (million $)	173049	110.33	483.19	-217.20	0.06	4426.94
Cash (million $)	173049	0.14	0.19	0	0.06	0.97
market_to_book	173049	3.0534	10.10	0.002	1.30	113.81
sale_growth	173049	0.3088	1.48	-1	0.058	15.79
age (year)	173049	18.63	10.91	0	9.3	41

Panel B	**Payout activities**	
Payout activities	Obs	% of total obs
0. No payout	102502	59.2%
1. Repurchases only	27435	15.9%
2. Dividends only	23716	13.7%
3. Both	19396	11.2%
Total	173049	100.0%

Panel C	**Investment activities**		
Investment activities	Obs	% of total obs	Mean. inv. ratio
Inv. spikes (2X of the median)	25962	15.0%	0.1391
Investment (non spikes, non zero)	137045	79.0%	0.0548
Investment (non spikes, zeros)	10042	6%	0
Total	173049	100.0%	0.0641

Table 2.2 Payout cuts and investment spikes

Panel A — **Payout cut**

Payout cut	Obs	Precondition	Base obs	% of base obs
0. No div cut and repo decrease	28928	l.repo>0 or l.div>0	82571	35.0%
1. Non-trivial repo decrease only	22909	l.repo>0	60474	37.9%
2. Dividends cut only	8940	l.div>0	58086	15.4%
3. Cut both	21794	l.div>0&l.repo>0	35989	60.6%
4. Not appliable	90478	l.div=0 & l.repo=0	-	-
Total	173049			

Panel B — **Payout cut when there is an investment spike**

Payout cut	Obs	Precondition 1	Precondition 2	Base obs	% of base obs	Dif
0. No div cut and repo decrease	2729	l.repo>0 or l.div>0	inv_spk=1	10826	25.2%	-9.8%
1. Non-trivial repo decrease only	2764	l.repo>0	inv_spk=1	8553	32.3%	-5.6%
2. Dividends cut only	931	l.div>0	inv_spk=1	7686	12.1%	-3.3%
3. Cut both	4402	l.div>0&l.repo>0	inv_spk=1	5413	81.3%	20.8%
4. Not appliable	15136	l.div=0 & l.repo=0	inv_spk=1	15136	-	-
Total	25962					

Panel C (winsorized at 10%) — **Economic significance of cut**

	median	mean
Div cut to inv. ratio	7.85%	50.54%
Non-trivial repo. cut to inv. ratio	11.43%	57.41%

year range: 1983-2011

48

Table 2.3 Aggregate regression

The regression model is:

$$prob(payout\_cut_{it} = j) = \frac{\exp(\alpha_j + \beta_j investment\_spike_{it} + \gamma_j X_{it} + \delta_j i.Y_{it} + \lambda_j D)}{\sum_{k=1}^{5} \exp(\alpha_j + \beta_j investment\_spike_{it} + \gamma_j X_{it} + \delta_j i.Y_{it} + \lambda_j D)} \quad (1)$$

j=1,2,…,5. $payout\_cut_{it}$ =1, 2, 3, 4 or 5 if firm i cuts nothing, cuts repurchases only, cut dividends only, cuts both, or falls in a category of "not applicable". X_{it} is a vector of predetermined firm characteristic variables, including repurchase yield, dividend yield, market to book ratio, debt leverage ratio, log asset, cash flow, cash, sales growth, age, and age squared. All X_{it}'s are one year lagged except for age and age squared. Y_{it} is a variable that describes the partition of 1-year lagged payout categories. Y_{it} =1, 2, 3, or 4 if firm i paid out nothing, repurchased only, distributed dividends only, or paid out by both methods in period t-1. i. is an indicator operation. D is a vector of year dummy variables and industry dummy variables at two-digit SIC code level. Except for column 1, the investment spike is instrumented. We use a following fixed effect model to estimate investment at t:

$$investment_{it} = \theta_1 + \theta_2 investment_{it-1} + \theta_3 X_{it-1} + \theta_4 D^* + \omega_i + v_{it}$$

Then we define an investment spike when the estimated investment is at least 2X, 2.5X or 3X larger than the firm median.

Table 2.3 Aggregate regression

	Model 1			
	w/o IV	IV	Variation of inv. spike	
Criteria of inv_spk	2X	2X	2.5X	3X
Criteria of repo cut	10%	10%	10%	10%
Cut methods	RRR			
No cut	(base outcome)			
Repo cut only				
inv_spk_2x	1.09**			
E(inv_spk_2x)		1.12***		
E(inv_spk_2.5x)			1.10***	
E(inv_spk_3x)				1.08*
l.market_to_book	0.95***	0.95***	0.95***	0.95***
l.log_at	0.88***	0.88***	0.88***	0.88***
l.cash	0.54***	0.51***	0.52***	0.53***
l.cashflow	0.40***	0.41***	0.41***	0.41***
l.sale_growth	1.01	1.01	1.01	1.01
l.book_leverage_ratio	1.15***	1.15***	1.14***	1.14***
l.repo_yield	1.63e+4***	1.64e+4***	1.64e+4***	1.63e+4***
l.div_yield	0.28	0.27*	0.27*	0.27*
age	0.95***	0.95***	0.95***	0.95***
age2	1.00***	1.00***	1.00***	1.00***
Div cut only				
inv_spk_2x	1.00			
E(inv_spk_2x)		0.99		
E(inv_spk_25x)			1.03	
E(inv_spk_3x)				1.09
l.market_to_book	0.92***	0.92***	0.92***	0.92***
l.log_at	0.88***	0.88***	0.88***	0.88***
l.cash	2.25***	2.26***	2.22***	2.20***
l.cashflow	0.00***	0.00***	0.00***	0.00***
l.sale_growth	0.93**	0.93**	0.93**	0.93***
l.book_leverage_ratio	1.59***	1.59***	1.59***	1.59***
l.repo_yield	125.14***	125.96***	125.15***	124.97***
l.div_yield	3.85e+6***	3.88e+6***	3.77e+06***	3.65e+6***
age	0.93***	0.93***	0.93***	0.93***
age2	1.00***	1.00***	1.00***	1.00***
Cut both				
inv_spk_2x	1.14			
E(inv_spk_2x)		1.11		
E(inv_spk_25x)			1.26***	
E(inv_spk_3x)				1.29**
l.market_to_book	0.67***	0.67***	0.67***	0.67***
l.log_at	0.78***	0.78***	0.78***	0.78***
l.cash	0.39***	0.38***	0.36***	0.37***
l.cashflow	0.00***	0.00***	0.00***	0.00***
l.sale_growth	0.98	0.98	0.98	0.98
l.book_leverage_ratio	2.31***	2.31***	2.31***	2.31***
l.repo_yield	1.55e+08***	1.55e+08***	1.55e+08***	1.56e+08***
l.div_yield	4.53e+7***	4.35e+7***	4.09e+07***	4.08e+7***
age	0.93***	0.94***	0.94***	0.94***
age2	1.00***	1.00***	1.00***	1.00***
N	145482	145482	145482	145482
Pseudo R2	0.7425	0.7425	0.7425	0.7425
legend	* p<.1; ** p<.05; *** p<.01			

H0: the corresponding coefficient=1

Table 2.4 Interaction with size

We equally partition firms into small, median and large groups by size in a year. Then we interact the size group with investment spikes. The model is as follows.

$$prob(payout\_cut_{it} = j) = \frac{\exp(\alpha_j + \beta_j i.size\_grp_{it} * investment\_spike_{it} + \gamma_j X_{it} + \delta_j i.Y_{it} + \lambda_j D)}{\sum_{k=1}^{5} \exp(\alpha_j + \beta_j i.size\_grp_{it} * investment\_spike_{it} + \gamma_j X_{it} + \delta_j i.Y_{it} + \lambda_j D)} \quad (2)$$

j=1,2,…,5. $size\_grp$ =1, 2, or 3 if the firm size is small, medium or large. $payout\_cut_{it}$ =1, 2, 3, 4 or 5 if firm i cuts nothing, cuts repurchases only, cut dividends only, cuts both, or falls in a category of "not applicable". X_{it} is a vector of predetermined firm characteristic variables, including repurchase yield, dividend yield, market to book ratio, debt leverage ratio, log asset, cash flow, cash, sales growth, age, and age squared. All $X_{it}'s$ are one year lagged except for age and age squared. Y_{it} is a variable that describes the partition of 1-year lagged payout categories. Y_{it} =1, 2, 3, or 4 if firm i paid out nothing, repurchased only, distributed dividends only, or paid out by both methods in period t-1. i. is an indicator operation. D is a vector of year dummy variables and industry dummy variables at two-digit SIC code level. The investment spike is instrumented. We use a following fixed effect model to estimate investment at t:

$$investment_{it} = \theta_1 + \theta_2 investment_{it-1} + \theta_3 X_{it-1} + \theta_4 D^* + \omega_i + v_{it}$$

Then we define an investment spike when the estimated investment is at least 2X, 2.5X or 3X larger than the firm median.

Table 2.4 Interaction with size

	Model 2				
	Original model	Variation of repo cut		Variation of inv. spike	
Criteria of inv_spk	2X	2X	2X	2.5X	3X
Criteria of repo cut	10%	20%	ma	10%	10%
Cut methods			RRR		
No cut			(base outcome)		
Repo cut only					
i.E(inv_spk)*size					
small	1.17***	1.14**	1.15***	1.09	1.04
medium	1.13***	1.12***	1.03	1.12**	1.09
large	1.06	1.05	1.08*	1.09	1.1
l.market_to_book	0.95***	0.96***	0.98***	0.95***	0.95***
l.log_at	0.88***	0.87***	0.86***	0.88***	0.87***
l.cash	0.51***	0.52***	0.49***	0.52***	0.53***
l.cashflow	0.41***	0.42***	0.36***	0.40***	0.41***
l.sale_growth	1.01	1.02	1	1.01	1.01
l.book_leverage_ratio	1.15***	1.14***	1.28***	1.16***	1.14***
l.repo_yield	1.63e+4***	0.51e+4***	0.37***	1.57e+4***	1.63e+4***
l.div_yield	0.26*	0.27*	2.28	0.35	0.27*
age	0.95***	0.95***	0.97***	0.95***	0.95***
age2	1.00***	1.00***	1.00***	1.00***	1.00***
Div cut only					
i.E(inv_spk)*size					
small	1.06	1.06	1.05	1.02	1.07
medium	1.14**	1.13*	1.15**	1.22***	1.33***
large	0.87**	0.87**	0.89*	0.89	0.92
l.market_to_book	0.92***	0.92***	0.91***	0.92***	0.92***
l.log_at	0.88***	0.88***	0.89***	0.88***	0.88***
l.cash	2.21***	2.23***	1.94***	2.11***	2.19***
l.cashflow	0.00***	0.00***	0.00***	0.00***	0.00***
l.sale_growth	0.93**	0.93**	0.94**	0.93**	0.93***
l.book_leverage_ratio	1.59***	1.59***	1.35***	1.54***	1.59***
l.repo_yield	123.58***	145.39***	166.46***	109.51***	120.71***
l.div_yield	3.66e+06***	3.59e+06***	1.34e+06***	3.35e+06***	3.47e+06***
age	0.93***	0.93***	0.93***	0.93***	0.93***
age2	1.00***	1.00***	1.00***	1.00***	1.00***
Cut both					
i.E(inv_spk)*size					
small	1.39**	1.35*	1.42***	1.52**	1.62**
medium	1.16	1.18	1.13	1.26*	1.26
large	0.99	0.99	1	1.24*	1.17
l.market_to_book	0.67***	0.68***	0.71***	0.67***	0.67***
l.log_at	0.79***	0.78***	0.78***	0.79***	0.78***
l.cash	0.36***	0.35***	0.46***	0.32***	0.36***
l.cashflow	0.00***	0.00***	0.00***	0.00***	0.00***
l.sale_growth	0.98	0.99	0.94	0.96	0.98
l.book_leverage_ratio	2.32***	2.31***	2.34***	2.07***	2.32***
l.repo_yield	1.54e+8***	4.63e+7***	6965.17***	7.14e+07***	1.56e+8***
l.div_yield	4.01e+7***	5.57e+7***	2.98e+7***	1.37e+07***	3.98e+7***
age	0.93***	0.93***	0.93***	0.93***	0.94***
age2	1.00***	1.00***	1.00***	1.00***	1.00***
N	145482	145482	145482	145482	145482
Pseudo R2	0.7426	0.7397	0.7046	0.7425	0.7425
legend	* p<.1; ** p<.05; *** p<.01				

H0: the corresponding coefficient=1

Table 2.5 Interaction with leverage

We equally partition firm into low, median and high groups by leverage ratio in a year. Then we interact the leverage ratio group with investment spikes. The model is as follows.

$$prob(payout\_cut_{it} = j) = \frac{\exp(\alpha_j + \beta_j i.lev\_grp_{it} * investment\_spike_{it} + \gamma_j X_{it} + \delta_j i.Y_{it} + \lambda_j D)}{\sum_{k=1}^{5} \exp(\alpha_j + \beta_j i.lev\_grp_{it} * investment\_spike_{it} + \gamma_j X_{it} + \delta_j i.Y_{it} + \lambda_j D)} \quad (3)$$

where lev_grp=1, 2, or 3 if the leverage ratio of a firm is low, medium or high. j=1,2,…,5. $payout\_cut_{it}$ =1, 2, 3, 4 or 5 if firm i cuts nothing, cuts repurchases only, cut dividends only, cuts both, or falls in a category of “not applicable”. X_{it} is a vector of predetermined firm characteristic variables, including repurchase yield, dividend yield, market to book ratio, debt leverage ratio, log asset, cash flow, cash, sales growth, age, and age squared. All X_{it}'s are one year lagged except for age and age squared. Y_{it} is a variable that describes the partition of 1-year lagged payout categories. Y_{it} =1, 2, 3, or 4 if firm i paid out nothing, repurchased only, distributed dividends only, or paid out by both methods in period t-1. i. is an indicator operation. D is a vector of year dummy variables and industry dummy variables at two-digit SIC code level. The investment spike is instrumented. We use a following fixed effect model to estimate investment at t:

$$investment_{it} = \theta_1 + \theta_2 investment_{it-1} + \theta_3 X_{it-1} + \theta_4 D^* + \omega_i + v_{it}$$

Then we define an investment spike when the estimated investment is at least 2X, 2.5X or 3X larger than the firm median.

Table 2.5 Interaction with leverage

	Model 3				
	Original model	Variation of repo cut		Variation of inv. spike	
Criteria of inv_spk	2X	2X	2X	2.5X	3X
Criteria of repo cut	10%	20%	ma	10%	10%
Cut methods			RRR		
No cut			(base outcome)		
Repo cut only					
i.E(inv_spk)*leverage					
low	1.05	1.02	1	1.08	1.04
medium	1.19***	1.21***	1.08**	1.15**	1.17**
high	1.10*	1.11*	1.19***	1.09	1.03
l.market_to_book	0.95***	0.96***	0.98***	0.95***	0.95***
l.log_at	0.88***	0.87***	0.86***	0.88***	0.88***
l.cash	0.52***	0.54***	0.50***	0.52***	0.53***
l.cashflow	0.38***	0.41***	0.35***	0.41***	0.41***
l.sale_growth	1.01	1.02	1	1.01	1.01
l.book_leverage_ratio	1.15***	1.13***	1.24***	1.14***	1.15***
l.repo_yield	1.68e+4***	0.51e+4***	0.37***	1.64e+4***	1.62e+4***
l.div_yield	0.38	0.28	2.3	0.28*	0.28
age	0.95***	0.95***	0.97***	0.95***	0.95***
age2	1.00***	1.00***	1.00***	1.00***	1.00***
Div cut only					
i.E(inv_spk)*leverage					
low	0.97	0.97	0.97	0.98	1.03
medium	0.96	0.94	0.92	1.09	1.19**
high	1.08	1.06	1.18**	1.04	1.06
l.market_to_book	0.92***	0.91***	0.91***	0.92***	0.92***
l.log_at	0.88***	0.88***	0.88***	0.88***	0.88***
l.cash	2.18***	2.30***	2.03***	2.25***	2.21***
l.cashflow	0.00***	0.00***	0.00***	0.00***	0.00***
l.sale_growth	0.93***	0.93***	0.94**	0.93**	0.93***
l.book_leverage_ratio	1.52***	1.57***	1.31***	1.58***	1.58***
l.repo_yield	102.94***	145.77***	164.61***	125.15***	123.59***
l.div_yield	2.68e+6***	3.79e+6***	1.47e+6***	3.82e+06***	3.63e+6***
age	0.93***	0.93***	0.93***	0.93***	0.93***
age2	1.00***	1.00***	1.00***	1.00***	1.00***
Cut both					
i.E(inv_spk)*leverage					
low	1.07	1.07	1.01	1.17	1.24
medium	1.02	1.05	1.06	1.11	1.12
high	1.44***	1.28**	1.32***	1.60***	1.58***
l.market_to_book	0.65***	0.68***	0.71***	0.67***	0.67***
l.log_at	0.79***	0.78***	0.77***	0.78***	0.78***
l.cash	0.33***	0.37***	0.48***	0.38***	0.38***
l.cashflow	0.00***	0.00***	0.00***	0.00***	0.00***
l.sale_growth	0.96	0.99	0.94	0.97	0.97
l.book_leverage_ratio	1.83***	2.24***	2.16***	2.22***	2.26***
l.repo_yield	7.07e+7***	4.58e+7***	7228.62***	1.53e+08***	1.49e+8***
l.div_yield	1.24e+7***	5.93e+7***	3.54e+7***	4.15e+07***	3.88e+7***
age	0.94***	0.93***	0.94***	0.94***	0.94***
age2	1.00***	1.00***	1.00***	1.00***	1.00***
N	145482	145482	145482	145482	145482
Pseudo R2	0.7424	0.7397	0.7046	0.7425	0.7425
legend	* p<.1; ** p<.05; *** p<.01				

H0: the corresponding coefficient=1

Table 2.6 Interaction with age

We equally partition firm into low, median and high groups by leverage ratio in a year. Then we interact the leverage ratio group with investment spikes. The model is as follows.

$$prob(payout\_cut_{it} = j) = \frac{\exp(\alpha_j + \beta_j i.age\_grp_{it} * investment\_spike_{it} + \gamma_j X_{it} + \delta_j i.Y_{it} + \lambda_j D)}{\sum_{k=1}^{5} \exp(\alpha_j + \beta_j i.age\_grp_{it} * investment\_spike_{it} + \gamma_j X_{it} + \delta_j i.Y_{it} + \lambda_j D)} \quad (4)$$

where age_grp=1, 2, or 3 if the age of a firm is young, medium or matured. j=1,2,…,5. $payout\_cut_{it}$ =1, 2, 3, 4 or 5 if firm i cuts nothing, cuts repurchases only, cut dividends only, cuts both, or falls in a category of “not applicable”. X_{it} is a vector of predetermined firm characteristic variables, including repurchase yield, dividend yield, market to book ratio, debt leverage ratio, log asset, cash flow, cash, sales growth, age, and age squared. All X_{it}'s are one year lagged except for age and age squared. Y_{it} is a variable that describes the partition of 1-year lagged payout categories. Y_{it} =1, 2, 3, or 4 if firm i paid out nothing, repurchased only, distributed dividends only, or paid out by both methods in period t-1. i. is an indicator operation. D is a vector of year dummy variables and industry dummy variables at two-digit SIC code level. The investment spike is instrumented. We use a following fixed effect model to estimate investment at t:

$$investment_{it} = \theta_1 + \theta_2 investment_{it-1} + \theta_3 X_{it-1} + \theta_4 D^* + \omega_i + v_{it}$$

Then we define an investment spike when the estimated investment is at least 2X, 2.5X or 3X larger than the firm median.

Table 2.6 Interaction with age

	Model 4				
	Original model	Variation of repo cut		Variation of inv. Spike	
Criteria of inv_spk	2X	2X	2X	2.5X	3X
Criteria of repo cut	10%	20%	ma	10%	10%
Cut methods			RRR		
No cut			(base outcome)		
Repo cut only					
i.E(inv_spk)*age					
young	1.21***	1.20***	1.08*	1.20***	1.18**
medium	1.06	1.06	1.03	1.07	1.07
mature	1.09*	1.07	1.08*	1.06	0.97
l.market_to_book	0.95***	0.96***	0.98***	0.95***	0.95***
l.log_at	0.88***	0.87***	0.86***	0.88***	0.87***
l.cash	0.51***	0.52***	0.48***	0.52***	0.53***
l.cashflow	0.41***	0.42***	0.29***	0.41***	0.41***
l.sale_growth	1.01	1.02	1	1.01	1.01
l.book_leverage_ratio	1.14***	1.14***	1.31***	1.14***	1.14***
l.repo_yield	1.65e+4***	0.51e+4***	0.41***	1.64e+4***	1.62e+4***
l.div_yield	0.27*	0.28	3.11*	0.27*	0.27*
age	0.95***	0.95***	0.97***	0.95***	0.95***
age2	1.00***	1.00***	1.00***	1.00***	1.00***
Div cut only					
i.E(inv_spk)*age					
young	1.13*	1.13*	1.21***	1.15*	1.27***
medium	0.95	0.95	1.01	1	1.08
mature	0.9	0.89*	0.96	0.94	0.9
l.market_to_book	0.92***	0.91***	0.89***	0.92***	0.92***
l.log_at	0.88***	0.88***	0.89***	0.88***	0.88***
l.cash	2.29***	2.31***	1.73***	2.25***	2.25***
l.cashflow	0.00***	0.00***	0.01***	0.00***	0.00***
l.sale_growth	0.93***	0.93***	0.93**	0.93***	0.93***
l.book_leverage_ratio	1.58***	1.58***	1.30***	1.58***	1.58***
l.repo_yield	125.79***	147.02***	62.51***	124.03***	122.65***
l.div_yield	3.79e+6***	3.71e+6***	1.48e+5***	3.74e+6***	3.63e+6***
age	0.94***	0.94***	0.94***	0.94***	0.94***
age2	1.00***	1.00***	1.00***	1.00***	1.00***
Cut both					
i.E(inv_spk)*age					
young	1.34**	1.32**	1.21*	1.59***	1.70***
medium	1.03	1.04	1.20*	1.16	1.24
mature	1.06	1.06	1.14	1.17	1.08
l.market_to_book	0.67***	0.68***	0.64***	0.67***	0.67***
l.log_at	0.78***	0.78***	0.79***	0.78***	0.78***
l.cash	0.38***	0.36***	0.38***	0.37***	0.37***
l.cashflow	0.00***	0.00***	0.01***	0.00***	0.00***
l.sale_growth	0.98	0.99	0.90**	0.98	0.98
l.book_leverage_ratio	2.30***	2.29***	1.94***	2.30***	2.31***
l.repo_yield	1.55e+8***	4.63e+7***	2048.42***	1.54e+08***	1.53e+8***
l.div_yield	4.17e+7***	5.75e+7***	2.32e+6***	3.94e+07***	3.96e+7***
age	0.94***	0.94***	0.94***	0.94***	0.94***
age2	1.00***	1.00***	1.00***	1.00***	1.00***
N	145482	145482	145482	145482	145482
Pseudo R2	0.7426	0.7397	0.7029	0.7425	0.7425
legend	* p<.1; ** p<.05; *** p<.01				

H0: the corresponding coefficient=1

Table 2.7 Pooled vs. pairwise: by size

	Model 2	
Regression method	**Pooled**	**Pair wise**
Criteria of inv_spk	2X	2X
Criteria of repo cut	10%	10%
Cut methods		
No cut	(base outcome)	
Repo cut only		
i.E(inv_spk)*size		
small	1.17***	1.14**
medium	1.13***	1.12**
large	1.06	1.07
l.market_to_book	0.95***	0.95***
l.log_at	0.88***	0.87***
l.cash	0.51***	0.51***
l.cashflow	0.41***	0.42***
l.sale_growth	1.01	1.01
l.book_leverage_ratio	1.15***	1.12***
l.repo_yield	1.63e+4***	15591.96***
l.div_yield	0.26*	0.04***
age	0.95***	0.96***
age2	1.00***	1.00***
Div cut only		
i.E(inv_spk)*size		
small	1.06	1.05
medium	1.14**	1.15**
large	0.87**	0.87**
l.market_to_book	0.92***	0.91***
l.log_at	0.88***	0.89***
l.cash	2.21***	2.31***
l.cashflow	0.00***	0.00***
l.sale_growth	0.93**	0.94**
l.book_leverage_ratio	1.59***	1.64***
l.repo_yield	123.58***	902.21***
l.div_yield	3.66e+06***	8.05e+06***
age	0.93***	0.93***
age2	1.00***	1.00***
Cut both		
i.E(inv_spk)*size		
small	1.39**	1.04
medium	1.16	0.98
large	0.99	0.93
l.market_to_book	0.67***	0.57***
l.log_at	0.79***	0.77***
l.cash	0.36***	0.32***
l.cashflow	0.00***	0.00***
l.sale_growth	0.98	0.97
l.book_leverage_ratio	2.32***	2.42***
l.repo_yield	1.54e+8***	8.01e+10***
l.div_yield	4.01e+7***	4.98e+09***
age	0.93***	0.93***
age2	1.00***	1.00***
N	145482	N/A
Pseudo R2	0.7426	N/A
legend	* p<.1; ** p<.05; *** p<.01	
H0: the corresponding coefficient=1		

Table 2.8 Pooled vs. pairwise: by leverage

	Model 3	
Regression method	**Pooled**	**Pair wise**
Criteria of inv_spk	2X	2X
Criteria of repo cut	10%	10%
Cut methods		
No cut	(base outcome)	
Repo cut only		
i.E(inv_spk)*leverage		
low	1.05	1.04
medium	1.19***	1.18***
high	1.10*	1.11*
l.market_to_book	0.95***	0.95***
l.log_at	0.88***	0.87***
l.cash	0.52***	0.53***
l.cashflow	0.38***	0.42***
l.sale_growth	1.01	1.01
l.book_leverage_ratio	1.15***	1.11***
l.repo_yield	1.68e+4***	15680.38***
l.div_yield	0.38	0.04***
age	0.95***	0.96***
age2	1.00***	1.00***
Div cut only		
i.E(inv_spk)*leverage		
low	0.97	0.97
medium	0.96	0.96
high	1.08	1.04
l.market_to_book	0.92***	0.91***
l.log_at	0.88***	0.88***
l.cash	2.18***	2.37***
l.cashflow	0.00***	0.00***
l.sale_growth	0.93***	0.94**
l.book_leverage_ratio	1.52***	1.62***
l.repo_yield	102.94***	897.75***
l.div_yield	2.68e+6***	8.55e+06***
age	0.93***	0.93***
age2	1.00***	1.00***
Cut both		
i.E(inv_spk)*leverage		
low	1.07	0.91
medium	1.02	0.89
high	1.44***	1.13
l.market_to_book	0.65***	0.57***
l.log_at	0.79***	0.76***
l.cash	0.33***	0.34***
l.cashflow	0.00***	0.00***
l.sale_growth	0.96	0.97
l.book_leverage_ratio	1.83***	2.33***
l.repo_yield	7.07e+7***	7.80e+10***
l.div_yield	1.24e+7***	5.34e+09***
age	0.94***	0.93***
age2	1.00***	1.00***
N	145482	N/A
Pseudo R2	0.7424	N/A
legend	* p<.1; ** p<.05; *** p<.01	
H0: the corresponding coefficient=1		

Table 2.9 Pooled vs. pairwise: by age

	Model 4	
Regression method	**Pooled**	**Pairwise**
Criteria of inv_spk	2X	2X
Criteria of repo cut	10%	10%
Cut methods		
No cut	(base outcome)	
Repo cut only		
i.E(inv_spk)*age		
young	1.21***	1.23***
medium	1.06	1.04
mature	1.09*	1.08
l.market_to_book	0.95***	0.95***
l.log_at	0.88***	0.87***
l.cash	0.51***	0.51***
l.cashflow	0.41***	0.42***
l.sale_growth	1.01	1.01
l.book_leverage_ratio	1.14***	1.12***
l.repo_yield	1.65e+4***	15816.31***
l.div_yield	0.27*	0.04***
age	0.95***	0.96***
age2	1.00***	1.00***
Div cut only		
i.E(inv_spk)*age		
young	1.13*	1.13*
medium	0.95	0.95
mature	0.9	0.89*
l.market_to_book	0.92***	0.91***
l.log_at	0.88***	0.88***
l.cash	2.29***	2.38***
l.cashflow	0.00***	0.00***
l.sale_growth	0.93***	0.94**
l.book_leverage_ratio	1.58***	1.63***
l.repo_yield	125.79***	927.33***
l.div_yield	3.79e+6***	8.33e+06***
age	0.94***	0.94***
age2	1.00***	1.00***
Cut both		
i.E(inv_spk)*age		
young	1.34**	1.43*
medium	1.03	0.9
mature	1.06	0.88
l.market_to_book	0.67***	0.57***
l.log_at	0.78***	0.76***
l.cash	0.38***	0.32***
l.cashflow	0.00***	0.00***
l.sale_growth	0.98	0.97
l.book_leverage_ratio	2.30***	2.41***
l.repo_yield	1.55e+8***	8.33e+10***
l.div_yield	4.17e+7***	4.74e+09***
age	0.94***	0.94***
age2	1.00***	1.00***
N	145482	N/A
Pseudo R2	0.7426	N/A
legend	* p<.1; ** p<.05; *** p<.01	

H0: the corresponding coefficient=1

Table 2.10 Interaction with size, age, and leverage under the 1.5X criteria

	Model 2	Model 3	Model 4
Criteria of inv_spk	1.5X	1.5X	1.5X
Criteria of repo cut	10%	10%	10%
Cut methods			
No cut		(base outcome)	
Repo cut only			
i.E(inv_spk)*size			
small	1.18***		
medium	1.10**		
large	1.02		
i.E(inv_spk)*age			
young		1.16***	
medium		1.03	
mature		1.07*	
i.E(inv_spk)*leverage			
low			1.02
medium			1.10**
high			1.15***
Div cut only			
i.E(inv_spk)*size			
small	0.97		
medium	1.04		
large	0.83***		
i.E(inv_spk)*age			
young		1.05	
medium		0.85***	
mature		0.87***	
i.E(inv_spk)*leverage			
low			0.89**
medium			0.86***
high			1.03
Div cut only			
i.E(inv_spk)*size			
small	1.28*		
medium	1.11		
large	0.96		
i.E(inv_spk)*age			
young		1.44***	
medium		1.02	
mature		0.96	
i.E(inv_spk)*leverage			
low			0.98
medium			0.91
high			1.39***
N	145482	145482	145482
Legend	* p<.1; ** p<.05; *** p<.01		
H0: the corresponding coefficient=1			

CHAPTER 3

FINANCIAL FUNDAMENTALS AND MARKET TIMING: WHEN A REPURCHASE IS NOT JUST A PAYOUT

3.1. Abstract

Previous literature has documented two stylized facts: (1) stock prices respond negatively to dividend cuts and positively to dividend increases, and (2) firms time the market when they repurchase. However, the correlation between these two facts has received little consideration. This study is among the first attempts to fill in this gap. Specifically, we develop a series of hypothesis tests to analyze the influence of dividend adjustments on firms' market timing behavior. We find that firms with more information asymmetry, lower opportunity costs, or higher financial flexibility are more likely to increase repurchases after dividend cuts and decrease repurchases after dividend increases. That is, the market timing effects are more likely to dominate. On the other hand, both dividends and repurchases are signals of firms' financial fundamentals and can be used to pay back when firms have strong positive cash flows. We find that for firms with less information asymmetry, higher opportunity costs, or lower financial flexibility, repurchases move in the same direction as dividends, and function mainly as a payout method to distribute redundant cash. That is, the financial fundamental effects are more likely to dominate. Finally, we show that these two effects are not incompatible.

Even if the financial fundamental effects dominate, firms still time the market: the internal rates of returns of their actual repurchases are higher than those of a pseudo smoothed repurchase strategy.

3.2. Introduction

In the payout literature, the impact of dividend adjustments on share prices has been extensively analyzed. For example, Grullon, Michaely, and Swaminathan (2002) document a 3-day cumulative abnormal return of -3.74% for dividend cuts. Fracassi (2008) shows that the price increases by 0.71% on average in the three days following the announcement of a dividend increase. A plausible explanation for these findings is a signal hypothesis. Because of information asymmetry, a dividend adjustment serves as a signal to the market, revealing whether the firm has a sustainable profitability or not (Nissim and Ziv 2001). In order to maximize their present value[9], firms do not cut dividends unless they are under extreme situations say, serious financial stress, nor do they increase dividends frequently, unless they believe this increase is sustainable (Brav et al. 2005).

Another well-documented stylized fact is that firms time the market when they repurchase. Numerous studies have shown that firms tend to buy more when stocks are undervalued. These researchers find negative abnormal returns before repurchases, and positive abnormal returns after repurchases. (Ginglinger and Hammon 2007, Brockman and Chung 2001). In addition, Bonaime et al. (2014) find that the actual repurchases beat the smoothed (no timing) repurchase by 2% per year on average.

In the present paper, we combine these two streams of the literature to hypothesize that firms might time the market when they cut or increase dividends. We explore the

[9] Unwarranted variability in stock prices can be regarded as risky, and having a negative effect on the present value of firms.

relationship between dividend adjustments and the market timing of repurchases[10]. We find that some firms take advantage of dividend adjustments to time the market, while others do not. To explain this phenomenon, we propose two mechanisms, namely, the market timing mechanism and the financial fundamental mechanism.

Under the market timing mechanism, a cut in dividends presses the stock price down, giving the firm incentives to repurchase after the cut. By a similar logic, the firm would reduce repurchases following an increase in dividends. Hence, the market timing mechanism indicates that repurchases should move in the opposite direction of dividend adjustments. On the contrary, under the financial fundamental mechanism, the main function of repurchases is to distribute redundant cash instead of timing the market. Firms with spare cash will return it by repurchasing stock or increasing dividends, whereas firms short of cash will cut repurchases or dividends. Therefore, according to the financial fundamental mechanism, repurchases and dividend adjustments should move in the same direction.

The rest of the paper is organized as follows. In section 2, we briefly review the two branches of the literature: (1) why and how the market responds to dividend increases and cuts, and (2) how firms time the market. Section 3 presents the data and variable construction. In section 4 we form hypotheses and explain the models. In section 5 we discuss the regression results, showing how firms use different repurchase strategies

[10] The argument applies to share issuing as well, but this paper only examines the repurchasing and reserves the market timing of issuing for future research.

depending on whether dividends are cut or increased. In section 6, we analyze the dynamics of price changes surrounding dividend adjustments, and relate it to repurchase strategies. Section 7 focuses on the robustness of the results. In section 8 we look at the price fluctuations surrounding dividend adjustments at the quarterly level, and relate them to repurchase dynamics. Section 9 evaluates the economic effects of timing. Finally, in section 10 we draw conclusions and discuss directions for future research.

3.3. Literature Review

3.3.1. Market responses to dividend adjustments

Many researchers have documented that cuts and increases in dividends lead to share price shocks. Dhillon and Johnson (1994) find that the excess return is -2.01% for a dividend cut and 0.98% for a dividend increase in a two-day window. Grullon, Michaely, and Swaminathan (2002) estimate cumulative abnormal returns of -3.71% for a dividend cut and 1.34% for a dividend increase in a three-day window. Fracassi (2008) and Ali and Chowdhury (2010) report similar findings. Xiang (2016) finds that the market responses to dividend adjustment are also similar at quarterly intervals. All of the studies show that share prices fall after a dividend cut and rise after a dividend increase. Therefore, Brav, Graham, Harvey, and Michaely (2005) claim in their survey that firms do not to cut dividends unless they are in extreme situations, say, serious financial stress, nor do firms increase dividends frequently, unless they believe this increase is sustainable.

Signaling is a plausible explanation of why the market responds to dividend changes. The dividend signaling hypothesis states that there is an information asymmetry problem between managers and the market. To mitigate this problem, firms use dividend adjustments to send signals to the market. An increase in dividends indicates a higher cash flow in the future, whereas a cut implies a lower cash flow (Nissim and Ziv 2001). In addition, it is difficult for bad firms to mimic good firms by paying dividends, because doing so is costly (John and Williams 1985), thereby making the signals mechanism effective. Therefore, only smaller and younger firms are in favor of such strategies (Adhikari, 2013).

Later researchers provide more explanations for the signaling hypothesis. For example, Fama and French (2001) suggest that a firm has life cycles: growth stage, mature stage, and decline stage. An increase in dividends signals that the firm moves from the growth stage into the mature stage, which is represented by a stable cash flow and lower systematic risk. A cut in dividends signals that the firm changes from the mature stage into the decline stage, which is characterized by higher systematic risk and lower profitability. A limitation of the life cycle hypothesis is that it only applies to long-term cuts and increases. Firms may cut dividends for a certain periods when they are in difficult times, and recover (increase) dividends later. Under this situation, cuts or increases would convey little information about the life cycle.

Some scholars argue that dividend decisions convey little information about future earnings (DeAngelo, DeAngelo, and Skinner 1996, Grullon, Benartzi, and Thaler 2005).

Instead, dividend changes are a signal of past earnings changes (Koch and Sun 2004). Regardless of the debates regarding past vs. future earnings, the effects on share prices are the same: the market typically responds positively to dividend increases and negatively to dividend cuts. After all, cuts are bad news, while increases are good.

There are other explanations for the reaction of markets to dividend adjustments. For example, the agency cost hypothesis postulates that firms are characterized by agency costs: managers may invest in projects to favor themselves but with negative present value to shareholders (e.g., pet programs). An increase in dividends reduces the agency costs, thereby increasing the value of the firm, i.e., its stock price (Jensen 1986; DeAngelo, DeAngelo, and Stulz 2004).

Fracassi (2008) tries to reconcile the signal hypothesis and the agent cost hypothesis. He finds that higher future earnings, catering to clientele, and reduction of agency problems are the main reasons for the positive market response to dividend increases, whereas transition of life cycle stages is the main explanation for the negative response to cuts.

3.3.2. Repurchases and market timing

When firms repurchase, they time the market. Because of information asymmetry, managers know their own firms better than the market. They repurchase when they believe the stock is undervalued[11] (Ikenberry and Vermaelen 1996; Cook et al. 2004,

[11] Managers also issue new shares when they believe their stocks are overpriced, but stock issues are not investigated in the present study.

Chan and Lee 2007, De Cesari et al. 2012, Dittmar and Field 2015). The view of market timing is supported by two stylized facts: there are negative abnormal returns before repurchases, and positive abnormal returns after repurchases. For example, Stephen and Weisbach (1998) find that the average annual return is -1.1% for firms that announce a repurchase program instead of increasing dividends in the successive year. Ikenberry, Lakonishok, and Vermaelen (1995) show that the average abnormal return is 12.1% after repurchase announcements.

Some researchers further explore the factors that affect market timing, finding that information asymmetry is crucial. For example, De Cesari et al. (2012) claim that institutional ownership reduces the opportunities to time the market. Because institutional investors are sophisticated, they suffer less from information asymmetry. The managers' timing skills are mixed. They may time the market over a short period of time, but repurchases are also clustered at market peaks, when prices are usually high (Dittmar and Dittmar 2008). The clustered repurchases indicate that firms' timing behavior may be suboptimal, a view supported by Bonaime et al. (2014). Finally, poor market timing is correlated with indicators of poor corporate governance, such as low monitoring, few alternative uses of cash, inadequate earning management, and weak shareholder rights (Bonaime et al. 2014).

Previous studies have focused on repurchase announcements or repurchase executions to determine the effect of repurchases. Repurchase announcements have been found to be followed by positive long-run abnormal returns (e.g., Ikenberry, Lakonishok, and Vermaelen 1995). The execution of repurchases provides indirect evidence, usually related to information asymmetry, to support the activities of timing. For example, Brockman and Chung (2001) document that the stock liquidity is lower before the implementation of repurchases than after, indicating that managers take advantage of information asymmetry to time the market. Dittmar and Field (2015) use a similar method and find that firms repurchase at significant lower prices than the market average.

3.4. Data and variable construction

We use Compustat quarterly data from 1993 through 2012, for a total of 80 quarters. We choose quarterly instead of annual data because the higher frequency allows us to obtain more information about timing. The large number (80) of time series observations has the additional advantage of greatly reducing dynamic panel bias (Nickell 1981, Mudelsee 2001).

We construct variables associated with firm characteristics and payouts. The variables measuring firm characteristics are cash, cash flow, sales growth, leverage ratio, market-to-book ratio (MB), size, investment ratio, dividend yield, repurchase yield, and age. Cash is computed as cash and short-term investment (CHEQ, item 36) divided by assets[12] (ATQ, item 44). Cash flow is income before extraordinary items (IBQ, item 8) plus depreciation and amortization (DPQ, item 5), divided by assets. Sales growth is sales (SALEQ, item 2) in the current quarter minus sales in the previous quarter, divided by

[12] Unless specifically noted, asset is lagged by one quarter when used as denominator.

sales in the previous quarter. Leverage ratio is debt (DLTTQ+DLCQ, item 51+item 45) divided by assets. MB equals market assets (ATQ-CEQQ+CSHOQ*PRCCQ, item 44-item 59+item 61*item 13) divided by assets. Size is the logarithm of assets. Investment ratio is investment (CAPXQ=CAPXY, or CAPXY minus lagged CAPXY if not in quarter 1, item 90 or item 90-lagged item 90 if not in quarter 1) divided by assets. Dividend yield equals dividends common/ordinary (DVQ=DVY, or DVY-lagged DVY if not in quarter 1) divided by assets. Repurchase yield equals purchase of common and preferred stock (PRSTKCQ=PRSTKCY or PRSTKCY-lagged PRSTKCY, item93 or item 93-lagged item 93 if not in quarter 1) divided by assets. Age is the number of quarters that a firm has been listed on Compustat. For firms already listed in 1993, we go back 12 years (back to 1981) to calculate the age.

The payout variables are dividend cuts and dividend increases. A dividend cut is defined to occur in a quarter if the dividend per share (adjusted for splits) is smaller than in the previous 2 quarters and does not recover for at least 2 quarters. We require the cut to last at least 2 quarters to rule out "naïve cuts"[13]. The definition of a dividend increase is analogous.

Financial institutions and utility firms (SIC 4400-4999, 6000-6999) are dropped from our sample because their operating characteristics are quite different from other firms. To prevent the results from being driven by a few outliers, we winsorize the data at

[13] Assume a firm pays dividends of $1, $1, $1.2, and $1 per share in quarters 1 through 4. This firm temporarily increases its dividends in quarter 3. A "naïve cut" occurs in quarter 4 because it is just a return to the historical dividend instead of a real cut.

the 0.5% level. The final sample consists of 13,444 firms and 493,741 firm-quarter observations.

Table 3.1 summarizes descriptive statistics for the sample under study. Payouts prove to be quite popular among the firms in the sample, as repurchases occurred in 19.98% of firm-quarters, and dividends were paid in 24.27% of firm-quarters (Panel B). Consistent with the literature, dividend adjustments, and cuts in particular, were not common: dividends were (net) increased in 11.5% of firm-quarters, and cut in only 1.9% of firm-quarters.

3.5. hypotheses and estimation models

In this section, we carry out a series of analyses to explore how firms adjust their repurchases after dividend cuts and increases. As discussed in the introduction section, it is hypothesized that firms' repurchases after dividend cuts or increases can be explained by two mechanisms with contrasting implications: the market timing mechanism and the financial fundamental mechanism. Under the market timing mechanism, repurchases move in the opposite direction of dividend adjustments, whereas under the financial fundamental mechanism, repurchases move in the same direction as dividend adjustments. Our analysis below provides evidence that there are at least three factors affecting which mechanism dominates, namely, information asymmetry, opportunity cost of repurchases, and financial flexibility. The details are discussed next.

3.5.1. Information asymmetry: market timing vs. financial fundamentals

Information asymmetry exists between firms and the market. When firms increase or reduce dividends, they send signals to the market (Nissim and Ziv 2001) that mitigate the asymmetry. The market responds to these signals, and the sensitivity of responses depends on the degree of information asymmetry. Therefore, for firms with greater information asymmetry, dividend adjustments lead to larger price shocks, creating more market timing opportunities. Under this situation, firms have stronger incentives to time the market, i.e., the market timing mechanism is more likely to dominate.

On the other hand, dividend adjustments may be mostly driven by financial fundamentals, which may also affect repurchases. Firms with stable earnings and abundant cash may be more favorable toward increasing dividends and/or repurchasing stock to payout redundant cash. In contrast, firms facing financial problems and cash shortages might be pressured to cut dividends and/or repurchases. In summary, in this situation one would observe larger repurchases accompanied by increased dividends, and reduced repurchases accompanied by dividend cuts[14]. Therefore, the financial fundamental mechanism is more likely to dominate.

Which of the two mechanisms dominates is therefore postulated to depend on the degree of information asymmetry, which can be measured by firm size[15] (Vermaelen

[14] Because repurchases are more flexible, firms show a payout hierarchy, tending to adjust repurchases before adjusting dividends (see Xiang and Lence, 2016). However, this phenomenon is not the focus of the present study.

[15] There are many proxies to measure information asymmetry, such as size, price volatility, trade volume, and leverage. Firms with small size, high price volatility, and low trade volume have more information asymmetry. Firms with high leverage ratios also have more information asymmetry, because their earnings' volatility is magnified by leverage. Bid-ask spread, fat-tail of returns, institutional ownership, ownership concentration, board monitoring, news appearing on the newspaper in a year are also measures of information asymmetry. We only use size as our measurement of information asymmetry in the present study, and reserve the others for future research.

1981, Diamond and Verrecchia 1991). Therefore, we equally divide the sample into three groups according to firm size, and form our hypotheses as follows:

H1-a: Small firms increase repurchases after dividend cuts and reduce repurchases after dividend increases. In contrast, large firms reduce repurchases after dividend cuts and increase repurchases after dividend increases.

Hypothesis H1-a is tested by means of the regression on model (1):

$$repo_{i,t} = \alpha_i + \beta_1 Div\_inc_{i,t-1} * repo_{i,t-1} + \beta_2 Div\_cut_{i,t-1} * repo_{i,t-1} + \gamma_i X_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

where repo is the repurchase yield, and Div_inc and Div_cut denote dummy variables for dividend increases and cuts respectively. Vector X comprises control variables, including lagged repurchase yield, dividend yield, log of assets, MB, leverage ratio, cash, cash flow, sales growth, investment ratio, and age. We also include a fixed effect, and quarter and year effects. Then we run separate regressions for the small- and the large-firm groups.

According to model (1), a firm's repurchase yield behavior in a particular quarter depends on whether the firm increased or cut dividends in the previous quarter. We incorporate only the slope effect because the payout in the current period is highly correlated with the payout in the previous period. In addition, the literature (Lintner 1956, Timmermann 1996) typically uses a self-adaptive model or its variations to capture the dynamics of payout, which only allows for slope changes. Lintner's model (1956) is the most famous one among the examples. A more general model than (1) is (1-a), which allows for slope and intercept effects.

$$repo_{i,t} = \alpha_i + \beta_1 Div\_inc_{i,t-1} * repo_{i,t-1} + \beta_2 Div_{cut_{i,t-1}} * repo_{i,t-1} + \delta_1 Div\_inc_{i,t-1}$$

$$+\delta_1 Div\_cut_{i,t-1} + \gamma_i X_{i,t-1} + \varepsilon_{i,t} \quad (1\text{-a})$$

We use this model as a robustness test and discuss it in section 6.

As noted earlier, the large number of time series observations (80 observations) used for the estimation should greatly mitigate the problem of dynamic panel data bias (Nickell 1981, Mudelsee 2001). To reduce it even further, we employ the instrumental variable method. Specifically, we use $\mathrm{repo}_{i,t-2}$ and $X_{i,t-2}$ to estimate $\mathrm{repo}_{i,t-1}$ and compute the estimated value, $E(\mathrm{repo}_{i,t-1})$. Then, we replace all of the $\mathrm{repo}_{i,t-1}$'s shown in the models by $E(\mathrm{repo}_{i,t-1})$, including both the stand-alone term and the interaction terms. Finally, we run the models as standard fixed-effect models.

3.5.2. Opportunity cost to repurchase: market timing vs. financial fundamentals

There is no free lunch to time the market, because the cash used to repurchase stock can be used to invest in other projects with positive net present values. Firms with more (less) profitable investment opportunities have higher (lower) opportunity costs to time the market. Therefore, the greater (smaller) the set of profitable investment opportunities a firm has, the more likely the financial fundamental (market timing) mechanism is to dominate.

Adam and Goyal (2008) have shown that MB is the most informative proxy for the investment opportunity set. Assuming that a firm's MB accurately reflects its profitable investment opportunities, we partition the sample into three groups of equal number of observations according to MB, and postulate the following hypothesis:

H1-b: Low-MB firms increase repurchases after dividend cuts and reduce repurchases after dividend increases. In contrast, high-MB firms increase repurchases after dividend increases and reduce repurchases after dividend cuts.

We test hypothesis H1-b by means of model (1), estimated using the low- and high-MB subsamples.

3.5.3. Financial flexibility: market timing vs. financial fundamentals

Financial flexibility is a firm's ability to take advantage of potential opportunities or deal with unexpected events. It determines whether a firm's market timing strategy is feasible, because the firm must have enough cash to be able to repurchase stock[16].

If the market timing mechanism dominates, firms reduce their financial flexibility. The market timing mechanism implies that firms repurchase more (i.e., use cash) even if they are short of cash, and repurchase less (i.e., retain cash) even though they have abundant cash. On the contrary, if the financial fundamental mechanism dominates, firms improve their financial flexibility. Firms distribute more cash via repurchases when they have abundant cash, and reserve more cash by reducing repurchases when they have tight budgets. Therefore, the financial fundamental effect should dominate when the financial flexibility is low, and the market timing effect should prevail when the flexibility is high.

DeAngelo and DeAngelo (2007) have shown that a firm's financial flexibility can be measured by its leverage ratio. Accordingly, we partition the sample into three groups

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[16] Although sometimes a firm may borrow to repurchase, this strategy is risky because it increases the leverage ratio (Baker, Gallagher, and Morgan, 1981).

with the same number of observations based on the leverage ratio, and state the following hypothesis:

H1-c: Low-leverage firms increase repurchases after dividend cuts and reduce repurchases after dividend increases. In contrast, high-leverage firms increase repurchases after dividend increases and reduce repurchases after dividend cuts.

To test hypothesis H1-c, we estimate model (1) employing data for the low- and high-leverage subsamples.

3.5.4. A cut is not always bad news: market timing vs. financial fundamentals

In general, managers are reluctant to cut dividends, because the market responds negatively regardless of the reasons for the dividend cut (Brav et al. 2005, Bulan et al. 2007). However, a dividend cut does not always need to be bad news. For example, an article in stockopedia.com[17] asserts that a cut is good news when a firm has strong operating cash flow and low leverage. This view is supported by academic researchers. Bulan et al. (2007) show that dividend omission can be good news if a firm has strong fundamentals, say, low leverage ratio. Xiang and Lence (2014) find that firms might systematically cut dividends to finance large investments. The cuts in dividends due to large investments are different from general cuts and should be regarded as good news.

Given that the market responds negatively to all dividend cuts, but not all cuts are driven by bad news, the gap between the market value and intrinsic value (known by managers) should tend to widen with "good" cuts, thus creating good opportunities for

[17] http://www.stockopedia.com/content/dividend-cuts-are-they-always-bad-news-66531/

firms to time the market. Based on this argument, and the evidence from Xiang and Lence (2014) suggesting that dividend cuts to finance large investment represent good news, we postulate the following hypothesis:

H1-d: Small, low-MB, and low-leverage firms increase repurchases when dividend cuts are accompanied by large investments. In contrast, large, high-MB, and high-leverage firms reduce repurchases when dividend cuts are accompanied by large investments.

We test hypothesis H1-d by means of model (2), which consists of model (1) expanded to incorporate an investment spike dummy and the interaction term:

$$repo_{i,t} = \alpha_i + \beta_1 Div_{inc_{i,t-1}} * repo_{i,t-1} + \beta_2 Div_{cut_{i,t-1}} * repo_{i,t-1}$$

$$+\theta_1 Inv_{spk_{i,t-1}} + \theta_2 Inv\_spk_{i,t-1} * Div\_cut_{i,t-1} * repo_{i,t-1} + \gamma_i X_{i,t-1} + \varepsilon_{i,t} \qquad (2)$$

where Inv_spk is a dummy for an investment spike. Following Xiang and Lence (2014) and Whited (2006), Inv_spk equals 1 if the investment ratio is at least two times larger than the median investment for the firm. The coefficient of interest is θ_2, which corresponds to the interaction of the three variables: $\mathrm{Inv\_spk}_{i,t-1} * \mathrm{Div\_cut}_{i,t-1} * \mathrm{repo}_{i,t-1}$. Again, a more general model includes the dummies of cut, dcut and two other interaction terms, Div_cut*Inv_spk and repo*Inv_spk. We discuss these extensions in the section on robustness tests.

3.6. Results

3.6.1. Market timing mechanism vs. Financial fundamental mechanism

The regression results of model (1) comparing how firms adjust their repurchases after dividend cuts or increases are reported in Table 3.2. Firms are grouped by size (columns 2 and 3), MB ratio (columns 4 and 5), and leverage ratio (columns 6 and 7). As discussed before, we use these three variables to proxy for information asymmetry, opportunity cost, and financial flexibility, respectively.

Columns 2 and 3 show how information asymmetry affects firms' repurchase strategies. Small firms, characterized by greater information asymmetry, exhibit significant market timing behavior. They increase repurchases after a dividend cut by 35.9% at a 0.1% significance level, and reduce repurchases after a dividend increase by 12.1% at a 1% significance level. The changes to repurchases are not only statistically but also economically significant. In contrast, large firms, which face less information asymmetry, repurchase following a financial fundamental rule. They repurchase more after a dividend increase by 4% at a 5% significance level. They also reduce repurchases after a dividend cut, but the result is neither statistically (t=-0.74) nor economically significant (only 3%). These results are consistent with hypothesis H1-a. When information asymmetry does loom large, the market timing mechanism is more likely to prevail; otherwise, the financial fundamental mechanism is more likely to dominate.

The next two columns report results regarding repurchases when firms face different opportunity costs. Low-MB firms, which have low opportunity costs, show market timing behavior. They reduce repurchases after a dividend increase by 21.5% at a 0.1% significance level. They also increase repurchases after a dividend cut, but this change is neither statistically (t=0.03) nor economically significant (0.46%). In contrast, high-MB firms, which have high opportunity costs, increase their repurchases after a dividend increase by 5.3% at a 1% significance level. But we do not find significant effects after a dividend cut, as high-MB firms' adjustment to repurchases after a dividend cut is neither statistically (t=0.6) nor economically significant (2.5%). Overall, these results provide evidence that after a dividend increase, the market timing mechanism is more likely to overshadow the financial fundamental mechanism among firms with low opportunity costs, and be overshadowed by the latter among firms with high opportunity costs. Neither mechanism outweighs the other for any firm group after a dividend cut. The reason is unclear.

Results concerning the role of financial flexibility are reported in columns 6 and 7. Low-leverage firms have more financial flexibility, and show significant market timing behavior. They increase their repurchases after a dividend cut by 11.7% at a 5% significance level; they also increase repurchases after a dividend increase, but the increase is neither statistically (t=1.35) nor economically (3.18%) significant. A possible explanation for the latter result is that the market response is less sensitive to a dividend increase than to a dividend cut.

In contrast, high-leverage firms repurchase following the financial fundamental rule. They increase repurchases after a dividend increase by 6.2% at a 1% significance level, and reduce repurchases after a dividend cut (but the reduction is not statistically significant). This analysis shows that the market timing mechanism is more likely to dominate among high financial-flexibility firms in the case of dividend cuts, and the financial fundamental mechanism is more likely to prevail among low financial-flexibility firms in the case of dividend increases.

To sum up, the above results are consistent with our hypotheses H1-a, H1-b, and H1-c. The market timing mechanism is more likely to dominate among firms with more information asymmetry, lower opportunity costs, and greater financial flexibility. In contrast, the financial fundamental mechanism is more likely to prevail for firms with less information asymmetry, higher opportunity costs, and lower financial flexibility. In the case of dividend cuts, no sub groups are dominated by the financial fundamental mechanism at any statistical significant level. We attribute this result to the payout cut hierarchy (Xiang and Lence 2014): firms tend to cut repurchases before they cut dividends. Hence, repurchases might have been cut to the target level ex ante, rather than cut ex post.

3.6.2. When a cut is not bad news

In this section, we analyze how firms adjust their repurchases when a dividend cut is not bad news, i.e., a dividend cut is accompanied by an investment spike. Results are reported in Table 3.3, whose columns are analogous to the columns in Table 3.2. The following table is provided to facilitate the comparison of the results from models (1), which does not control for the nature of the news, and (2), which does. The table shows that the differential repurchase behavior following cuts becomes much stronger when controlling for the nature of the news.

Table for comparison

	Size		MB		Leverage	
	Small	Large	Low MB	High MB	Low Leverage	High Leverage
Model 2						
repo*Div_cut*Inv_spk	0.755***	-0.375***	0.778**	-0.243*	0.196	-0.638***
	(3.95)	(-3.68)	(2.75)	(-2.11)	(1.52)	(-6.15)
repo*Div_cut	0.224	-0.0107	-0.139	0.0848	0.0696	0.0381
	(1.94)	(-0.24)	(-0.84)	(1.78)	(1.06)	(0.69)
Model 1						
repo*Div_cut	0.359***	-0.0300	0.0046	0.0250	0.117*	-0.0498
	(3.97)	(-0.74)	(0.03)	(0.60)	(2.11)	(-1.08)

Following a cut accompanied by an investment spike, small firms (i.e., firms with more information asymmetry) increase repurchases by 75.5% at a 0.1% significance level, which is more than double the 35.9% increase estimated without controlling for news (see Table 3.2). Similarly, low-MB firms (i.e., firms with low opportunity costs) increase share repurchases by 77.8% at a 1% significance level, compared to the statistically and economically insignificant increase (0.5%, t=0.03) estimate reported in Table 3.2. Finally, low-leverage firms (i.e., firms with high financial flexibility) increase repurchases by an economically significant level, 19.6%, although this coefficient is only statistically significant (t=1.52) at marginal level. Counter intuitively, the corresponding estimate without controlling for news shown in Table 3.2 is smaller (11.7%) but statistically significant (t=2.11). Succinctly, the market timing mechanism dominates for these firm groups, as the exhibit prominent timing behaviors, both from statistical and economic standpoints.

On the other hand, large firms (which are characterized by less information asymmetry) reduce repurchases by 37.5% at a 0.1% significance level following cuts accompanied by spikes, compared to an insignificant reduction of 3% with t=-0.74 estimated without controlling for news (see Table 3.2). High-MB firms (i.e., firms with high opportunity costs) reduce repurchases by 24.3% at a 5% significance level, compared to an insignificant change of 2.5% with t=0.6. Finally, high-leverage firms (i.e., firms with low financial flexibility) reduce repurchases by 63.8% at a 0.1% significance level, compared to a 5% decrease with t=-1.08 computed without controlling for news.

Importantly, neither of the three groups consisting of large, high-MB, and high-leverage firms exhibits statistically or economically significant repurchase adjustments when model (1) is fitted to them. However, all three groups show both economically and statistically significant repurchase adjustments under model (2), providing strong evidence that the fundamental mechanism dominates.

The results lend strong support to Xiang and Lence (2016), who found that small firms are more likely to cut dividends to finance large investments, and large firms are reluctant to cut. The present study further shows that when it happens, firms may aggressively repurchase their undervalued shares in the following quarter[18]. If a dividend cut occurs with large investments, these firms might be substantially short of cash: the fundamental mechanism is more likely to dominate.

[18] A more comprehensive explanation is that firms want to mitigate the negative market response in addition to time the market.

To sum up, when dividend cuts are accompanied by large investments, the market timing mechanism is more likely to prevail among firms characterized by substantial information asymmetry, high opportunity costs, and high financial flexibility. These firms increase their repurchases aggressively after dividend cuts. In contrast, the financial fundamental mechanism is more likely to dominate among firms with less information asymmetry, high opportunity costs, and low financial flexibility. Such firms reduce their repurchases to reserve more cash.

Finally, for firms with less information asymmetry, high opportunity costs, and low financial flexibility, the financial fundamental effect dominates in the case of investment-financing cuts, but not general cuts. A plausible explanation for this difference is that, in the case of a general cut (Table 3.2), firms might have already reduced repurchases to the target level before they cut dividends. In contrast, in the case of investment-financing cuts (Table 3.3), firms are less likely to precut repurchases to the target level, because the investment is lumpy and the cash shortage is substantial.

3.6.3. Information asymmetry is everywhere

In the previous discussion, we have argued that information asymmetry, opportunity cost, and financial flexibility affect firms' market timing. Information asymmetry is represented by size, opportunity cost by the MB ratio, and financial flexibility by the leverage ratio. However, these characteristics are intertwined, and all of them affect the degree of information asymmetry. Their effects are sometimes in the same direction, and sometimes in the opposite direction.

For example, in addition to measuring opportunity costs, the MB ratio can be used as a proxy for information asymmetry. High-MB firms with high are likely to have more investment opportunities. The true values of these investment opportunities are usually known better by insiders than by the market. As a result, the information asymmetry is magnified by the investment opportunities. Some researchers use a firm's MB ratio to measure the degree of information asymmetry in their analysis (McLaughlin, Safieddine, and Vasudevan 1998; Clarke and Shastri 2000). Therefore, the effect of MB ratio is complex: on the one hand, it indicates more information asymmetry, which favors market timing; on the other hand, it suggests more investment opportunities and consequently higher opportunity costs to time the market, which works against market timing. In our paper, opportunity costs determine whether it is worth for a firm to time the market, whereas information asymmetry affects how much its shares are mispriced (discussed in section VIII).

Similarly, the leverage ratio measures financial flexibility, but it can also be used as a proxy for information asymmetry. First, it is difficult for firms with severe information asymmetry to borrow money (Xiang and Lence 2014); hence, these firms tend to have low leverage ratio[19]. Second, firms with high leverage ratio receive more supervision from the lending banks, thus mitigating the information asymmetry (Sufi 2007). Both arguments suggest that high-leverage firms have less information asymmetry problems.

[19] It is also difficult for these firms to get external financing from the equity market. But in general, these firms tend to have low leverage ratios.

Finally, other methods have been used by researchers to measure information asymmetry. For example, Elton, Gruber, and Gultekin (1984) use analysts' forecast errors as a proxy for information asymmetry. If the forecast errors are large, the information asymmetry is high. Chung et al. (1995) adopt the bid-ask spread as a proxy for information asymmetry. Low bid-ask spreads indicate high market liquidity and more information communication, thus less information asymmetry. Additional methods to measure information asymmetry include the share concentration of insider holdings and institutional ownerships (Chiang and Venkatesh 1988). The present paper uses only firm size to control for information asymmetry, and reserves other methods for future research.

3.7. Robustness Tests

To assess the robustness of the results, the previous analysis was repeated under alternative model specifications. Adding intercept dummies for dividend increases and cuts (Div_inc and Div_cut, respectively) does not change the previous conclusions. Table 3.4 reports the corresponding results for small and large firms, with and without control for investment spikes. In the case of model 1-a (see columns 2 and 3 of Table 3.4), small firms reduce repurchases by 16.3% with t=-2.98 after a dividend increase and reduce repurchases by 43.9% with t=3.84 after a dividend cut. In contrast, large firms increase repurchases by 4.01% with t=2.10. Regarding model 2-a (see columns 4 and 5 of Table 3.4), small firms increase repurchases by 74.1% with t=3.86 when dividend cuts and investment occur at the same time. In contrast, larger firms reduce repurchases by 37.2%

with t=-3.64. The coefficients of the added intercept dummies (Div_inc and Div_cut) are not significant at any statistical level in either of the models. In summary, allowing for intercept changes does not alter the findings from the regressions run by firm size sub groups.

Results are also robust to the addition of intercept dummies to the regressions fitted to the sub groups defined by MB and leverage ratio (tables are not reported in the interest of space). Further, the coefficients corresponding to the added terms are neither economically nor statistically significant, confirming that the original model specifications are acceptable.

In addition, we repeat the previous analysis after allowing for 2 lags of repurchases ($\mathrm{repo}_{i,t-2}$ and $\mathrm{repo}_{i,t-3}$) as the instrumental variables for $\mathrm{repo}_{i,t-1}$. Similar to the other alternative specifications, the results are essentially unchanged compared to the original specification. Finally, we run the regressions after dropping all of the firms that have no dividend distributions or repurchases during the entire observation period (i.e., 1992-2012). The total sample shrinks by 30% of firm-quarters, but the regression results are similar (tables omitted to save space).

To sum up, our results are robust, regardless of the changes to model specifications or the number of lags used as instrumental variables.

3.8. Repurchase Dynamics

In our previous discussion, we examine repurchases one quarter after the dividend cuts and increases. To shed more light on the market timing and fundamental financial mechanisms, we explore firms' behavior over more quarters. For this purpose, we modify model (1) by allowing for more lags of the variables of interest, namely, Div_cut*repo and Div_inc*repo:

$$repo_{i,t} = \alpha_i + \sum_{k=1}^{4} \beta_{1k} Div\_inc_{i,t-k} * repo_{i,t-k} + \sum_{k=1}^{4} \beta_{2k} Div\_cut_{i,t-k} * repo_{i,t-k} + \gamma_i X_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

where k=1, 2, 3, and 4. An alternative model consists of:

$$repo_{i,t} = \alpha_i + \sum_{k=1}^{4} \beta_{1k} Div\_inc_{i,t-k} * repo_{i,t-1} + \sum_{k=1}^{4} \beta_{2k} Div\_cut_{i,t-k} * repo_{i,t-1} + \gamma_i X_{i,t-1} + \varepsilon_{i,t} \quad (4)$$

That is, in model (4) the interactions are the dividend events of k lags with the repurchase of one lag. Specification (3) is preferable[20] because it better reflects the dynamics of repurchases; it uses quarter 0 as the base, thus comparing the repurchase changes in quarters 1, 2, 3, and 4 to the repurchases in quarter 0.

Figures 3.1 through 6 depict the point estimates of the regression coefficients corresponding to the interaction terms in model (3) (i.e., β_{1k} and β_{2k} for k = 1, 2, 3, and 4), as a function of the quarters in which cuts or increases occur. The plots reveal three important facts. First, in most instances, the paired groups show opposite

[20] The results from fitting regression (4) are very similar to the results from model (3), and therefore not reported to save space.

repurchasing behavior in the quarter immediately after the dividend cuts/increases (figures 3.1, 3.2, 3.4, and 3.5). The difference between the market timing mechanism and the financial fundamental mechanism can be clearly appreciated from the spread between the curves.

Second, the largest effect on repurchases typically occur immediately after the dividend cuts/increases. For example, in the quarter following dividend cuts, the difference between small- and large-size groups is approximately 40%, and the difference between low- and high-leverage groups is 17%. Similarly, the difference between low- and high-MB groups is almost 30% in the quarter after dividend increases.

Third, the effects of dividend events fade out over time. Coefficient estimates tend to become smaller in magnitude and more similar between groups, converging after 3 or 4 quarters. For example, after 3 quarters, the differences between the aforementioned paired groups become 2%, 4%, and 3%, respectively. These dynamics show that the timing activities mainly occur in the first or second quarters.

3.9. Internal Rate of Return: How smart are these repurchases?

3.9.1. Measure the timing effect

In this section, we examine the internal rate of return (IRR) of the repurchases. This IRR is defined as the return such that the net present value of all the cash flows corresponding to repurchases equals to zero over the time window. In our case, a firm buys and holds shares from quarter 0 through 3 and sell all of them at the beginning of quarter 4. We assume all repurchases and selling occur at the beginning of the corresponding quarter, and all the received dividends are reinvested to buy more shares immediately. In addition, dividend adjustments occur at the end of quarter -1 and right before the repurchases in quarter 0. The window analyzed comprises four quarters (i.e., five time points). The corresponding cash flows are:

$$CF_t = -repo_t, \quad t=0, 1, 2, \text{ and } 3$$

$$CF_4 = repo_0 * R_1 * R_2 * R_3 * R_4 + repo_1 * R_2 * R_3 * R_4 + repo_2 * R_3 * R_4 + repo_3 * R_4$$

where $R_i = \frac{Price_i + Div_i}{Price_{i-1}}$ is the quarterly return of the stock at period i (not annualized), and i=1, 2, 3, and 4. We choose four instead of two or three quarters as the length of the window because it may take some time for stock prices to recover, and the repurchase will not turn out to be a smart buy unless the price recovers. We do not choose a window longer than four quarters because the timing opportunities generated by dividend cuts or increases might fade out with time. Figures 3.1 through 3.6 suggest that a four-quarter window is a good compromise.

For each firm that repurchases after a dividend cut or increase, we form a smoothed non-timing strategy that a firm equally repurchases every quarter:

$$CF_t = -\frac{1}{4}\sum_{i=0}^{3} repo_t, \; t=0, 1, 2, \text{ and } 3.$$

$$CF_4 = \frac{1}{4}\sum_{i=0}^{3} repo_t * (R_1 * R_2 * R_3 * R_4 + R_2 * R_3 * R_4 + R_3 * R_4 + R_4)$$

The IRR of this strategy is used as a benchmark. The timing effect is measured by the difference between the IRR of the actual repurchases and the IRR of the benchmark.

As before, we explore the relationships between the timing effect and factors including information asymmetry, opportunity costs, and financial flexibility. To analyze information asymmetry, we partition the sample into three groups with the same number of observations according to firm size. Similarly, we partition the sample into three groups based on MB to study the effect of opportunity costs, and into other three groups based on leverage ratio to explore financial flexibility. The values of firm size, MB, and leverage ratio used to separate the groups correspond to the quarter before a cut or an increase occurs (i.e., quarter -1). We examine the IRR of actual repurchases, the IRR of the smoothed repurchases, and the timing effect for the subgroups corresponding to the largest and smallest proxy values (i.e., the middle subgroups are dropped). The results are presented below.

3.9.2. How large are the timing effects?

Table 3.5 shows the actual IRRs, smoothed IRRs, and their difference. On average, all of the actual repurchases have positive net present values. The actual IRRs range from 2.88% to 3.38% per quarter after dividend increases (Column 2, Panel A), and from 2.21% to 4.25% per quarter after dividend cuts (Column 2, Panel B). Most notably, every sub group beats the pseudo smoothed repurchase strategy. The timing effects (Actual-Smoothed IRR) range between 0.46% and 0.96% per quarter for dividend increases (Column 6, Panel A), and between 0.45% and 1.60% per quarter for dividend cuts (Column 6, Panel B). Only four out of twelve of t-statistics are not statistically significant at the 10% level. The timing effects are also economically significant. For example, the smallest timing effect is 0.46% per quarter for the sub groups with t>1.64 (low-MB sub group after dividend increases), which is equivalent to an annualized rate of 1.85%. The largest timing effect is 1.60% per quarter (high-MB size sub group after a dividend cut), which is as high as 6.56% if annualized. We change the window length to 2 quarters and repeat the analysis of IRR. The results are similar, but less significant (Table 3.6). A possible explanation is that a period of 2 quarters is too short to accumulate significant timing effects.

The above results provide evidence of firms timing repurchases, supporting the view that repurchases are smart buys. This conclusion does not contradict our previous hypothesis, which states that financial fundamental effects dominate under some scenarios. These results simply suggest that firms time the market whenever possible, but they are more concerned about retaining cash when the fundamental mechanism dominates. The following table provides a hypothetical numerical example.

Example: Timing effect, financial fundamental effect, and the mix

		Smoothed Repo Strategy	Market Timing Strategy	Financial Fundamental Strategy	Mixed Strategy
	Net Quarterly Return	Cash Flow	Cash Flow	Cash flow	Cash Flow
Q0 (div cut)	-10%	-1	-1	-1	-1
Q1	3%	-1	-1.3	-0.8	-0.8
Q2	3%	-1	-1.3	-0.8	-1.3
Q3	3%	-1	-1.3	-0.8	-1.3
Q4		4.17	5.12	3.53	4.58
IRR		1.64%	1.85%	1.46%	1.68%

Assume there is a dividend cut at the end of quarter 0. The net quarterly return drops to -10% (negative) for the quarter because of the cut, and recovers to 3% in the next 3 quarters, Q1, Q2, and Q3. Again, we assume that the firm repurchases shares at the beginning of quarters 0, 1, 2, and 3, and sell of them at the beginning of quarter 4. The IRR of a smoothed repurchase strategy is 1.64%. To execute a pure market timing strategy, the firm increases repurchases after the dividend cut and continues this increase for the next 3 quarters. The IRR of this strategy rises to 1.85%. Alternatively, the firm executes a pure financial fundamental strategy because it is short of cash, in which case the firm reduces repurchases over the next three quarters. The IRR of this strategy is 1.46%, which is lower than 1.64%, the IRR of the smoothed strategy. However, when both mechanisms work at the same time, the firm uses a mixed strategy. It decreases the repurchases in Q2 to retain more cash, and recovers in Q3 and Q4 to time the market. The IRR is 1.68%, lower than that of a pure market timing strategy, but still higher than that of a smoothed strategy. The coexistence of the market timing and the financial fundamental mechanisms helps explain why firms' repurchases might be sub-optimal and clustered at market peaks (Bonaime et al. 2014).

3.10. Conclusions

The literature has documented two stylized facts: (1) stock prices respond negatively to dividend cuts and positively to dividend increases, and (2) firms repurchase more when stock prices are low and less when prices are high, i.e., time the market. We put these two facts together, and examine firms' repurchase behavior after dividend cuts and increases. We find that firms' repurchase behavior is affected by both a market timing mechanism and a financial fundamental mechanism. According to the market timing mechanism, firms' repurchases move in opposite direction of dividend adjustments because share prices co-move with the dividend adjustments, thereby providing incentives for firms to time the market. In contrast, in the case of the financial fundamental mechanism, firms' repurchases move in the same direction as dividend adjustments. The explanation for this behavior is that dividend adjustments reveal firms' financial fundamentals, and firms manage repurchases and dividends to maintain their cash at a desired level.

Which mechanism is the most important one depends on at least three factors: information asymmetry, opportunity cost, and financial flexibility. When the information asymmetry is severe, stock prices are likely to be more responsive to changes in dividends, thereby providing firms with more opportunities to time the market. Low opportunity costs are more conducive to market timing, because firms have less to lose by using their cash to time the market instead of investing in alternative projects, such as expanding production. Firms with high financial flexibility have the cash needed to time the market. Therefore, for firms with more information asymmetry, low opportunity costs, and high financial flexibility, the market timing mechanism is more likely to dominate. Contrastingly, for firms with less information asymmetry, high opportunity costs, and low financial flexibility, the fundamental mechanism is more likely to prevail.

Using firm size to proxy for information asymmetry, MB ratio to proxy for opportunity cost, and leverage ratio to proxy for financial flexibility, we find evidence consistent with our hypothesis. The market timing mechanism dominates as small firms and low-leverage-ratio firms increase repurchases after dividend cuts, and as small firms and low-MB firms reduce repurchases after dividend increases. In comparison, the financial fundamental mechanism dominates as large firms, high-MB firms, and high-leverage firms increase repurchases after dividend increases. In a few instances, neither mechanism outweighs the other, but none of them statistically contradicts our hypothesis.

The information asymmetry is magnified when firms cut dividends to finance large lumpy investments. The market tends to regard dividend cuts as bad news in general, but this investment-financing cut is not bad news because the firm is expanding. We find that small and low-leverage firms aggressively increase repurchases after this kind of dividend cuts, i.e., the market timing mechanism prevails. In contrast, large, high-MB, and high-leverage firms substantially reduce their repurchases, i.e., the financial fundamental effect is more important.

We use the difference in the internal rates of return for the actual and the smoothed repurchases to measure the market timing effect. We find that all firms exhibit positive timing skills, even those firms for which the financial fundamental effect dominates their repurchase activities. However, the magnitude of the latter firms' timing effect is smaller, especially when the event is a dividend cut. The sensitivity of market responses to dividend adjustment is the key.

Our paper is the first to rigorously study the repurchase activities surrounding dividend cuts and increases. To examine the market timing behavior, we use dividend cuts and increases as proxies for stock under/over valuation. This method starts a new research area. For example, future researchers might study equity issuance after dividend cuts and increases. Because equity issuances are the opposite of repurchases, market timing and financial fundamental status are still the two major factors that should affect managers' decisions. The two mechanisms we propose are not new, but we are the first to treat them as a mix in the repurchase literature. By considering them together, it is easier to explain many phenomena. For example, our findings help explain why some firms increase repurchases while other reduce repurchases. They also help explain why repurchases are only sub optimal (Bonaime et al. 2014). In this sense, our research lends support not only to the literature on payout policies, but also to the literature about market microstructure.

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Appendix A: Tables

Table 3.1 Descriptive statistics

Panel A Firm characteristics

Variable	n	Mean	Min	Median	Max
Cash	493,741	0.183	0	0.081	2.602
CashFlow	493,741	0.029	0	0.022	0.305
SalesGrowth	493,741	0.329	-1	0.081	16.75
Leverage	493,741	0.283	0	0.191	8.619
MB	493,741	2.38	0.20	1.41	102.50
Asset	493,741	4.71	-3.69	4.64	10.65
Investment	493,741	0.018	0	0.009	0.028
Dividend	493,741	0.002	0	0	0.050
Dividend > 0	130,944	0.007	4.82E-08	0.004	0.050
Repurchase	493,741	0.003	0	0	0.090
Repurchase > 0	94,747	0.014	4.85E-08	0.005	0.090
Age	493,741	47.75	5	40	157
Cash	493,741	0.183	0	0.081	2.602
Total quarters		80 qtrs			
Total firms		13444			

Panel B Positive payout

	Obs.	% of total obs
Dividend > 0 and Repurchase > 0	44,008	8.91%
Dividend > 0 and Repurchase = 0	86,936	17.61%
Dividend = 0 and Repurchase > 0	50,739	10.28%
Dividend = 0 and Repurchase = 0	312,058	63.20%
Total	493,741	100.00%

Panel C Payout adjustments

	obs.	%(gross)
Cut	2,550	0.52%
Increase	13,342	2.70%
No change in dividends	477,849	96.78%
Total	493,741	100%

Panel D. Dividend cuts and increases by firm groups

Dividend Adjustments		Total	Size Group		MB Group		Leverage Group	
			Small	Large	Low	High	Low	High
Cut	Observ.	2,550	223	1,503	1,165	456	686	944
	(%)	0.52%	0.05%	0.30%	0.24%	0.09%	0.14%	0.19%
Increase	Observ.	13,342	428	10,226	2,059	5,320	3,330	3,757
	(%)	2.70%	0.09%	2.07%	0.42%	1.08%	0.67%	0.76%

Table 3.2 Repurchases surrounding div cuts and increases

The regression model is:

$$\text{repo}_{i,t} = \alpha_i + \beta_1 \text{Div\_inc}_{i,t-1} * \text{repo}_{i,t-1} + \beta_2 \text{Div\_cut}_{i,t-1} * \text{repo}_{i,t-1} + \gamma_i X_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

where repo is the repurchase yield, and Div_inc and Div_cut denote dummy variables for dividend increases and cuts respectively. Vector X comprises control variables, including lagged repurchase yield, dividend yield, logarithm of assets, MB, leverage, cash, cash flow, sales growth, investment ratio, and age. We also include a fixed effect, and quarter and year effects. We also include a fixed effect, and quarter and year effects. We partition the sample into three groups by size, MB, and leverage ratio (each with the same number of observations), and drop the middle group. Then we run the regression on each group.

Table 3.2 Repurchases surrounding div cuts and increases

	Size		Market to Book Ratio		Leverage Ratio	
	Small	**Large**	**Low MB**	**High MB**	**Low Leverage**	**High Leverage**
repo*increase	-0.121**	0.0407**	-0.215***	0.0526**	0.0318	0.0620**
	(-2.63)	(2.76)	(-4.84)	(3.18)	(1.35)	(3.18)
repo*cut	0.359***	-0.0300	0.00461	0.0250	0.117*	-0.0498
	(3.97)	(-0.74)	(0.03)	(0.60)	(2.11)	(-1.08)
repo_yield	0.555***	0.658***	0.345***	0.630***	0.588***	0.681***
	(26.36)	(65.67)	(11.36)	(60.09)	(49.00)	(38.44)
MB	2.4300E-06	0.00020***	0.00051***	0.000023**	0.0000152	0.00000789
	(0.48)	(4.91)	(3.47)	(2.64)	(1.08)	(1.07)
leverage	0.00000083	-0.0078***	-0.0011***	-0.0000901	-0.0124***	-0.000186**
	(0.02)	(-23.09)	(-8.14)	(-1.12)	(-4.59)	(-3.28)
log_asset	0.000148**	0.00073***	0.000128**	0.00063***	0.00119***	-0.0000667
	(2.95)	(7.49)	(2.67)	(8.03)	(14.50)	(-1.15)
cash	0.000542***	0.00583***	0.00381***	0.00089***	0.00180***	0.000309
	(4.61)	(13.70)	(16.87)	(4.64)	(9.01)	(1.37)
cashflow	0.00201**	0.00609**	0.00367***	0.00580***	0.00230	0.00249*
	(2.81)	(2.66)	(3.61)	(4.27)	(1.64)	(2.31)
sale_growth	-0.0000286	-0.000149*	-0.000059*	-0.000051*	-0.0000546	0.00000596
	(-1.96)	(-2.32)	(-2.45)	(-1.98)	(-1.87)	(0.26)
investment_ratio	-0.00306**	-0.00993***	-0.00376***	-0.00856***	-0.0101***	-0.00247*
	(-2.91)	(-4.60)	(-3.37)	(-4.42)	(-4.30)	(-2.20)
age	0.0000281	0.0000295	0.000137	0.0000513	0.000101	-0.000146
	(0.20)	(0.13)	(0.82)	(0.20)	(0.41)	(-0.92)
div_yield	-0.00383	0.00658	-0.00532	0.0123	-0.00576	-0.0140
	(-0.58)	(0.70)	(-0.75)	(1.28)	(-0.66)	(-1.58)
N	103907	117545	112448	106726	109459	110018

t statistics in parentheses

* p<0.05 ** p<0.01 *** p<0.001"

Table 3.3 Repurchases surrounding dividend cuts & increases with investment spikes

The regression model is:

$$\text{repo}_{i,t} = \alpha_i + \beta_1 \text{Div\_inc}_{i,t-1} * \text{repo}_{i,t-1} + \beta_2 \text{Div\_cut}_{i,t-1} * \text{repo}_{i,t-1} + \delta_1 \text{Div\_inc}_{i,t-1} + \delta_1 \text{Div\_cut}_{i,t-1} + \theta_1 \text{Inv}_{\text{skp}_{i,t-1}} + \theta_2 \text{Inv}_{\text{spk}_{i,t-1}} * \text{Div}_{\text{cut}_{i,t-1}} * \text{repo}_{i,t-1} + \gamma_i X_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

where Inv_spk is a dummy for an investment spike. Following Xiang and Lence (2014) and Whited (2006), Inv_spk equals 1 if the investment ratio is at least two times larger than the median investment for the firm. The coefficient of interest is θ_2, which corresponds to the interaction of the three variables: $\text{Inv\_spk}_{i,t-1} * \text{Div\_cut}_{i,t-1} * \text{repo}_{i,t-1}$.

Table 3.3 Repurchases surrounding div. cuts & increases with investment spikes

	Size		Market to Book Ratio		Leverage Ratio	
Variable	**Small**	**Large**	**Low MB**	**High MB**	**Low Leverage**	**High Leverage**
Repo*Div_cut*Inv_spk	0.755***	-0.375***	0.778**	-0.243*	0.196	-0.638***
	(3.95)	(-3.68)	(2.75)	(-2.11)	(1.52)	(-6.15)
Investment_spike	-0.000153*	-0.000293*	-0.000129	-0.000302*	-0.000353**	0.0000968
	(-2.20)	(-2.00)	(-1.77)	(-2.37)	(-2.88)	(1.07)
repo*Div_inc	-0.118*	0.0399**	-0.209***	0.0540**	0.0311	0.0627**
	(-2.56)	(2.71)	(-4.69)	(3.26)	(1.32)	(3.20)
repo*Div_cut	0.224	-0.0107	-0.139	0.0848	0.0696	0.0381
	(1.94)	(-0.24)	(-0.84)	(1.78)	(1.06)	(0.69)
repo_yield	0.552***	0.657***	0.331***	0.630***	0.586***	0.680***
	(26.18)	(65.62)	(10.89)	(60.05)	(48.87)	(38.41)
MB	0.00000280	0.000199***	0.000528***	0.0000231**	0.0000169	0.00000780
	(0.56)	(5.00)	(3.63)	(2.70)	(1.19)	(1.06)
leverage	-0.00000209	-0.00783***	-0.00106***	-0.0000956	-0.0125***	-0.000183**
	(-0.05)	(-23.08)	(-8.25)	(-1.19)	(-4.60)	(-3.23)
log_asset	0.000155**	0.000730***	0.000128**	0.000640***	0.00120***	-0.0000679
	(3.07)	(7.47)	(2.67)	(8.13)	(14.61)	(-1.17)
cash	0.000550***	0.00585***	0.00382***	0.000882***	0.00180***	0.000306
	(4.68)	(13.75)	(16.93)	(4.66)	(9.01)	(1.35)
cashflow	0.00205**	0.00628**	0.00368***	0.00585***	0.00237	0.00251*
	(2.86)	(2.74)	(3.63)	(4.31)	(1.69)	(2.33)
sale_growth	-0.0000279	-0.000150*	-0.0000595*	-0.0000503	-0.0000528	0.00000494
	(-1.91)	(-2.33)	(-2.49)	(-1.95)	(-1.81)	(0.22)
investment_ratio	-0.00185	-0.00701**	-0.00278*	-0.00580**	-0.00617*	-0.00307*
	(-1.53)	(-2.78)	(-2.18)	(-2.59)	(-2.26)	(-2.35)
age	0.0000287	0.0000306	0.000141	0.0000458	0.0000992	-0.000144
	(0.20)	(0.14)	(0.84)	(0.18)	(0.40)	(-0.91)
div_yield	-0.00286	0.00806	-0.00517	0.0121	-0.00555	-0.0115
	(-0.43)	(0.86)	(-0.73)	(1.26)	(-0.63)	(-1.30)
N	103907	117545	112448	106726	109459	110018

t statistics in parentheses

* p<0.05 ** p<0.01 *** p<0.001

Table 3.4 Model Specification & Robustness

In the regression model for columns 2 and 3, we add $\delta_1 \text{Div\_inc}_{i,t-1} + \delta_2 \text{Div\_cut}_{i,t-1}$ to model (1), allowing for changes in both the intercept and the slopes.

$$\text{repo}_{i,t} = \alpha_i + \beta_1 \text{Div}_{\text{inc}_{i,t-1}} * \text{repo}_{i,t-1} + \beta_2 \text{Div}_{\text{cut}_{i,t-1}} * \text{repo}_{i,t-1}$$

$$+\delta_1 \text{Div\_inc}_{i,t-1} + \delta_2 \text{Div\_cut}_{i,t-1} + \gamma_i X_{i,t-1} + \varepsilon_{i,t} \tag{1-a}$$

Similarly, in the regression model for columns 4 and 5, we add $\delta_1 \text{Div\_inc}_{i,t-1} + \delta_2 \text{Div\_cut}_{i,t-1}$ to model (2), allowing for changes in both the intercept and the slopes.

$$\text{repo}_{i,t} = \alpha_i + \beta_1 \text{Div\_inc}_{i,t-1} * \text{repo}_{i,t-1} + \beta_2 \text{Div}_{\text{cut}_{i,t-1}} * \text{repo}_{i,t-1} + \delta_1 \text{Div\_inc}_{i,t-1}$$

$$+ \delta_2 \text{Div\_cut}_{i,t-1}$$

$$+ \theta_1 \text{Inv\_spk}_{i,t-1} + \theta_2 \text{Inv\_spk}_{i,t-1} * \text{Div\_cut}_{i,t-1} * \text{repo}_{i,t-1} + \gamma_i X_{i,t-1}$$

$$+ \varepsilon_{i,t} \tag{2-a}$$

Table 3.4 Model Specification & Robustness

	No control for inv. spikes		Control for inv. spikes	
Variable	**Small**	**Large**	**Small**	**Large**
D_repo*cut*inv_spk			0.741***	-0.372***
			(3.86)	(-3.64)
D_investment_spike			-0.000152*	-0.000293*
			(-2.19)	(-2.00)
repo*increase	-0.163**	0.0401*	-0.121*	0.0472*
	(-2.98)	(2.10)	(-2.25)	(2.51)
repo*cut	0.439***	-0.0293	0.303*	-0.0195
	(3.84)	(-0.60)	(2.23)	(-0.37)
repo_yield	0.614***	0.684***	0.551***	0.657***
	(28.18)	(67.90)	(26.04)	(65.28)
market_to_book	0.00000383	0.000226***	0.00000286	0.000199***
	(0.69)	(5.35)	(0.57)	(5.01)
book_leverage_ratio	-0.00000376	-0.00787***	-0.00000179	-0.00784***
	(-0.08)	(-22.33)	(-0.04)	(-23.10)
log_at	0.000153**	0.000732***	0.000157**	0.000733***
	(2.82)	(7.25)	(3.11)	(7.49)
cash	0.000549***	0.00612***	0.000551***	0.00585***
	(4.33)	(13.83)	(4.69)	(13.75)
cashflow	0.00164*	0.00440	0.00206**	0.00634**
	(2.15)	(1.85)	(2.88)	(2.77)
sale_growth	-0.0000318*	-0.000142*	-0.0000280	-0.000149*
	(-1.96)	(-2.08)	(-1.92)	(-2.32)
inv_ratio	-0.00307**	-0.00928***	-0.00185	-0.00700**
	(-2.70)	(-4.15)	(-1.54)	(-2.78)
age	0.0000690	-0.0000509	0.0000291	0.0000324
	(0.44)	(-0.22)	(0.21)	(0.14)
dv_yield	-0.00360	0.00736	-0.00169	0.00938
	(-0.50)	(0.76)	(-0.25)	(0.99)
D_dv_increase	0.000209	-0.000137	-0.00000194	-0.000157
	(0.61)	(-0.71)	(-0.01)	(-0.83)
D_dv_cut	-0.000755	0.0000441	-0.000887*	0.000139
	(-1.89)	(0.15)	(-2.25)	(0.49)
N	97812	114207	103907	117545

t statistics in parentheses * $p<0.05$ ** $p<0.01$ *** $p<0.001$

Table 3.5 Internal Rate of Return (IRR) and Timing Effect (4 quarters)

Panel A **Internal rate of returns after a dividend increase**

	IRR of Actual Repurchases (Dividend Increases)		IRR of Smoothed Repurchases (Dividend Increases)		Timing Effect Diff.in IRR (Actual-Smoothed)			
Group	**Mean**	**Std.Dev.**	**Mean**	**Std.Dev.**	**Mean**	**Std.Dev.**	**t**	**Obs.**
small	3.38%	9.76%	2.78%	8.64%	0.60%	5.54%	1.40	166
large	3.15%	9.63%	2.48%	8.06%	0.67%	4.81%	**10.18**	5341
low_mb	2.90%	11.27%	2.44%	9.48%	0.46%	5.69%	**2.49**	951
high_mb	2.94%	9.38%	2.13%	7.80%	0.81%	4.96%	**8.63**	2795
low_lever	3.08%	9.98%	2.12%	8.29%	0.96%	5.19%	**7.54**	1661
high_leve	2.88%	10.61%	2.27%	9.02%	0.61%	5.47%	**4.43**	1581

Panel B **Internal rate of return after a dividend cut**

	IRR of Actual Repurchases (Dividend Cuts)		IRR of Smoothed Repurchases (Dividend Cuts)		Timing Skills Diff.in IRR (Actual-Smoothed)			
Group	**Mean**	**Std.Dev.**	**Mean**	**Std.Dev.**	**Mean**	**Std.Dev.**	**t**	**Obs.**
small	3.24%	10.77%	2.16%	9.11%	1.08%	5.85%	1.63	78
large	3.28%	13.03%	2.72%	10.70%	0.56%	7.07%	**1.75**	487
low_mb	3.12%	13.67%	2.70%	11.01%	0.42%	9.00%	0.77	271
high_mb	4.25%	12.26%	2.65%	9.65%	1.60%	6.44%	**3.47**	195
low_lever	2.98%	11.35%	2.28%	9.53%	0.70%	6.86%	**1.68**	272
high_lever	2.21%	15.96%	1.79%	12.81%	0.45%	9.16%	0.71	211

Table 3.6 Internal Rate of Return (IRR) and Timing Effect (2 quarters)

Panel A **Internal rate of returns after a dividend increase**

	IRR of Actual Repurchases		IRR of Smoothed Repurchases		Timing Skills			
Group	**Mean**	**Std.Dev.**	**Mean**	**Std.Dev.**	**Mean**	**Std.Dev.**	**T**	**Obs.**
small	3.10%	14.93%	3.08%	12.66%	0.01%	6.70%	0.02	144
large	2.90%	12.09%	2.38%	11.03%	0.52%	4.35%	**8.38**	4915
low_mb	3.33%	14.60%	2.92%	13.14%	0.41%	5.59%	**2.12**	835
high_mb	2.76%	11.59%	2.13%	10.57%	0.63%	4.21%	**7.62**	2591
low_lever	2.76%	12.18%	2.01%	11.11%	0.75%	4.52%	**6.34**	1461
high_lever	2.81%	12.48%	2.30%	11.40%	0.52%	5.22%	**3.78**	1439

Panel B **Internal rate of return after a dividend cut**

	IRR of Actual Repurchases		IRR of Smoothed Repurchases		Timing Skills			
Group	**Mean**	**Std.Dev.**	**Mean**	**Std.Dev.**	**Mean**	**Std.Dev.**	**t**	**Obs.**
small	0.19%	13.99%	-0.17%	12.97%	0.36%	3.72%	0.76	61
large	3.68%	21.10%	3.26%	16.45%	0.42%	10.06%	0.83	391
low_mb	4.16%	25.06%	3.18%	18.30%	0.98%	12.50%	1.13	208
high_mb	2.84%	14.23%	2.72%	12.48%	0.12%	5.23%	0.29	155
low_lever	1.86%	13.71%	1.56%	12.92%	0.29%	4.85%	0.88	216
high_lever	4.08%	26.84%	3.31%	19.13%	0.78%	13.87%	0.74	174

Appendix B: Figures

Figures 3.1-3.6: Repurchase % Changes after Dividend Increases/Cuts

Quarter 0 is the quarter that dividend cuts or increases occur

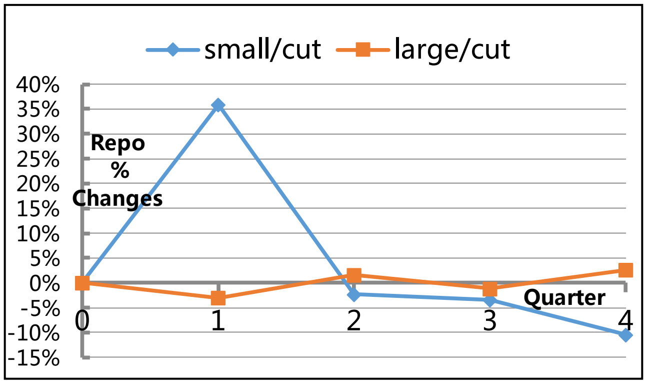

Figure 3.1
Repo. % Changes after Div. Cuts (by Size)

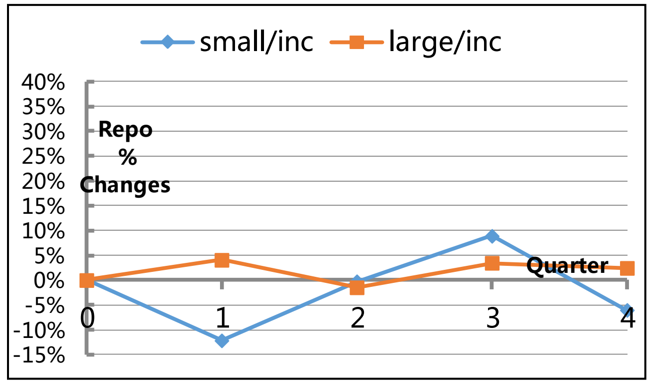

Figure 3.2
Repo. % Changes after Div. Inc. (by Size)

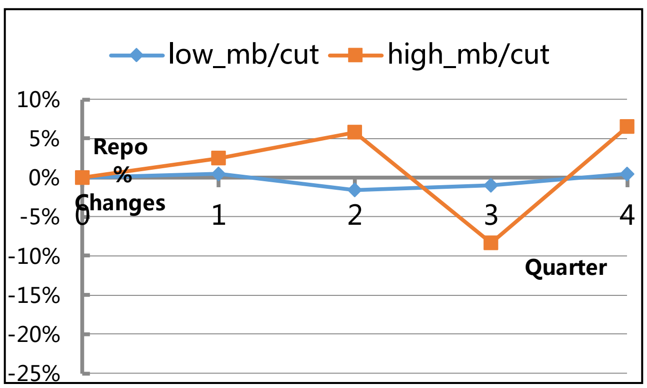

Figure 3.3
Repo. % Changes after Div. Cuts (by MB)

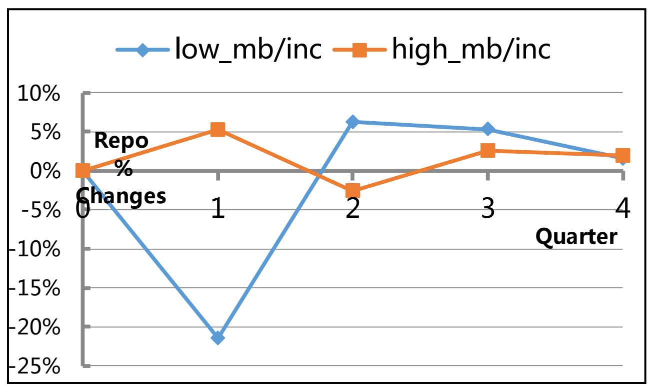

Figure 3.4
Repo. % Changes after Div. Inc. (by MB)

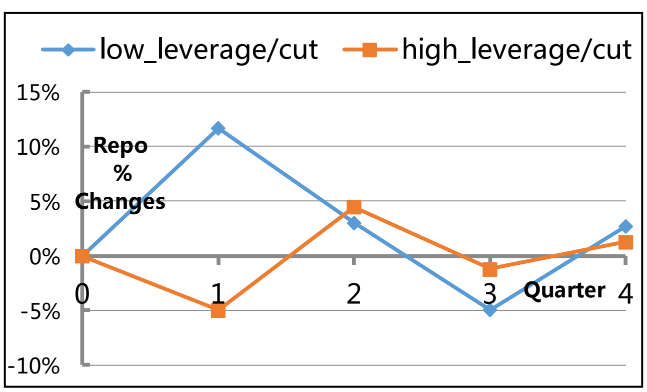

Figure 3.5
Repo. % Changes after Div Cuts (by leverage)

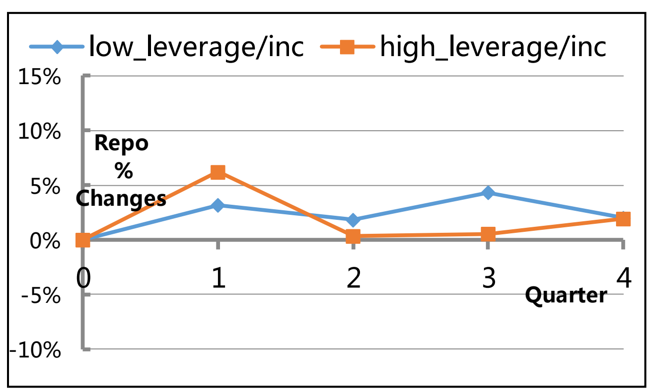

Figure 3.6
Repo. % Changes after Div. Inc. (by leverage)

Appendix C: Dynamic panel bias

Our models have the problem of dynamic panel bias, and we mitigate it in this session. Dynamic panel bias exists when the lagged depended variable appears on the right hand side of a fixed effect model (Nickell,1981). Consider a model with fixed effect:

$$y_{i,t} = \alpha_i + \beta_1 y_{i,t-1} + \beta_2 x_{i,t} + \varepsilon_{i,t}$$

To remove the fixed effect α_i, differentiate it:

$$y_{i,t} - y_{i,t-1} = \beta_1(y_{i,t-1} - y_{i,t-2}) + \beta_2(x_{i,t} - x_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1})$$

When using the OLS method to regress on this equation, the regressor $y_{i,t-1} - y_{i,t-2}$ and the error term $\varepsilon_{i,t} - \varepsilon_{i,t-1}$ are not independent, because $y_{i,t-1}$ and $\varepsilon_{i,t-1}$ are correlated. Therefore, the estimation is biased, and this is called a “dynamic panel bias”. Nickell (1981) shows that the bias is

$$\underset{n\to\infty}{plim}(\hat{\beta} - \beta) \cong \frac{-(1+\beta)}{T-1}$$

where n is the number of units, T is the time span, β is the true value of the coefficient, and $\hat{\beta}$ is the estimate of β using a naïve estimation. The bias does not go away as n goes large, but becomes small as T goes large. To remove the correlation between $y_{i,t-1} - y_{i,t-2}$ and $\varepsilon_{i,t} - \varepsilon_{i,t-1}$, Anderson and Hsiao (1982) use an instrumental method (IV). Candidates for $y_{i,t-1}$ can be $y_{i,t-2}$, $y_{i,t-3}$, and more lags. Arellano and Bond (1991) suggest a generalized method of moments (GMM), which is more efficient than the IV method. Blundell and Bond (1998) discussed the initial conditions and moment restrictions of the GMM and further refine the estimation.

We use the IV method instead of the GMM or the method proposed by Blundell and Bond, because our model is not a standard linear model discussed in their research. Our models include not only the lagged term $\mathrm{repo}_{i,t-1}$, but also its interaction terms such as $\mathrm{dcut}_{i,t-1} * \mathrm{repo}_{i,t-1}$. The methods advocated by Arellano and Bond (1991) and Blundell and Bond (1998) are not applicable. Specifically, we use $\mathrm{repo}_{i,t-2}$ and $x_{i,t-2}$ to estimate $\mathrm{repo}_{i,t-1}$, and get the estimated value, $E(\mathrm{repo}_{i,t-1})$. Then, we replace all the $\mathrm{repo}_{i,t-1}$'s shown in the models by $E(\mathrm{repo}_{i,t-1})$, including both the stand-alone term and the interaction terms. Finally, we run the models as standard fixed effect models.