Essays in Corporate Policy:

Dividend Policy, Index Labeling Effect, Investment, and Cash Flow Duration

by

Tae Eui Lee

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Approved April 2015 by the
Graduate Supervisory Committee:

Rajnish Mehra, Co-Chair
Yuri Tserlukevich, Co-Chair
Cláudia Custódio

ARIZONA STATE UNIVERSITY

May 2015

ABSTRACT

This dissertation consists of two essays on corporate policy. The first chapter analyzes whether being labeled a "growth" firm or a "value" firm affects the firm's dividend policy. I focus on the dividend policy because of its discretionary nature and the link to investor demand. To address endogeneity concerns, I use regression discontinuity design around the threshold to assign firms to each category. The results show that "value" firms have a significantly higher dividend payout - about four percentage points - than growth firms. This approach establishes a causal link between firm "growth/value" labels and dividend policy.

The second chapter develops investment policy model which associated with duration of cash flow. Firms are doing their business by operating a portfolio of projects that have various duration, and the duration of the project portfolio generates different duration of cash flow stream. By assuming the duration of cash flow as a firm specific characteristic, this paper analyzes how the duration of cash flow affects firms' investment decision. I develop a model of investment, external finance, and savings to characterize how firms' decision is affected by the duration of cash flow. Firms maximize total value of cash flow, while they have to maintain their solvency by paying a fixed cost for the operation. I empirically confirm the positive correlation between duration of cash flow and investment with theoretical support. Financial constraint suffocates the firm when they face solvency issue, so that model with financial constraint shows that the correlation between duration of cash flow and investment is stronger than low financial constraint case.

DEDICATION

For Boram,

whose love, support, and encouragement made everything possible.

And for my parents,

who set high expectations and provided the foundation to help me achieve my goals.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

LABELING EFFECT ON PAYOUT POLICY

1.1 Introduction

Publicly traded firms are often categorized on the basis of identifiable characteristics, such as their size, industry, and past performance. Investors must choose among thousands of financial assets when allocating capital; financial institutions can ease this choice by using labeling to convey information to investor and reduce the complexity of asset allocation decisions. With this information in hand, investors can trade entire asset categories without scrutinizing individual assets. Index labels can affect investor sentiment and expectations for the asset category, an effect that would be absent if individual investors already have detailed information for each firm.

In this paper, I examine whether corporate policies, especially payout policy is affected by whether a firm is labeled a "growth" firm or a "value" firm. How firms are categorized can change investors' expectations for firms' growth opportunities and their future value. Firms have several choices about how to use their earnings. For example, a firm may reinvest earnings in production through capital investment or research & development if such opportunities exist. If not, the firm may choose to retain its earnings or distribute the earnings to its shareholders. Growth firms are typically expected to invest more in growth opportunities, while value firms are expected to pay out more from their earnings. If a firm is labeled "value," investors do not expect much growth in the stock price, but they expect more stable value than they do from a "growth" firm; investors might even leave value firms that do not provide enough dividends.

I investigate dividend policy in particular because it is one of the most direct channels through which a firm can respond to investor sentiment. Investors maximize their expected present value by allocating their assets. The expected value of holding stock is based on the combination of dividend payouts and the future value of the stock. Growth firms are expected to reinvest their earnings rather than distribute them to shareholders. Investors do not demand high dividend payouts from growth firms. Investors can hold stock even without a dividend payout if they expect the value of the stock itself to compensate for lower dividends. However, if investors do not observe much growth possibility from a firm, they will demand a high dividend payout to compensate for the low expected rate of value growth from holding the stock. These "value" firms have an incentive to pay a higher dividend to investors. Therefore, a firm's dividend policy depends not only on the firm's characteristics, but also on investors' demand. This makes the labeling effect on dividend policy feasible because index labeling delivers information, which affects investor demand through the change in expected value for the firms.

While the previous literature has focused on the index labeling effect from the investors' side, this study contributes by investigating the labeling effect on corporate policy from the firms' side. The idea that investors' behavior is influenced by index membership is well established. Barberis and Shleifer (2003) use the terminology "style investing," which means that investors allocate funds across labels rather than in individual securities. Boyer (2011) also analyzes whether investors actually use index labels to determine how to allocate capital.

Baker and Wurgler (2004) propose a new dividend theory, which considers investors' demand for dividend payout stocks. Their so-called catering theory hypothesizes that investors categorize stocks as dividend payers and non-payers; categories that are assumed to represent growth and value firms, and they give more value on payers than on non-payers. By introducing a "dividend premium," which measures a valuation difference between dividend payers and non-payers, they report that the dividend premium is related to aggregate dividend initiations. However, there is no plausible explanation why investor evaluate differently. Moreover, according to Hoberg and Prabhala (2009), the dividend premium has little power to explain dividend trends. In this paper, I investigate whether economically meaningless labeling induce payout policy through sentiment of investors who allocate capital across styles described by labels. This provide empirical evidence for catering theory in the context of growth versus value index labeling.

The data set I utilize includes firms in the S&P 500, which is a U.S. stock market index based on the market capitalization of 500 large companies in leading industries. Barra divided these S&P 500 companies into two groups - "Growth" and "Value" - based on their book-to-market ratios. These S&P/Barra Growth and Value index groups are rebalanced every June and December to equate the market cap of both groups. Although Barra first created the index in May 1992, the index data were backdated to May 1981, as if the index had existed during this period. I utilize data from 1981 to 2003, so the 1981-1992 subsample can be used as a "control sample" that is not expected to have any labeling effect, while the 1992-2003 "test sample" is expected to have some labeling effect.

It is difficult to estimate the effect of labeling on corporate policy with standard regressions. The potential problem is that unobservable systematic factors related to each group might affect the corporate policy. Growth/value labeling only depends on book-to-market ratio; however, there are firm characteristics other than book-to-market ratio that clearly differ between the two groups. For example, changes in corporate policy might be different across the two groups due to systematic disparities, rather than to labeling itself.

I use regression discontinuity design on the dividend policy to overcome the limitation of standard regressions. This empirical strategy compares the dividend policy changes among firms that are labeled "value" by a small margin and labeled "growth" by a small margin. S&P/Barra must reset the boundary to rebalance the market cap of each index group. As a result, a stock's label can be switched to "value" after its book-to-market ratios decrease, and vice versa. For firms that are close to the cut-off value of the index, labeling is considered an exogenous and random event and therefore uncorrelated with firm characteristics. Since indexation is exogenous from the point of view of managers, the event should not have any effect on corporate policy if the corporate policy is based on firms' fundamentals. However, the labeling leads to a discrete change in the dividend policy. I examine the labeling effects of dividend payout empirically for both the control and the test samples. For S&P 500 firms during the test sample years, a positive increase in the dividend payout ratio is observed when firms are assigned to the "value" index; during the control sample years, there is no observable increase. The positive effect on dividend supports the idea that the label has an effect on dividend payout policy even without any changes in fundamental corporate conditions.

If the label affects individual investors' sentiment, then it is also expected to have an effect on institutional holdings. Grinstein and Michaely (2005) and Grullon and Michaely (2002) show that institutional holdings do not affect firm policy, but earnings distribution policy can attract institutional investors. Conversely, using Russell 1000 and Russell 2000 data, Crane, Michenaud, and Weston (2014) find that institutional holdings increase firms' dividend payouts. Even though there is no empirical evidence of discontinuity among institutional holdings with S&P 500 data, I control for institutional holdings in the analysis of dividend payout policy as a robustness test.

In addition to dividend policy, I also consider share repurchases. Dividend policy has become more conservative, and firms use repurchases as well as dividends to return earnings to their investors (Skinner, 2008). I therefore examine whether repurchases are also affected by index labeling. I also investigate other corporate policies, such as leverage, investment, R&D, saving, and employment, and no other variables show significant discontinuity.

The rest of the paper is organized as follows: section 2 describes the data and the index, while section 3 discusses empirical methods. Section 4 presents the empirical evidence. Section 5 concludes this paper.

1.2 Data

I use index generated by Barra on book-to-market (BM) ratio of firms from 1981 though 2003. Even though Barra stopped providing S&P/Barra Value and Growth index data from their official website, the index data is available from May 1981 through March 2003 from Boyer's website. [1] While Barra first created the index in May 1992, the index data were backdated to May 1981, dividing the S&P 500 into two groups and rebalancing the market cap of each groups every June and December, exactly as if the index existed over this period. I refer to data before May 1992 as the "control sample", because index labeling is not expected to enter into firm's payout policy during this period, and data from May 1992 through 2003 is referred as the "test sample."

The threshold of BM is reset and the index is rebalanced every June and December. For the purpose of empirical tests, I define a new variable Z to be the distance of a firm's BM from the cut-off BM that defines the boundary between categories,

[1] http://marriottschool.net/emp/boyer/Research/barradata.html

BM^*

$$Z_{i,t} = BM_{i,t} - BM_t^*$$

The empirical sample consists of the S&P 500 firms from quarterly Compustat/CRSP merged data of the period of 1981-2003. I use BM calculated from Compustat to match S&P/Barra index data.

For the test of labeling effect on corporate policies, I analyze each corporate policies of dividend, repurchase, investment, R&D, leverage policy, saving, and employment. Dividend policy is measured by dividend payout ratio which is a ratio of dividend per share to earning per share. Other frequently used payout measures in recent literatures are dividend yield and payment rate, which measure the portion of payers. These measures are used as substitutes for dividend payout ratio in the robustness test. Repurchase is defined as total expenditure on the purchase of common and preferred stocks. Sale of common and preferred stock is subtracted from repurchase for the net repurchases. Following Fama and French (2001), net repurchases are also considered with treasury stock. Not all repurchases are dividend substitutes. Thus net repurchase is defined as the increment in common treasury stock if a firm uses the treasury stock method for repurchases. Alternatively, the difference between stock purchase and stock issuance is applied only if a firm has zero treasury stock for eight consequent quarters. If either of the amounts is negative, repurchases are set to zero. Leverage is defined as the ratio of long-term debt to total debt. For the estimation of dividend policy, profitability, investment opportunities and size are considered as dividend factors which is consistent with Fama and French (2001) which provide evidence of the difference between dividend payers and non-payers in term of these three factors. Return on assets (ROA) measures profitability of firms, and the coefficient on ROA is expected to be positive. Growth rate is measured by total assets change for investment opportunities, and the coefficient on growth rate is expected to be negative. To control institutional block holder effect, institutional holdings are also included in the payout estimation for the robustness test. Institutional holdings are percentage of institution owned shares to total number of share outstanding which are from Spectrum 13F filings. Every variable is windsorized top and bottom by 1 percent.

It is a possible hypothesis that employment depends on firms' earnings distribution decision, then these value may be affected by index labeling. Since only annual data is available for these two variables, it may be hard to see the exact effect from S&P/Barra index which has higher frequency. However, I compare these in graphs which are shown in the appendix to illustrate how these will be shown with index labeling. Annual data is matched with fourth quarter of quarterly data.

1.2.1 Summary Statistics

Table 2.1 contains summary statistics for sample quarterly data from Compustat/CRSP. The sample period is 1981 through 2003. The table report dividend payout ratio, dividend yield, dividend payment rate, share repurchases, net repurchases, normalized *BM* measure (Z), asset size, growth rate of assets, return on assets as a proxy for profitability, capital investment, R&D, leverage, cash saving, institutional holdings, number of employees, number of observation and the number of firms. All financial values except leverage are scaled by total assets. Each section indicates overall firms, control sample, test sample. Each column of control and test sample section presents overall firms, growth index firms and value index firms. Test sample in Table 2.1 indicates that average percentile size of value firms are about 12 percents higher and average age is also about 3 years higher. While value firms show lower growth rate by 2 percents and pay 9 percents higher dividend payout ratio than

Table 1: Summary Statistics

This table contains summary statistics for sample data from quarterly Compustat/CRSP merged data. The sample period is 1981 through 2003. The table report dividend payout ratio, dividend yield, dividend payment rate, share repurchases, net repurchases, normalized BM measure ($Z_{i,t} = BM_{i,t} - BM_t^*$, where BM_t^* is a threshold) , asset size, growth rate of assets, return on assets as a proxy for profitability, capital investment, R&D, leverage, cash saving, number of employees, number of observation and the number of firms. All financial values are scaled by total assets, but leverage. Each column indicate overall firms, control sample, test sample. Data before May 1992 is the "Control sample" and data from May 1992 through 2003 is the "Test sample." Every variable is windsorized top and bottom by 1%.

	Total	Control Sample			Test sample		
		Total	Growth	Value	Total	Growth	Value
Dividend	36.7687	40.1714	34.1292	44.6107	33.6138	27.6787	36.0735
	(50.8710)	(53.9485)	(38.8187)	(62.4130)	(47.6257)	(36.5170)	(51.3328)
Dividend Yield	0.6752	0.8548	0.5705	1.0635	0.5089	0.3359	0.5803
	(0.5923)	(0.6636)	(0.4256)	(0.7265)	(0.4587)	(0.3354)	(0.4831)
Payment Rate	0.8364	0.8760	0.8696	0.8807	0.7996	0.7369	0.8255
	(0.3700)	(0.3296)	(0.3367)	(0.3242)	(0.4003)	(0.4404)	(0.3796)
Repurchases	0.8694	0.5586	0.7942	0.3860	1.1572	2.0989	0.7684
	(2.2801)	(1.7935)	(2.1843)	(1.4168)	(2.6196)	(3.5317)	(2.0075)
Net Repurchase	4.0425	2.0433	3.0780	1.2842	5.8914	10.3677	4.0383
	(8.9414)	(5.3527)	(6.8593)	(3.7142)	(10.9672)	(14.7427)	(8.2690)
Z	0.1582	0.1303	-0.2610	0.4175	0.1841	-0.1206	0.3099
	(0.4017)	(0.4789)	(0.2196)	(0.4092)	(0.3113)	(0.1047)	(0.2797)
Size Percentile	50.9096	50.9307	41.0996	58.1471	50.8900	42.8781	54.1975
	(28.9021)	(28.9984)	(25.2486)	(29.4493)	(28.8133)	(27.1708)	(28.8233)
Growth Rate	1.6711	1.6564	2.9230	0.7280	1.6846	3.1083	1.0969
	(8.8381)	(8.2088)	(7.8232)	(8.3597)	(9.3835)	(8.8602)	(9.5297)
ROA	1.2060	1.2684	2.1773	0.6021	1.1482	2.4517	0.6101
	(2.8151)	(2.2722)	(2.2736)	(2.0270)	(3.2367)	(2.7455)	(3.2709)
Investment	3.1109	2.9899	3.9199	2.3082	3.2229	3.9195	2.9354
	(3.8790)	(4.0165)	(4.4921)	(3.4739)	(3.7439)	(3.5228)	(3.7945)
R&D	0.3768	0.1594	0.1746	0.1482	0.5781	1.0148	0.3978
	(1.1151)	(0.7136)	(0.7375)	(0.6954)	(1.3562)	(1.7522)	(1.1046)
Leverage	76.0068	74.9476	74.0160	75.6211	74.7522	70.7687	76.2961
	(24.8720)	(26.3517)	(27.5393)	(25.4388)	(25.7493)	(28.4831)	(24.4353)
Saving	0.2395	0.1775	0.3469	0.0531	0.2969	0.6819	0.1380
	(3.8590)	(3.7008)	(4.5428)	(2.9267)	(3.9991)	(5.3754)	(3.2534)
Age	25.2501	22.0541	21.1932	22.6861	28.2100	25.9587	29.1394
	(8.7846)	(5.7857)	(6.2075)	(5.3685)	(9.9709)	(10.9015)	(9.4049)
Institutional Holdings	15.1315	6.9840	6.4775	7.4207	19.5593	18.3854	20.1134
	(9.6284)	(4.4179)	(3.9522)	(4.7402)	(9.1473)	(10.0176)	(8.6518)
Employee	0.1582	38.5990	37.2163	39.5687	40.9903	48.0771	38.2484
	(0.4017)	(65.1845)	(51.9270)	(73.0547)	(71.0857)	(99.0675)	(56.4482)
No. of firms	997	707	492	557	790	447	684
No. of Obs.	38332	18431	7802	10629	19901	5815	14086

growth firms, growth firms invest about 1 percent more fraction from total asset.

Value firms have lower profitability, growth rate, investment, and R&D than growth index firms. One of the most prominent factors of dividend payment is profitability. Fama and French (2001) suggest profitability is a factor of dividend payment. However, the summary shows growth index firms have higher profitability than value index firms, which seems inconsistent with other literature. Average ROA, yet, is higher with dividend payout firms within categories. For example, within value index firms of test sample, average ROA of firms who pay dividend is 2.4 percent while non-pay firms have 2.0 percent of ROA. Regression results for dividend policy also show that ROA has significant positive effect which is consistent with other literature.

Of greater interest, the average value of dividend is higher in value index. Dividend payout ratio in value index is 44.61 percent with control sample and 36.07 percent with test sample, which is higher than 34.13 percent and 27.68 percent in growth index.

1.3 Model/Methodology

This section describes how to adapt the regression discontinuity methodology to an event study in order to estimate the effect of value and growth index on corporate dividend policy.

1.3.1 Identification

Regression discontinuity design in this study satisfies required identifying assumptions.

1. Index labeling is solely a function of BM ratio. S&P/Barra indices have simple rules for classify stocks as "growth" and "value" based on BM ratio. No other variable can contaminate the labeling.

2. Firms do not know what kind of index they would be labeled as, because the threshold is based on random components. S&P/Barra must reset the boundary to rebalance the market cap of each index group. As a result, the label of stocks can be switched to "value" after their BM ratios actually decrease, or switched to "growth" after their BM ratios actually increase. Thus labeling contains, at least near the cut-off, random components. This is the key assumption of the local randomization. Lee

(2008) formally shows that as long as there is a random component to the threshold, the assignment into each group is random around the threshold.

3. For the same reason, firms cannot manipulate their value to get a specific label they want. Thus index membership does not suffer from endogeneity issues. If firms can effectively choose the BM ratio for the labeling, firms who choose above the threshold could be somewhat different from those who below the threshold. It will invalidate the regression discontinuity approach.

1.3.2 Regression Discontinuity in Dividend Policy

Suppose that a firm i have the value of book to market $BM_{i,t}$ at time t: If $BM_{i,t}$ is larger than the threshold BM_t^*, then this firm is labeled as a value firm and the firm has the indicator $I_{i,t}$ =1 ($BM_{i,t} > BM^*$). Let $Z_{i,t} = BM_{i,t} - BM_t^*$, then the cut-off value Z_t^* based on the new measure $Z_{i,t}$ will be always zero. The effect of labeling on an outcome $D_{i,t}$ can be written as

$$D_{i,t} = \alpha + I_{i,t}\beta + f(Z_{i,t}) + \mu_{i,t}$$

where the coefficient β is the effect of index on the dividend payout $D_{i,t}$ and $\mu_{i,t}$ represents all other determinants of the outcome (E($\mu_{i,t}$) = 0). $I_{i,t}$ is a dummy variable indicating whether a firm is labelled "value" or "growth" based on a cut-off value. Estimating these kind of regressions is problematic, when the labeling is a highly endogenous outcome, and $I_{i,t}$ is unlikely to be independent of the error term ($E(I_{i,t}, \mu_{i,t}) \neq 0$); the estimate of β will be biased. To get a consistent β, labeling is ideally needed to be a randomly assigned variable. Since whether the value index or growth index is random in a small interval around the discontinuity (where a cut-off Z^*=0), the regression discontinuity framework helps me approximate this ideal setup. There is a random component to set the threshold of BM ratio, so that the assignment into "growth" ($I_{i,t} = 0$) and "value" ($I_{i,t} = 1$) groups is random around the threshold. This implies that the estimate of β using the regression discontinuity design is not affected by omitted variables even if they are correlated with the BM ratio, as long as their effect is continuous around the threshold. [2] Therefore, by comparing the dividend of firms that barely have value index to the dividend of firms that barely have growth index, I get a consistent estimate of the value of the labeling.

Global strategy of regression discontinuity is the methodology which use overall data set, and it is also called parametric strategy. This methodology assume that I can approximate the continuous underlying relationship between $D_{i,t}$ and $Z_{i,t}$ with a continuous function of book to market ratio. This continuous function captures the underlying relationship between any variable that is continuously affected by book to market ratio and the dividend payout, and $\hat{\beta}$ captures the discontinuity of dividend payout at the threshold. Allowing for a different function for observations on the left-hand side of the threshold $f(Z_{i,t})$ and on the right-hand side of the threshold $g(Z_{i,t})$ gives

$$D_{i,t} = \alpha + I_{i,t}\beta + f(Z_{i,t}) + I_{i,t} \cdot g(Z_{i,t}) + \eta_t + \lambda_i + \mu_{i,t} \tag{1.1}$$

For example, following the standard approach (Lee and Lemiuex, 2010), I can assume the relationship between $D_{i,t}$ and $Z_{i,t}$ as a quadratic polynomial, and the above equation can be transferred as follows

$$D_{i,t} = \alpha + I_{i,t}\beta + \gamma_1 Z_{i,t} + \gamma_2 I_{i,t} Z_{i,t} + \gamma_3 Z_{i,t}^2 + \gamma_4 I_{i,t} Z_{i,t}^2 + \eta_t + \lambda_i + \mu_{i,t} \tag{1.2}$$

In addition to the polynomial regression model, I control firm specific characteristics in (1.3). The parameter η_t contains fixed effects for the time periods of years and

[2] Continuity of other variables are revealed in section 1.4.7

quarters, and λ_i is an industry fixed effect based on two-digit SIC code. Regression discontinuity design does not require the control of other variables or fixed effect near the cut-off if regression discontinuity design is valid. Moreover, Lee and Lemieux (2010) argue that the use of other baseline covariates in an RD design is primarily to reduce sampling variability. I control firm specific characteristics such as size, profitability and growth rate as suggested by Fama and French (2001) to test robustness with broad range near the cut-off. The equation extended with firm characteristics is

$$D_{i,t} = \alpha + I_{i,t}\beta + \gamma_1 Z_{i,t} + \gamma_2 I_{i,t} Z_{i,t} + \gamma_3 Z_{i,t}^2 + \gamma_4 I_{i,t} Z_{i,t}^2 + X'_{i,t}\theta + \eta_t + \lambda_i + \mu_{i,t} \quad (1.3)$$

where X contains firm specific characteristics.

Choice of polynomial order is an important consideration to use above polynomial model, since linear or misspecified polynomial model may capture the curvature of regression rather than discontinuity. In the empirical test section, various polynomial orders, from a linear model up to polynomial of order of four on either side of the threshold, are placed into the model to illustrate the robustness of results.

An alternative methodology is the use of local linear regressions. Local linear estimation, which is called non-parametric strategy, is more flexible than global polynomial regression, which is called non-parametric strategy, to fit various shapes. The regression model is as follows

$$D_{i,t} = \alpha + I_{i,t}\beta + \gamma_1 Z_{i,t} + \gamma_2 I_{i,t} Z_{i,t} + \mu_{i,t}, \text{ where } -h \leq Z \leq h$$

for $h > 0$. The treatment effect is also captured by β. The choice of bandwidth, h, is an important consideration, as choice of polynomial order in the global regression. By using Imbens and Kalyanaraman (2012) procedure as a benchmark for the choice of bandwidth, I apply various bandwidths around the benchmark bandwidth into the model for testing the robustness of results. By applying additional fixed effects, the above equation can be rewritten as

$$D_{i,t} = \alpha + I_{i,t}\beta + \gamma_1 Z_{i,t} + \gamma_2 I_{i,t} Z_{i,t} + \eta_t + \lambda_i + \mu_{i,t}, \text{ where } -h \leq Z \leq h \tag{1.4}$$

The parameter η_t contains fixed effects for the time periods of years and quarters, and λ_i is an industry fixed effect based on two-digit SIC code. I also extend regression model (1.4) by controlling firm specific characteristics X for the robustness test.

$$D_{i,t} = \alpha + I_{i,t}\beta + \gamma_1 Z_{i,t} + \gamma_2 I_{i,t} Z_{i,t} + X'_{i,t}\theta + \eta_t + \lambda_i + \mu_{i,t}, \text{ where } -h \leq Z \leq h \tag{1.5}$$

1.4 Empirical Analysis

1.4.1 Graphical Analysis for Regression Discontinuity

I begin the empirical analysis with a simple plot of the dividend payout ratio as a function of BM ratio using information of S&P 500 listed firms during the control (1981-1992) and the test (1992-2003) sample years. Figure 1.1 illustrates a graphical analysis for dividend payout policy to characterize regression discontinuity. Each graph in the Figure 1.1 portrays a relationship that might exist between dividend payout policy and BM ratio, which is normalized to Z value. Each dot shows the average value of the dividend payout ratio for firms, in each bin with width 0.02, against the BM ratio. The vertical line in the center of each graph designates a cut-off point, above which firms are labeled "value" and below which firms are labeled "growth". To show the detailed characteristics, the BM ratio limits within 0.4 near the threshold, which is twice the bandwidth value based on Imbens and Kalyanaraman (2012) for the regression discontinuity design. The first graph in Figure 1.1 illustrates the relationship between dividend payout ratio and BM ratio in the control sample. As can be seen, the relationship is upward sloping to the right, which indicates that dividend payout ratio increases as BM ratio increases. This relationship passes continuously through the cut-off point, which implies that there is no difference in dividend payout ratio for value or growth index firms which are just above and below the cut-off point. The second graph in the Figure 1.1 illustrates the relationship between dividend payout ratio and BM ratio in the test sample. In the test sample period (after May 1992), by contrast, there is a sharp upward jump at the cut-off point in the relationship, which intuitively supports that labeling effect exist on dividend payout policy.

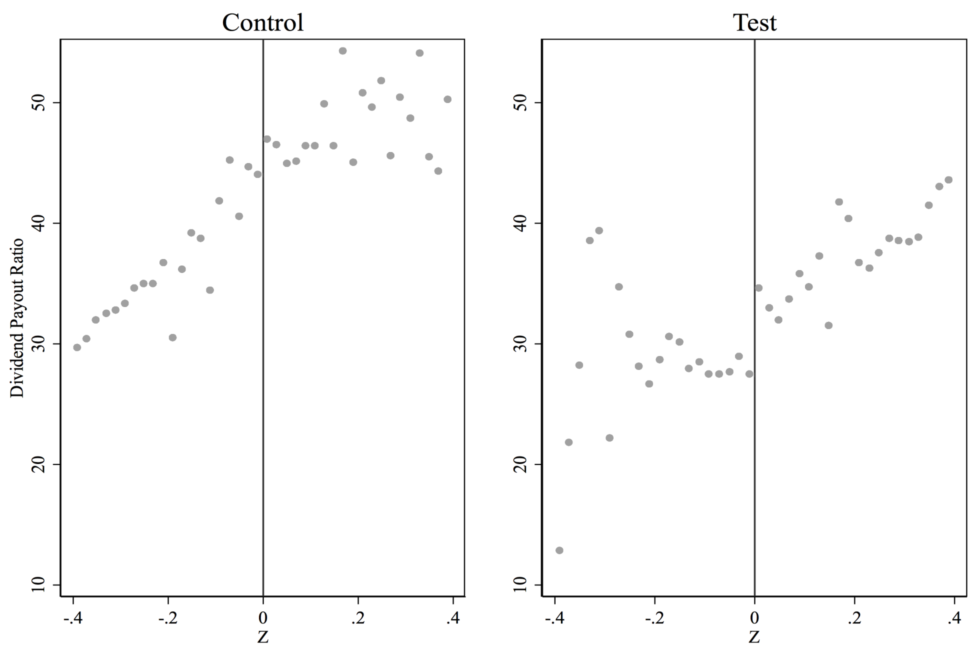

Figure 1.1: Dividend Payout Ratio

Conservatism in setting dividend may weaken the logic that dividend payout ratio reflects payout policy. On the contrary, this conservatism shed light on labeling effect for one side, only for value index. Conservatism in dividend comes from the classic field survey of managers by Lintner (1956). Lintner reports that managers are conservative in setting dividend policy. In particular, managers are reluctant to make upward changes in dividends that may have to be reversed in the future. Fifty years later, Brav, Graham, Harvey, and Michaely (2005) survey a larger number of 384 executives, and they report that managers are reluctant to cut dividends and take the current level of dividend payments as given. Thus it is possible that firms can increase dividend payout with value index due to investor's sentiment, however, it is hard to decrease payout from current level of dividend payout when the index is changed to growth. On the other hand, firms may more rely on whether they pay dividend, rather than how much they pay with reflecting on a notion of conservatism. In addition to analyzing dividend payout ratio, average payment rate, which measure how many firms are paying dividend, is taken for another measure of dividend policy change.

Figure 1.2 illustrates a graphical analysis for average dividend payment rate to characterize regression discontinuity. Each dot also shows the average dividend payment rate for firms in BM bin with width 0.02. The vertical line in the center of each graph designates a cut-off point, and the BM ratio limits within 0.4 near the threshold. The first graph in Figure 1.2 illustrates the relationship between dividend payment rate and BM ratio in the control sample. This relationship passes continuously through the cut-off point, which implies that there is no difference in dividend payment rate for value or growth index firms that are just above and below the cut-off point. The second graph in the Figure 1.2 illustrates the relationship between dividend payment rate and BM ratio in the test sample. In this case, there is a sharp upward jump at the cut-off point in the relationship, which is consistent with the dividend payout ratio graph. Therefore, this figure support that firms are more willing to payout dividend with value label.

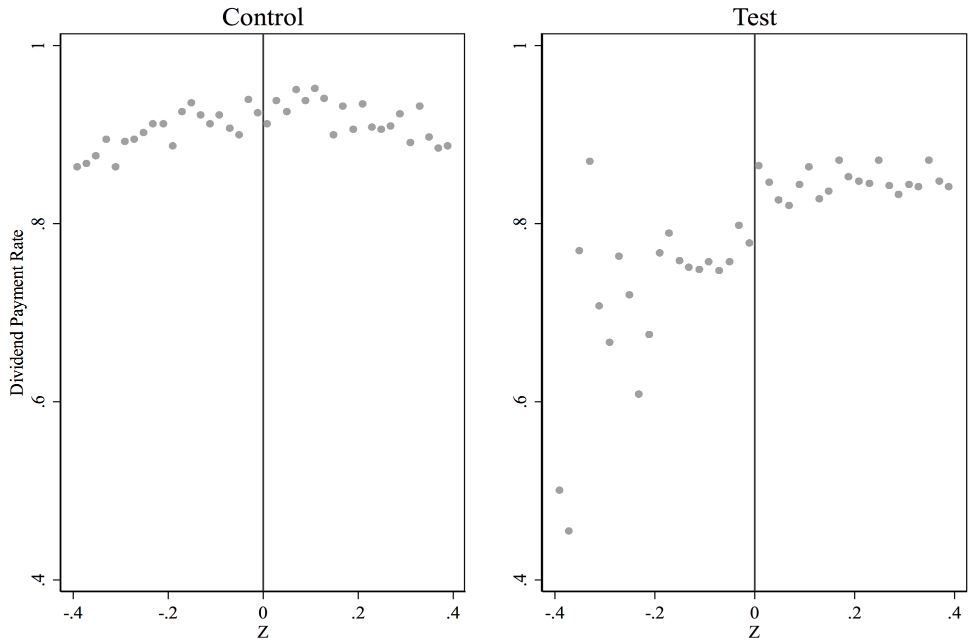

Figure 1.2: Dividend Payment Rate

1.4.2 Estimation of Regression Discontinuity - Global strategy

Significant discontinuity of dividend policy with labeling is observed through the global strategy. Table 1.2 contains global estimation results of sharp regression discontinuity in dividend payout ratio. Panel A presents standard global estimations of regression discontinuity with various polynomial regressions which are based on equation (1.1) and equation (1.2). For the test sample, a significant index discontinuity drive a jump of dividend payout ratio from 4.2 percent to 5 percent with the value index. This implies that dividend payout ratio increases by about 4.2 to 5 percent points when a firm has value label, where average payout ratio difference between growth and value group in the test sample is about 8.4 percents. These coefficients are significant through the different polynomial models. For the control sample, linear and quadratic models show significant value of discontinuity (7.81, 3.72), however, higher orders of polynomial models do not show discontinuity. With broad range of entire sample, as it named global strategy, linear and quadratic models may capture the curvature of regression rather than discontinuity. Moreover, regressions with different polynomial show inconsistent coefficient, while coefficients in the test sample are relatively consistent.

Robustness tests are performed in Panel B, and the tests also indicate that the index has a positive treatment effect on dividend payout ratios during the test sample period. Panel B controls for firms' other characteristics such as profitability, growth rate of assets and size, which are dividend factors suggested by Fama and Frech (2001). Institutional holdings are also controlled for as another factor influencing dividend policy. Both Grinstein and Michaely (2005) and Crane, Michenaud, and Weston (2014) suggest institutional holdings, but they have opposite expectation for the relationship between institutional holdings and dividend payout. Equation (1.3) is applied for this test. A robustness test with firm characteristics shows consistent result (from 4.39 to 5.38), and these values are statistically not different. Other variables are also significant for dividend payout. More profitable firms and big firms payout more, and growing firms invest more instead of payout. In regards to the institutional ownership, there is negative correlation between institutional holdings and dividend payout. The result is consistent with Grinstein and Michaely (2005), and contrary to Crane, Michenaud, and Weston (2014).

As Lee and Lemieux (2010) point out, a possible disadvantage of the parametric/global estimation approach is that it provides a regression over the entire range of BM ratios, while the regression continuity design depends on local estimates of the regression function at the cut-off point. The fact that global regression models use data far away from the cut-off point to predict the value of dividend near the

Table 1.2: Estimation of Sharp Regression Discontinuity - Global Strategy

This table contains global estimation of sharp regression discontinuity result for dividend payout ratio. Panel A presents standard global estimation of regression discontinuity and various polynomial regression which are based on equation (1.1) and equation (1.2). Panel B additionally control firms' other specifics such as boot to market, profitability, growth rate of assets and size, because dividend payout can be affected by several firm characteristics. Equation (1.3) is applied for this test. Both panels indicate that the index has positive treatment effect on dividend payout ratio for the test sample. In control panel, linear and polynomial regression model shows positive index effect, but it may capture the curvature of regression rather than discontinuity. All data are from the quarterly Compustat/CRSP. The sample period is 1981 through 2003. Data before May 1992 is the "Control sample" and data from May 1992 through 2003 is the "Test sample." The estimations include year fixed effect, quarter fixed effect and industry fixed effect which is based on two digit SIC. The associated standard errors are reported in parentheses.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

	Cotrol				Test			
	A. Standard Test							
	Linear	Poly	Cube	Quartic	Linear	Poly	Cube	Quartic
Index	7.8096***	3.7228**	0.223	0.0487	4.9526***	4.6581***	4.7779***	4.2487**
	(1.2293)	(1.4872)	(1.7748)	(2.1147)	(1.1257)	(1.4226)	(1.7402)	(2.1410)
No. of Obs.	18376	18376	18376	18376	19819	19819	19819	19819
R-Squared	0.08	0.082	0.083	0.083	0.121	0.122	0.122	0.122
	B. Extended Test - Control ROA, Size, Growth Rate							
	Linear	Poly	Cube	Quartic	Linear	Poly	Cube	Quartic
Index	7.3648***	3.0474*	-0.9635	0.3057	5.2059***	4.3865***	5.3756***	4.9832**
	(1.5096)	(1.7985)	(2.1477)	(2.5520)	(1.2867)	(1.5936)	(1.9541)	(2.3917)
ROA	1.2612***	1.4326***	1.4460***	1.4387***	0.9149***	0.9205***	0.9168***	0.9121***
	(0.2403)	(0.2430)	(0.2438)	(0.2441)	(0.1554)	(0.1569)	(0.1569)	(0.1572)
Growth Rate	-0.1751***	-0.1661***	-0.1694***	-0.1696***	-0.1623***	-0.1621***	-0.1624***	-0.1626***
	(0.0536)	(0.0536)	(0.0536)	(0.0536)	(0.0336)	(0.0336)	(0.0336)	(0.0336)
Size	0.1354***	0.1294***	0.1278***	0.1278***	0.1132***	0.1145***	0.1140***	0.1141***
	(0.0229)	(0.0229)	(0.0229)	(0.0229)	(0.0176)	(0.0176)	(0.0176)	(0.0176)
Inst. Holdings	-0.1796	-0.174	-0.2068*	-0.2046*	-0.4036***	-0.4024***	-0.4024***	-0.4027***
	(0.1227)	(0.1227)	(0.1228)	(0.1228)	(0.0515)	(0.0515)	(0.0515)	(0.0515)
No. of Obs.	11490	11490	11490	11490	14049	14049	14049	14049
R-Squared	0.085	0.086	0.088	0.088	0.12	0.121	0.122	0.122

Table 1.3: Estimation of Sharp Regression Discontinuity - Local Strategy

This table contains linear regression result for dividend payout ratio within a range of cut-off value. Panel A presents standard local estimation of regression discontinuity with bandwidth 0.2 which are based on bandwidth selector procedure by Imbens and Kalyanaraman (2012). On the top of the bandwidth 0.2, ±0.05 of the bandwidth are applied for the robustness. Equation (1.4) is applied for this test. Panel B additionally control firms' other specifics such as profitability, growth rate of assets and size, which are possible factors for dividend payout. Equation (1.5) is applied for this robustness test. The estimations include year fixed effect, quarter fixed effect and industry fixed effect which is based on two digit SIC. The sample period is 1981 through 2003. Data before May 1992 is the "Control sample" and data from May 1992 through 2003 is the "Test sample." All data are from the quarterly Compustat/CRSP. The associated standard errors are reported in parentheses.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

A. Standard Test

	Control Sample			Test Sample		
Bandwidth	+0.05	0	-0.05	+0.05	0	-0.05
Index	-0.726	-1.9434	-0.9419	3.6121***	3.4070**	4.5890***
	(2.2349)	(2.5486)	(2.9922)	(1.3931)	(1.5460)	(1.7374)
No. of Obs.	8539	6743	4942	15720	10905	8656
R-Squared	0.079	0.072	0.069	0.131	0.134	0.132

B. Extended Test

	Control Sample			Test Sample		
Bandwidth	+0.05	0	-0.05	+0.05	0	-0.05
Index	0.8460	0.4106	1.1883	3.6690**	4.0016**	5.2793***
	(2.7144)	(3.1051)	(3.6346)	(1.5602)	(1.7497)	(1.9748)
Z	47.3375***	59.4743***	32.9905	25.9536**	28.0553**	26.0176
	(12.8395)	(18.1674)	(27.6778)	(10.8090)	(12.4394)	(16.6142)
ROA	(0.5987)	(0.7135)	-1.5532**	0.7467***	0.5467***	0.4133*
	(0.4652)	(0.5394)	(0.6257)	(0.1860)	(0.2022)	(0.2205)
Growth Rate	-0.1255*	(0.0374)	(0.0801)	-0.1469***	-0.1348***	-0.1285***
	(0.0694)	(0.0813)	(0.0944)	(0.0341)	(0.0362)	(0.0389)
Size	0.0456	0.0224	(0.0043)	0.1237***	0.0886***	0.0966***
	(0.0308)	(0.0354)	(0.0410)	(0.0185)	(0.0202)	(0.0221)
Inst. Holdings	-0.5483***	-0.5970***	-0.8565***	-0.3807***	-0.4412***	-0.4641***
	(0.1776)	(0.2038)	(0.2362)	(0.0548)	(0.0609)	(0.0669)
Const	64.6733***	64.7418***	66.2452***	11.6070	13.7812	15.0307*
	(7.4964)	(8.0917)	(9.0102)	(9.5881)	(8.9944)	(8.9706)
No. of Obs.	5362	4199	3085	11254	8073	6467
R-Squared	0.084	0.08	0.095	0.124	0.133	0.14

cut-off point is not intuitively appealing. That said, trying more flexible specification by adding polynomials in BM ratio as regressors into the standard linear model is an important and useful way of assessing the robustness of the RD estimates of the treatment effect. Moreover, it is recommended to check both global and local model when implementing a regression discontinuity design.

1.4.3 Estimation of Regression Continuity - Local Strategy

In addition to the parametric/global estimation approach, non-parametric/local estimation approach is also applied near the cut-off value of Z. Consistent to global estimation, significant discontinuity from dividend policy is captured through overall local estimations. The local regression results for dividend payout ratio within a range of cut-off value are presented in Table 1.3. Panel A contains standard local estimation of regression discontinuity with bandwidth 0.2 that derived from the bandwidth selecting procedure of Imbens and Kalyanaraman (2012). While the entire range of Z is from -3.18 to 4.88, local bandwidth 0.2 near the cut-off value contains about 46.2 percent of observations (36.7% in control sample and 55% in test sample). On the top of the bandwidth 0.2, ± 0.05 of the bandwidth are applied for the robustness. Equation (1.4) is applied for this test. For the test sample, a significant index discontinuity drive a jump of dividend payout ratio from 3.4 percent to 4.6 percent with the value index. These coefficients are significant at least at the 5 percent level through the different bandwidth. For the control sample, no significant discontinuity is observed with any bandwidth values.

Both panels indicate that labeling has a positive effect on dividend payout ratio only for the test sample. These consistent results support that labeling has an effect on demand of dividend by providing information to the investors. Compared to the global strategy, local strategy captures less effect of labeling, however, the values are all within one standard error range, so the difference is statistically insignificant.

1.4.4 Changes in the Dividend Policy and Labeling

In addition to the static dividend policy measurement, I evaluate the effects of labeling on changes in the dividend policy. Evaluating these real effects are important

Table 1.4: Change of Dividend Payout - Within Firm Effect for Index Switchers

This table contains linear regression result for change of dividend payout ratio within a range of cut-off value. Panel A presents standard local estimation of regression discontinuity with bandwidth 0.17 which are based on bandwidth selector procedure by Imbens and Kalyanaraman (2012). On the top of the bandwidth 0.17, ±0.05 of the bandwidth are applied for the robustness. Equation (1.4) is applied for this test. Panel B uses index change dummies. If a firm change the index from "growth" to "value", then the firm assigned as G to V, V to G if a firm's label switches the other way. If a firm does not have previous index data, the firm is dropped. Panel C additionally control firms' other specifics such as profitability, growth rate of assets and size, which are possible factors for dividend payout. The estimations include year fixed effect, quarter fixed effect and industry fixed effect which is based on two digit SIC. The sample period is 1981 through 2003. Data before May 1992 is the "Control sample" and data from May 1992 through 2003 is the "Test sample." All data are from the quarterly Compustat/CRSP. The associated standard errors are reported in parentheses.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

A. Standard Test

	Control Sample			Test Sample		
Bandwidth	0.05	0	-0.05	0.05	0	-0.05
Index	-3.1414	-4.0135	-3.9149	1.1388	0.7463	-0.0558
	(2.7842)	(3.1984)	(3.7861)	(1.7991)	(1.9456)	(2.1795)
No. of Obs.	8528	6733	4933	12618	10884	8639
R-Squared	0.118	0.105	0.1	0.171	0.174	0.171

B. Standard Test for Index Change

	Control Sample			Test Sample		
Bandwidth	0.05	0	-0.05	0.05	0	-0.05
G to V	-1.3584	-3.8357	-3.1872	7.0202*	5.9778	6.7021
	(5.2242)	(5.7083)	(6.4051)	(4.0588)	(4.1266)	(4.3154)
V to G	-8.4367	-9.7248	-8.6575	1.4005	2.3554	1.5327
	(5.8044)	(6.3715)	(7.1494)	(4.2394)	(4.3032)	(4.5539)
Const	1.0721	4.1864	-1.1361	3.3019	3.8333	3.0998
	(9.8981)	(10.7004)	(12.1349)	(11.9043)	(11.7352)	(11.5227)
No. of Obs.	8249	6512	4762	12399	10685	8467
R-Squared	0.007	0.009	0.011	0.007	0.008	0.009

C. Extended Test for Index Change

	Control Sample			Test Sample		
Bandwidth	0.05	0	-0.05	0.05	0	-0.05
G to V	-1.3895	-3.8959	-3.1284	7.1334*	6.0982	6.828
	(5.2249)	(5.7098)	(6.4070)	(4.0573)	(4.1254)	(4.3168)
V to G	-7.4878	-8.6703	-7.1483	1.4811	2.4142	1.5715
	(5.8289)	(6.4019)	(7.1912)	(4.2374)	(4.3014)	(4.5543)
Z	0.6746	1.0371	0.6127	2.4694	5.4244	9.878
	(5.3120)	(7.2453)	(10.9882)	(4.2851)	(5.1815)	(6.9124)
ROA	-0.4942	-0.0365	-0.0647	0.6342***	0.6844***	0.6761***
	(0.5084)	(0.5915)	(0.6966)	(0.2188)	(0.2317)	(0.2499)
Growth rate	-0.0277	-0.0354	-0.111	-0.0022	-0.0008	0.0232
	(0.0733)	(0.0839)	(0.1012)	(0.0386)	(0.0412)	(0.0437)
Size	-0.0285	-0.0098	-0.0418	0.0225	0.0233	0.0199
	(0.0329)	(0.0377)	(0.0446)	(0.0208)	(0.0218)	(0.0236)
Const	3.1777	5.5555	1.8554	2.2221	2.7425	2.0777
	(9.9590)	(10.7715)	(12.2354)	(11.9077)	(11.7407)	(11.5363)
No. of Obs.	8239	6504	4757	12379	10670	8457
R-Squared	0.008	0.009	0.011	0.008	0.009	0.01

for determining whether the firms' payout ratio increases following the switching of index categories, especially for those switching from "growth" to "value". The changes in the dividend policy are applied into regression discontinuity design of equation 1.4. Thus the changes in the dividend policy is defined as follows

$$\Delta D_{i,t}(= D_{i,t} - D_{i,t-1}) = \alpha + I_{i,t}\beta + \gamma_1 Z_{i,t} + \gamma_2 I_{i,t} Z_{i,t} + \eta_t + \lambda_i + \mu_{i,t}, \text{ where } -h \leq Z \leq h. \tag{1.6}$$

Changes in the dividend payout are presented on the first panel of Table 1.4, but it is hard to address that the results provide an evidence of labeling effect. This test does not take into account changes of labeling whether a firm's label stays in value or changes to value.

To show changes of dividend policy in actual index switching effect, I divide firms into three groups, which are "growth to value", "value to growth", and "stay in the same index". The second panel presents the behavior of actual label switchers. The total observation of switchers are small, where growth to value switchers are 4.5 percents and value to growth switchers are 3.6 percents of the sample. Yet, these switchers are clustered in the local bandwidth of 0.2. While the bandwidth contains 46.2 percent of total observations, 88.7 percent of switchers are located in the bandwidth. The switching index of "growth to value" does not show significantly positive dividend payout effects from the labeling for the all bandwidth choices. Even though various bandwidth show consistent result with relatively small coefficient of variation, the test with wider bandwidth only shows significant coefficient. The third panel shows the robust test results by controlling additional firm characteristics.

From panel A, original "value" index does not explain labeling effect with new index for switchers, instead of index itself, consistent change of dividend payout ratio is estimated from panel B, and C. It simply says, if a firm were in growth index with 20% of payout ratio, the firm increases the payout ratio to 26% by shifting into the

Table 1.5: Regression Discontinuity - Dividend Payers Only

This table contains linear regression result for dividend payout ratio with dividend payers only. Local estimation of regression discontinuity with bandwidth 0.20 which are based on bandwidth selector procedure by Imbens and Kalyanaraman (2012). On the top of the bandwidth 0.20, ±0.05 of the bandwidth are applied for the robustness. Equation (1.5) is applied for this test. The estimations include year fixed effect, quarter fixed effect and industry fixed effect which is based on two digit SIC. The sample period is 1981 through 2003. Data before May 1992 is the "Control sample" and data from May 1992 through 2003 is the "Test sample." All data are from the quarterly Compustat/CRSP. The associated standard errors are reported in parentheses.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

Extended Local Regression Discontinuity with Dividend Payers Only						
	Control Sample			Test Sample		
Bandwidth	+0.05	0	-0.05	+0.05	0	-0.05
Index	-0.0409	-0.2097	0.4098	4.9916***	3.8213*	4.9867**
	(2.8608)	(3.2618)	(3.7970)	(1.9056)	(2.0333)	(2.2988)
Z	47.0102***	61.1063***	42.6881	2.4295	14.2720	10.2880
	(13.7174)	(19.3379)	(28.9927)	(12.6041)	(14.7242)	(19.9040)
ROA	-2.0840***	-2.2216***	-2.9387***	0.0129	0.0660	(0.0323)
	(0.5334)	(0.6113)	(0.6905)	(0.2688)	(0.2795)	(0.3113)
Growth rate	-0.1266*	(0.0435)	(0.0813)	-0.1159***	-0.1324***	-0.1238**
	(0.0726)	(0.0836)	(0.0964)	(0.0438)	(0.0457)	(0.0496)
Size	(0.0453)	-0.0618*	-0.0775*	(0.0118)	(0.0118)	0.0039
	(0.0328)	(0.0374)	(0.0430)	(0.0227)	(0.0236)	(0.0260)
Inst. Holdings	-0.4058**	-0.4519**	-0.6953***	-0.2720***	-0.3023***	-0.3329***
	(0.1959)	(0.2225)	(0.2551)	(0.0730)	(0.0768)	(0.0849)
Const	73.5291***	74.5574***	73.2704***	10.9611	13.3075	14.2822
	(7.9863)	(8.6139)	(9.4188)	(9.6434)	(9.4610)	(9.4818)
No. of Obs.	4913	3865	2853	7567	6563	5207
R-Squared	0.082	0.083	0.102	0.096	0.104	0.111

value index. Among all the dividend policy factors, only profitability has possible explanation power for change in dividend payout ratio.

Although the coefficients in panel B and C in Table 1.4 consistently show positive labeling effect it does not support enough for labeling effect with index switcher sample. "value to growth" does not show negative effect as expected from conservatism in setting dividend, even though these coefficients are not significant. I additionally check local discontinuity design with dividend payers only, and the result is shown in Table 1.5. For this test, firm quarters that do not show dividend payout, about 15 percent of sample, are dropped from each group.

1.4.5 Alternative Measure of Dividend Policy - Payment Decision

In addition to the regression discontinuity design with dividend payout ratio, Table 1.6 reports robustness test using three different setup with payment decision,

Table 1.6: Logit Result

This table contains logit regression result for dividend payment. Index increases dividend payment rate only for the test sample. Regression methods control firm's other specifications such as BM, profitability, growth rate of assets and size. Column (A) shows test result of logit with payment decision. For robustness purpose, column (B) replace dividend payout ratio to payment decision in regression discontinuity with the same bandwidth, while column (C) control firms' other specifications which are included in column (A) results. All data are from the quarterly Compustat/CRSP. The sample period is 1981 through 2003. Data before May 1992 is the "Control sample" and data from May 1992 through 2003 is the "Test sample." The estimations include year fixed effect, quarter fixed effect and industry fixed effect which is based on two digit SIC. The associated standard errors are reported in parentheses. Index* is original index from S&P/Barra, while Index refers matched value/growth index.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

	Control Sample			Test Sample		
	A. Matched Data Set					
	(A)	(B)	(C)	(A)	(B)	(C)
Index	0.3291***	0.1311	0.0712	0.7732***	0.3590***	0.2825**
	(0.0989)	(0.2177)	(0.2878)	(0.0734)	(0.1131)	(0.1411)
Z	0.0356	-0.0852	0.6324	-0.1984*	1.3144**	2.1576***
	(0.0948)	(0.9143)	(1.1943)	(0.1108)	(0.5364)	(0.6850)
ROA	0.1899***		0.1799***	0.1077***		0.0756***
	(0.0168)		(0.0374)	(0.0109)		(0.0154)
Growth rate	0.001		0.0041	-0.0072***		-0.0087***
	(0.0036)		(0.0071)	(0.0021)		(0.0026)
Size	0.0299***		0.0210***	0.0245***		0.0248***
	(0.0017)		(0.0033)	(0.0012)		(0.0017)
Inst. Holdings	0.0051		-0.0562***	-0.0311***		-0.0443***
	(0.0074)		(0.0159)	(0.0034)		(0.0046)
Const	2.6021***	3.0830***	2.5414***	0.486	3.3498***	1.3991***
	(0.4920)	(0.6160)	(0.6896)	(0.4377)	(0.4834)	(0.5339)
No. of Obs.	10200	6084	3310	13003	10472	7299
pseudo R-sq	0.214	0.181	0.241	0.242	0.212	0.276
	B. Premitive Data Set					
	(A)	(B)	(C)	(A)	(B)	(C)
Index*	0.3466***	0.0183	0.1611	0.6919***	0.3348***	0.3723***
	(0.0853)	(0.1186)	(0.1539)	(0.0662)	(0.0757)	(0.0974)
Z	0.0369	0.2249	0.0415	-0.0877	1.3378***	1.7568***
	(0.0856)	(0.5256)	(0.6732)	(0.1065)	(0.3794)	(0.4991)
ROA	0.2061***		0.2213***	0.1132***		0.0847***
	(0.0165)		(0.0342)	(0.0108)		(0.0148)
Growth rate	-0.0003		0.0003	-0.0081***		-0.0094***
	(0.0034)		(0.0061)	(0.0020)		(0.0025)
Size	0.0277***		0.0185***	0.0244***		0.0243***
	(0.0016)		(0.0029)	(0.0011)		(0.0015)
Inst. Holdings	0.001		-0.0634***	-0.0343***		-0.0495***
	(0.0071)		(0.0144)	(0.0032)		(0.0043)
Const	2.4510***	3.1186***	2.4627***	0.486	3.2840***	1.2158**
	(0.4268)	(0.5226)	(0.5719)	(0.4359)	(0.4784)	(0.5157)
No. of Obs.	11550	7512	4145	14097	12120	8365
pseudo R-sq	0.222	0.197	0.258	0.244	0.215	0.28

whether a firm pay dividend or not, in Panel A. For the binary payment variable, the robustness test borrows logit model following Fama and French (2001). As they test payment with three factors; profitability, growth rate, and size, the first robustness test is based on the three factors with index and normalized BM ratio, Z, and check whether the index has significant effect. The result of this estimation can be found in column (A). Column (B) shows the result of the logit which based on regression discontinuity model. Thus, payment decision replaces dividend payout ratio in regression with the same 0.2 bandwidth near the cut-off value of Z, which means only index and Z are controlled for dividend payment decision. Column (C) shows a robustness test with the extended regression discontinuity model which additionally controls three dividend factors and also limits the 0.2 range of Z near the cut-off value. Column (A) shows significant labeling effect for both of the control and the test sample, however, index coefficient may capture systematical difference across two groups, rather than the labeling itself. This is a reason why this paper applies regression discontinuity design which does not suffer from this problem. Column (B) and (C) shows significantly positive coefficient from only test sample.

When matching the original data with S&P/Barra index, eight percent of data was mismatched and dropped for the regression discontinuity test. However, the logit test does not require the same assumption as regression discontinuity regression. Thus Panel B uses original data with S&P/Barra index. No matter what kind of data sets are used and however it models, the results are quite consistent.

1.4.6 The Robustness Test Utilizing an additional Time Period

S&P/Barra index is generated until Barra has merged into MSCI in 2003. If the discontinuity is coming from systematical difference from book to market ratio, then discontinuity may exist with S&P/Barra measure even though labeling based on book to market ratio is not exist. Even though control sample periods can test this systematic difference, this section also consider the possibility that systematic differences which exist after control sample periods. The sample for the test is S&P firms after S&P/Barra stop generate growth/value index. I generate the index constituent data from April 2003 to June 2014, dividing the S&P 500 into two groups and rebalancing the groups every June and December, exactly as if the indices existed over this period.

Figure 1.3 illustrates a graphical analysis for dividend payout policy and dividend payment rate after test sample years. Each graph in the Figure 1.3 portrays a relationship that might exist between dividend payout policy and BM ratio. As it shows in control and test sample, each dot shows the average value of dividend payout ratio within bin-width 0.02. To show the detailed characteristics, the Z limits within 0.4 near the threshold, which is twice the bandwidth value based on Imbens and Kalyanaraman (2012) for the regression discontinuity design. 61.5% of samples are located within this bandwidth. The relationship between dividend payout ratio and BM ratio is upward sloping to the right. It is also observable from payment rate graph. It is hard to address that discontinuity exist at the cut-off. On the contrary, smooth continuous relationship is shown within this bandwidth.

Table 1.7 contains global estimation results of sharp regression discontinuity in dividend payout ratio after test sample periods. Left four columns presents standard global estimations of regression discontinuity with various polynomial regressions which are based on equation (1.1) and equation (1.2). Right four columns additionally control firms' other specifics such as boot to market, profitability, growth rate of assets and size. Equation (1.3) is applied for this test. Cubic and quartic polynomial models show significant value of discontinuity (-0.83, -1.392) in basic model. Cubic polynomial model in extended model shows significant discontinuity (1.5038), which is not consistent with basic model. Moreover, higher orders of polynomial models do

Table 1.7: Global Strategy after Test Sample Periods

This table contains global estimation of sharp regression discontinuity result for dividend payout ratio after S&P/Barra stop generating style index. Left four columns present standard global estimation of regression discontinuity and various polynomial regression which are based on equation (1.1) and equation (1.2). Right four columns additionally control firms' other specifics such as boot to market, profitability, growth rate of assets and size, because dividend payout can be affected by several firm characteristics. Equation (1.3) is applied for this test. All data are from the quarterly Compustat/CRSP. The sample period is 2003 through 2014. The estimations include year fixed effect, quarter fixed effect and industry fixed effect which is based on two digit SIC. The associated standard errors are reported in parentheses.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

	Basic				Extended			
	Cubic	Quartic	Quintic	Sextic	Cubic	Quartic	Quintic	Sextic
Index	-0.8300*	-1.3920**	-0.0378	0.8056	1.5038**	1.0457	1.2845	1.2267
	(0.4724)	(0.5668)	(0.6628)	(0.7568)	(0.6702)	(0.7951)	(0.9225)	(1.0484)
ROA					0.1165***	0.1154***	0.1153***	0.1150***
					(0.0126)	(0.0126)	(0.0126)	(0.0127)
Growth Rate					-0.0796***	-0.0796***	-0.0795***	-0.0798***
					(0.0086)	(0.0086)	(0.0086)	(0.0086)
Size					0.2696***	0.2689***	0.2688***	0.2691***
					(0.0076)	(0.0076)	(0.0076)	(0.0076)
Inst. Holdings					-0.1798***	-0.1800***	-0.1800***	-0.1802***
					(0.0114)	(0.0114)	(0.0114)	(0.0114)
No. of Obs.	311020	311020	311020	311020	158018	158018	158018	158018
R-Squared	0.102	0.103	0.103	0.103	0.139	0.139	0.139	0.139

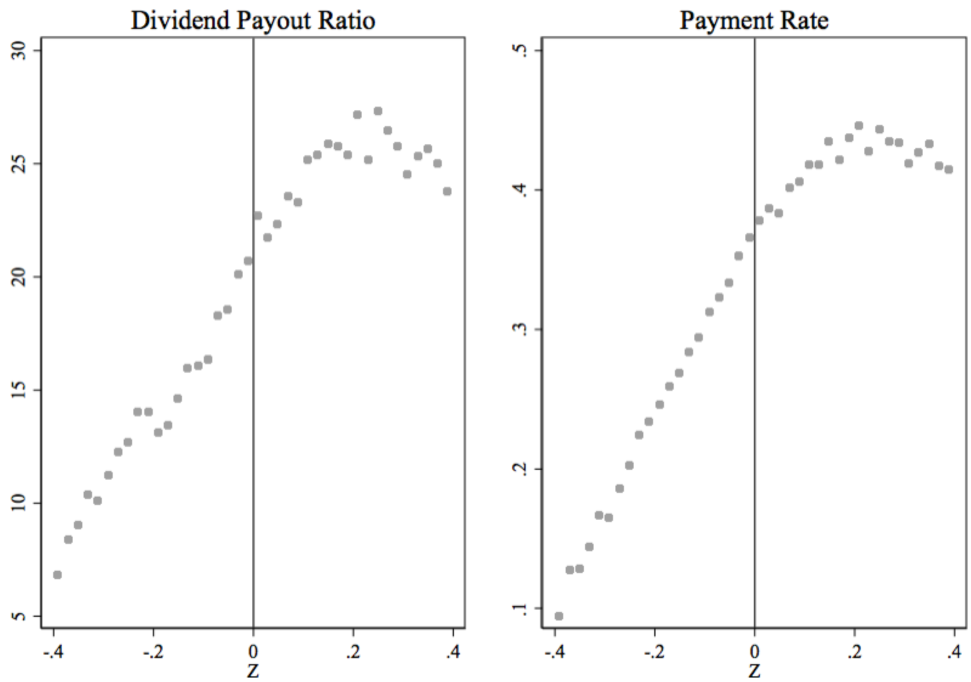

Figure 1.3: Dividend Payout Rate and Payment Rate after Test Sample Periods

not show discontinuity.

The local regression results for dividend payout ratio after S&P/Barra stop generating style index are presented in Table 1.8. Left three columns present standard local estimation of regression discontinuity with bandwidth 0.2 which are based on bandwidth selector procedure by Imbens and Kalyanaraman (2012). On the top of the bandwidth 0.2, ±0.05 of the bandwidth are applied for the robustness. Equation (1.4) is applied for this test. Right three columns additionally control firms' other specifics such as profitability, growth rate of assets and size, which are possible factors for dividend payout. Equation (1.5) is applied for this robustness test. No significant discontinuity is observed with basic test, and only wide bandwidth choice shows significant result in extended model.

In sum, systematic difference, which may exist based on index labeling, does not drive consistent discontinuity in dividend payout policy from both of global strategy and local strategy after S&P/Barra stop generating style index.

1.4.7 Share Repurchases and Other Corporate Policies

Dividend may not be the only policy which is affected by labeling. Other policies, which may be affected by investor sentiment, are also possible considerations for this labeling effect study such as repurchases, institutional ownership. Other corporate policies as investment, leverage, R&D, cash saving, and employment are tested in the section for the placebo effect. [3] If dividend discontinuity is happened by placebo

[3] In addition to checking other variables which might related with assignment variable, McCrary (2006) shows the density test is useful to check internal validity for manipulation incentive. This density is shown in the appendix section as a Figure A.1. However, it is hard to say that this density test provides meaningful result for this paper. That is because McCrary density test require monotonic incentive to manipulation, otherwise the test result say nothing about manipulation.

Table 1.8: Local Strategy after Test Sample Periods

This table contains linear regression result for dividend payout ratio within a range of cut-off value after S&P/Barra stop generating style index. Left three columns present standard local estimation of regression discontinuity with bandwidth 0.2 which are based on bandwidth selector procedure by Imbens and Kalyanaraman (2012). On the top of the bandwidth 0.2, ±0.05 of the bandwidth are applied for the robustness. Equation (1.4) is applied for this test. Right three columns additionally control firms' other specifics such as profitability, growth rate of assets and size, which are possible factors for dividend payout. Equation (1.5) is applied for this robustness test. The estimations include year fixed effect, quarter fixed effect and industry fixed effect which is based on two digit SIC. The sample period is 2003 through 2014. All data are from the quarterly Compustat/CRSP. The associated standard errors are reported in parentheses.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

	Basic			Extended		
Bandwidth	+0.05	0	-0.05	+0.05	0	-0.05
Index	0.0637	-0.2735	-0.0378	1.7917**	0.9682	0.7792
	(0.5591)	(0.6203)	(0.7114)	(0.7123)	(0.7791)	(0.8805)
Z				-1.6170	4.5793	-0.1008
				(3.8332)	(5.0464)	(7.4031)
ROA				0.3026***	0.3075***	0.2691***
				(0.0297)	(0.0337)	(0.0374)
Growth Rate				-0.1306***	-0.1363***	-0.1560***
				(0.0118)	(0.0134)	(0.0155)
Size				0.3456***	0.3582***	0.3822***
				(0.0099)	(0.0108)	(0.0121)
Inst. Holdings				-0.2950***	-0.3188***	-0.3558***
				(0.0149)	(0.0161)	(0.0181)
Const	2.6577	5.2278	2.1233	-11.4211***	-8.7121*	-8.9694*
	(3.5908)	(3.9910)	(4.4960)	(4.4309)	(4.7376)	(5.2329)
No. of Obs.	145462	120319	92415	84873	70883	54920
R-Squared	0.125	0.124	0.127	0.189	0.193	0.204

effect from labeling, that other corporate policies, which are not related with investor sentiment, are also affected by index labeling. Figure 1.6, Figure 1.7, and Table 1.9 show the graphical and empirical analysis for the discontinuity of these variables.

Repurchases

As Skinner (2008) tests substitution of repurchases and dividend policy, share repurchases are another method of transferring wealth to investors. However, share repurchases do not have conservatism as dividend policy does. Firms can choose how much to repurchases more flexibly than dividend payout. What kind of distribution methods a firm will take depends on the firm's own characteristics. Which types of firms use repurchases more for the earnings distribution can be shown in Figure 1.4 and Figure 1.5.

Figure 1.4 illustrates how dividend policies change in growth and value index firms through time. It shows that value firms use dividend payout flexibly, and growth firms do not use dividend flexibly as value firms. The top graph displays the equally weighted average of dividend payout rate for firms by labeling, while the second graph displays the same dividend payout ratio with only dividend payers. The vertical line divides the sample period into the control and test subsamples. In the first graph, the average growth firms have more stable dividend payout ratio than the average value firms, and this trend is more transparent in the second graph, which counts on only dividend payers. On the other side, in the dividend payment case, there is more significant downward change within growth index firms. On average, value firms manage more on their dividend payout rather than the payment decision whether they pay or not, while growth firms have relatively low and conservative dividend payout ratio and simply do not pay dividend. This can be seen in the bottom graph which shows how many firms are paying dividend in each year.

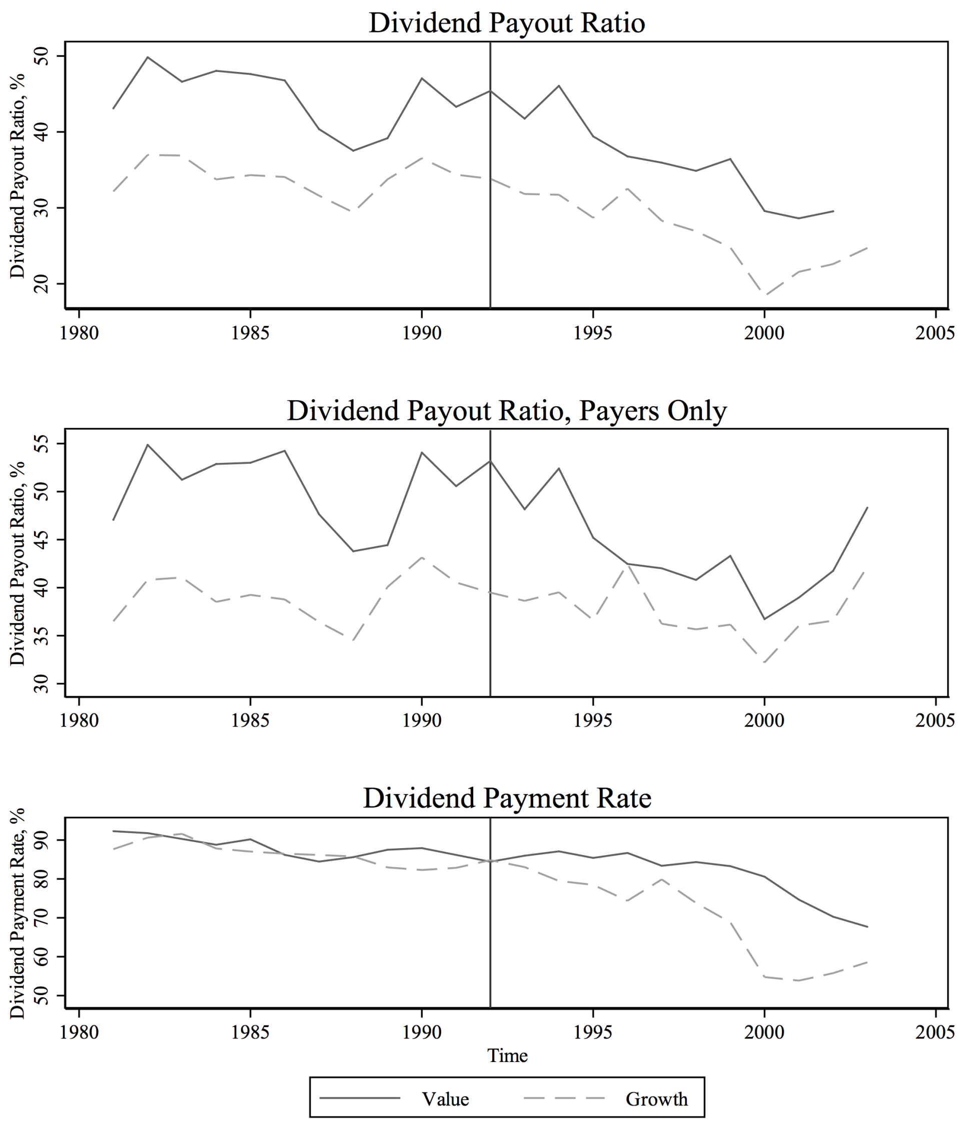

Figure 1.4: Time Trends in Dividend Policy

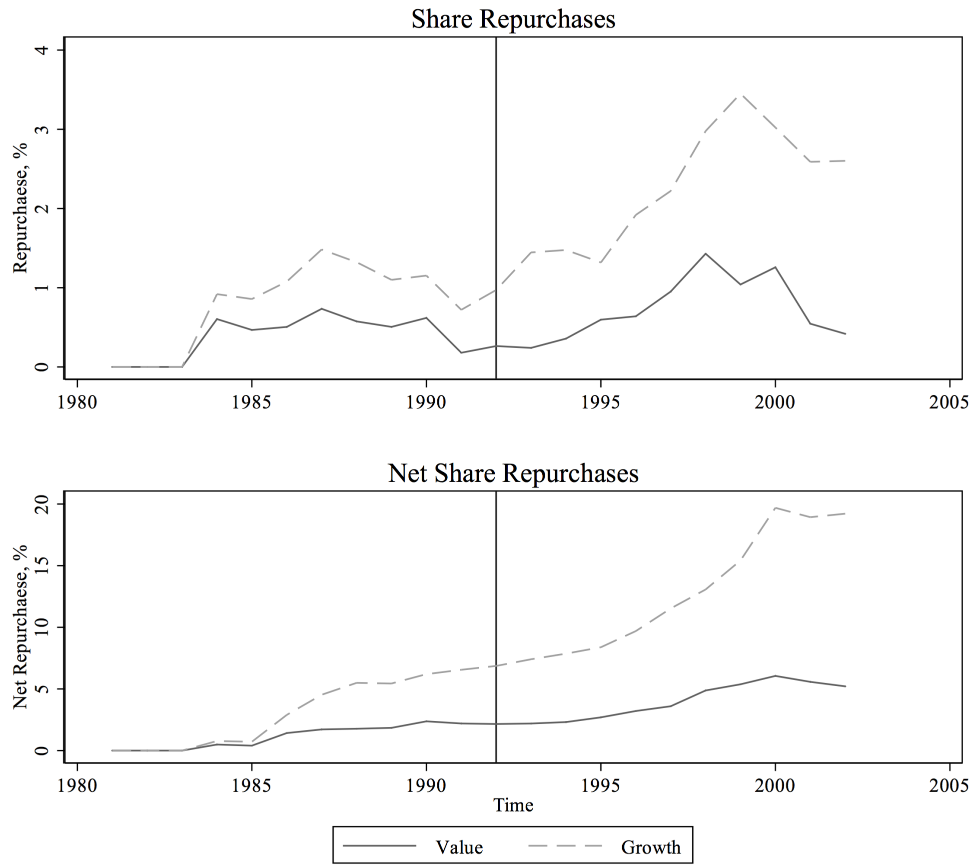

Figure 1.5: Time Trends in Share Repurchases

In terms of repurchases, growth firms use repurchases more often than average value firms, which can be shown in Figure 1.5. The first graph illustrates the equally weighted average of share repurchases for firms through time, and the second graph displays the equally weighted average of net share repurchase with considering treasury stock issuance for firms through time. Both graphs clearly show the higher rate of repurchases for growth firms while value firms present a relatively lower rate of repurchases. The comparison of these two figures provides graphical evidence for the substitution of dividend and repurchase methods, and which kinds of firms prefer to use share repurchase for their earnings distribution. Growth firms prefer share repurchases while value firms prefer dividend payout method.

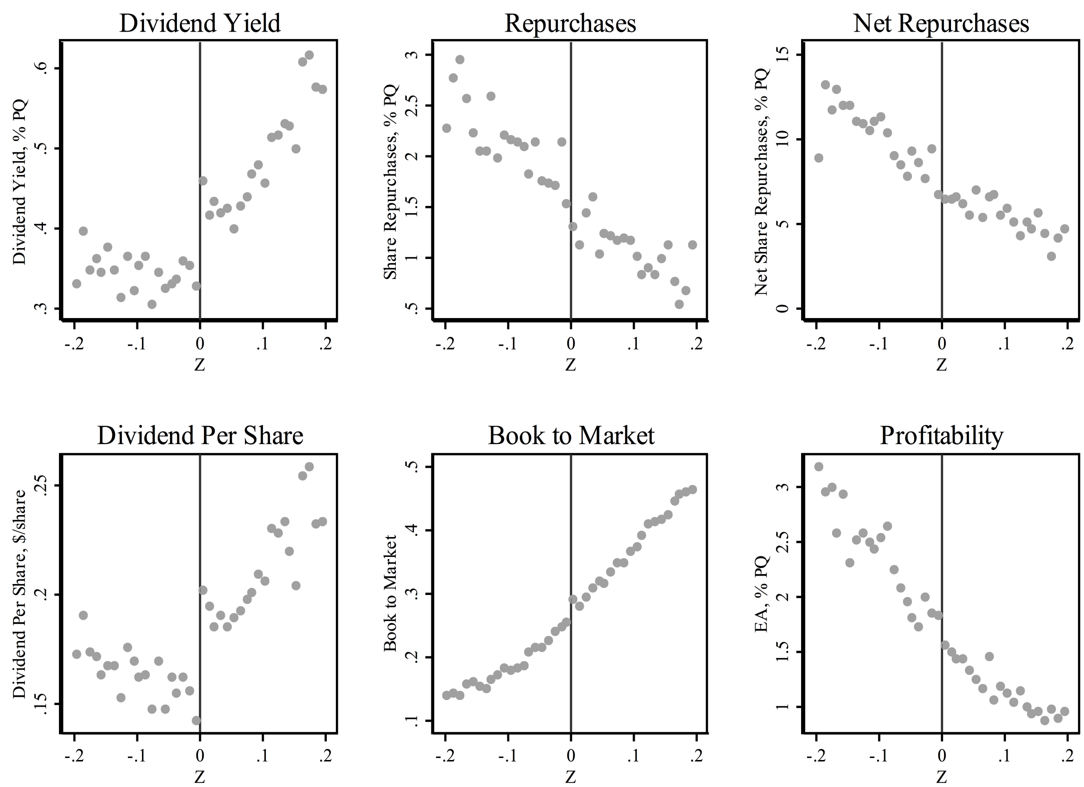

Figure 1.6: Dividend and Repurchase Policy

In Figure 1.6, regression discontinuity design is applied to repurchases based on distance to the threshold of book to market ratio, Z, and the graphical result is shown with other corporate policies. The first top left graph is for dividend yield, and the bottom left graph is for dividend per share as a robustness test of dividend payout policy. Share repurchases and net share repurchases do not provide visual discontinuity as clearly as other dividend policies. Repurchases may not depend on 'Investor sentiment' but rather on their actual earnings and re-investment level.

One of the fundamental value, which categorize firms into the two groups, is BM ratio. The bottom middle graph indicates that the BM ratio is continuous at the cut off. Profitability is one factor Fama and French(1997) use for the dividend policy test. It is hard to convince that the profitability has a discontinuity at the cut off from the graphical analysis from the bottom right graph in Figure 1.6.

Empirical test results are presented in Table 1.9. A jump in the graph is not enough to address meaningful discontinuity, but estimation results in Panel B and C provide some evidence for the possible discontinuity of repurchases. The discontinuity is not consistently shown as dividend policy and even signs are not consistent in net repurchases with various bandwidths, especially larger the bandwidth contains the bigger discontinuity in the local test. However, this may happen even if regression discontinuity is not valid, because the larger bandwidth may contains some systematical differences between growth and value categories. Thus it is hard to conclude that the repurchase policy shows the labeling effect with discontinuity.

Institutional Share Holdings

Institutional holdings are one of the factors which can affect earnings distribution policy.

Grinstein and Michaely (2005) and Grullon and Michaely (2002) show that institutional holdings do not affect firms' policy. While Grinstein and Michaely (2005) show one-way causality from dividend payout to institutional holdings, Crane, Michenaud, and Weston (2014) show how institutional holdings affect dividend payout policy. They use Russell index to show the effect of institutional ownership on payout policy with Russell 1000 and Russell 2000 indices, which are based on market capitalization. The largest 1000 firms are the Russell 1000 index while the next 2000 make up the Russell 2000, thus a total of 3000 firms are considered in the index. It is plausi-

Table 1.9: Regression Discontinuity Test for Corporate Policies

This table contains global and local estimation of sharp regression discontinuity result for corporate policies. Left three columns of each panel present global estimation of regression discontinuity with various polynomial regression methods which are based on equation (1.1) and equation (1.2). Right three columns of each panel present linear regression result for corporate policies within a range of cut-off value. These column presents standard local estimation of regression discontinuity with bandwidth which are based on bandwidth selector procedure by Imbens and Kalyanaraman (2012). Each panel has bandwidth value in the parenthesis with variable name. On the top of the bandwidth, ±0.05 of the bandwidth are applied for the robustness. Equation (1.4) is applied for this test. All data are from the quarterly Compustat/CRSP. The test sample period is 1992 through 2003. Dividend payout ratio increase in index dummy which support that value index affect demand of dividend by providing information to the investors. The estimations include year fixed effect, quarter fixed effect and industry fixed effect which is based on two digit SIC. The associated standard errors are reported in parentheses.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

	Global Test			Local Test		
	Quadratic	Cubic	Quartic	+0.05	0	-0.05
	Panel A. Dividend Yield (0.11)					
Index	0.0409***	0.0361***	0.0330*	0.0417***	0.0509***	0.0697***
	(0.0112)	(0.0137)	(0.0169)	(0.0125)	(0.0147)	(0.0205)
No. of Obs.	19901	19901	19901	9176	6428	3270
R-Squared	0.41	0.41	0.411	0.383	0.387	0.392
	Panel B. Repurchase (0.18)					
Index	-0.2204***	-0.0381	-0.2469**	-0.1954*	-0.1767	-0.0761
	(0.074)	(0.0898)	(0.1105)	(0.1000)	(0.1136)	(0.1357)
No. of Obs.	17666	17666	17666	10540	8772	6560
R-Squared	0.235	0.235	0.236	0.234	0.235	0.249
	Panel C. Net repurchase (0.15)					
Index	-0.2467	0.2226	-0.8836*	-0.9726**	-0.7282	-0.7347
	(0.2999)	(0.3670)	(0.4513)	(0.4483)	(0.5185)	(0.6374)
N	19766	19766	19766	9527	7510	5005
R-sq	0.267	0.267	0.268	0.293	0.288	0.282
	Panel D. Institutional Holdings (0.14)					
Index	0.9899***	0.8830***	0.6482	0.5685*	0.358	-0.2687
	(0.269)	(0.3278)	(0.4025)	(0.3337)	(0.3879)	(0.4918)
No. of Obs.	12596	12596	12596	6805	5277	3397
R-Squared	0.395	0.395	0.395	0.453	0.461	0.475
	Panel E. Investment (0.20)					
Index	-0.0997	-0.0004	-0.168	0.0079	0.0208	0.0203
	(0.0871)	(0.1065)	(0.131)	(0.0964)	(0.1058)	(0.1193)
No. of Obs.	19867	19867	19867	12670	10922	8668
R-Squared	0.467	0.468	0.468	0.496	0.499	0.508
	Panel F. R&D (0.18)					
Index	-0.0874**	-0.0012	-0.0613	-0.0345	-0.0477	-0.1016
	(0.0351)	(0.0429)	(0.0528)	(0.0464)	(0.0527)	(0.0619)
No. of Obs.	19867	19867	19867	12025	10038	7551
R-Squared	0.341	0.341	0.341	0.33	0.321	0.312

Table 1.9: Continued

	Global Test			Local Test		
	Quadratic	Cubic	Quartic	+0.05	0	-0.05
	Panel G. Leverage (0.17)					
Index	0.8693	0.4458	3.3769***	1.3646	2.3673**	1.6622
	(0.7309)	(0.8925)	(1.0987)	(0.9317)	(1.0520)	(1.2622)
No. of Obs.	19190	19190	19190	11159	9162	6675
R-Squared	0.243	0.243	0.244	0.209	0.196	0.197
	Panel H. Saving (0.21)					
Index	-0.2663**	-0.2692*	-0.2792	-0.1915	-0.2455	-0.2641
	(0.1173)	(0.1425)	(0.1753)	(0.1444)	(0.1538)	(0.1722)
No. of Obs.	17695	17695	17695	11427	9902	7988
R-Squared	0.016	0.016	0.016	0.018	0.02	0.021
	Panel I. Size percentile (0.21)					
Index	-0.6528	0.4131	1.6874	-0.5138	-0.3157	-0.0128
	(0.7248)	(0.8798)	(1.0821)	(0.8277)	(0.9119)	(1.0463)
N	17698	17698	17698	11430	9905	7990
R-sq	0.453	0.453	0.453	0.433	0.425	0.415
	Panel J. Log(size) (0.15)					
Index	-0.0076	0.0347	0.0914*	0.0275	0.0228	0.0611
	(0.0344)	(0.0417)	(0.0513)	(0.0428)	(0.0495)	(0.0615)
N	17666	17666	17666	9569	7548	5030
R-sq	0.52	0.521	0.521	0.511	0.509	0.518
	Panel K. Employee (0.19)					
Index	-14.4053***	-9.1344	-10.0502	-7.2189	-4.0819	-2.7331
	(4.5486)	(5.8777)	(7.1046)	(5.4873)	(6.4106)	(7.4849)
No. of Obs.	4320	4320	4320	2587	2177	1664
R-Squared	0.317	0.317	0.317	0.35	0.347	0.362
	Panel L. Employment growth (0.20)					
Index	-3.2736**	-2.8156	-2.5116	-1.6572	-1.7942	-2.5186
	(1.6467)	(2.1259)	(2.5689)	(1.8639)	(2.0860)	(2.5556)
No. of Obs.	4289	4289	4289	2632	2266	1772
R-Squared	0.06	0.061	0.061	0.071	0.076	0.071

ble that institutions pay more attention on leading firms in Russell 2000 than firms which barely stay in the Russell 1000. Since Russell 1000 covers over 90 percent of the total market capitalization of all listed U.S. stocks, institutions may look more on the leading firms from Russell 2000 when they need to invest on Russell 2000 firms. Moreover, Russell index methodology also shows more weight on higher market cap firms in each Russell 1000 and Russell 2000 indices. Since index weights more on large firms in each group, thus institutions, whether they are active or passive investor, take note of the leading firms of Russell 2000 than the tail of Russell 1000 as long as they care about Russell index. They use regression discontinuity design for index inclusion into Russell 1000 and Russell 2000 to use the index as an instrument variable of institutional holdings.

Different level of institutional holding is also expected from labeling within S&P/Barra index data, because institution is one of the biggest investors. If the labeling affects individual investors' sentiments, then it is also expected to have an effect on institutional holdings. However, empirical results does not support the difference with S&P 500 data. Even though institution holding does not show discontinuity, I control for it in the analysis of dividend payout policy.

Figure 1.6 contains the graphical result of institutional holdings with S&P 500 firms. It does not have visual jump near the cut-off. Moreover, the method on Russell 1000 and Russell 2000 in Conversely, Crane, Michenaud, and Weston (2014) include only 10 to 35 firms near the cut-off, which arise the issue of external validity. Figure 1.6 contains bandwidth of $\pm$ 0.2 near the cut-off, which based on Imbens and Kalyanaraman (2012), and this bandwidth contains about half of total S&P 500 observation. This alleviates the external validity issue. In spite of the significant effect of institutional holding on divided payout policy seen in Table 1.2 and 1.3, it is difficult to conceive that the jump of dividend payout policy is due to institutional holdings from Figure 1.6 and Table 1.9

Corporate Conditions and Policies

Figure 1.7 presents other corporate policies: capital investment, leverage, R&D, cash saving, and number of employees with a fundamental characteristic, firm size. None of these policies have clear visible discontinuity based on BM ratio.

Basic assumption of discontinuity design is no changes of firms' fundamental conditions. One of the basic fundamental characteristics of firm which has significant

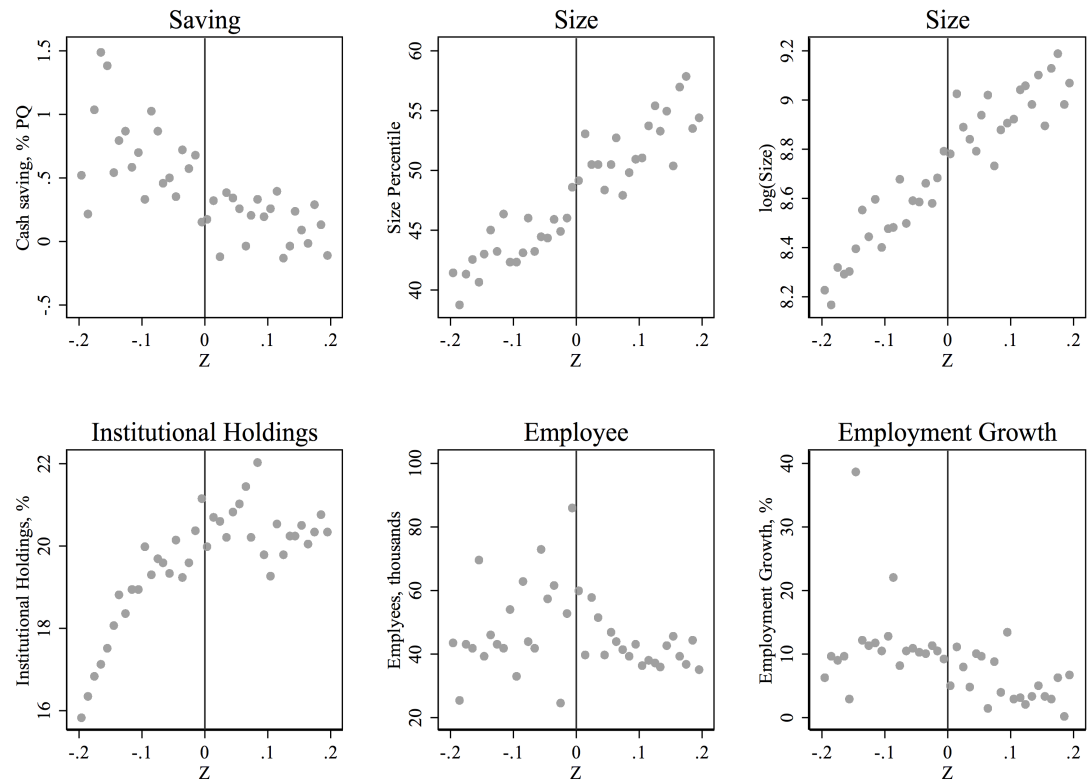

Figure 1.7: Corporate Condition and Policies

effect on corporate policies is firm size. As expected, firm size does not show discontinuity near the cut-off threshold with two different measures, which are size percentile and log transform.

Leverage and investment are connected in the sense of external finance. If labeling affects investors through the channels of external finance, leverage can be affected by index. In the same breath, external finance can affect the size of investment. This channel can also affect R&D in the same way. If this external finance give more financial room for firms with specific labeling, and cash saving could be changed as dividend policy changed. However, this scenario is strongly kin to the channel of external finance. From Figure 1.6, Figure 1.7, and Table 1.9, it is hard to conclude that the external finance channel is connected with labeling effect.

1.5 Conclusion

In this paper, by using regression discontinuity design and panel data analysis, I show that the labeling of firms as value or growth have important implications for firms' dividend payout policy. By Investigating the S&P/Barra index, which divides S&P 500 stocks into "growth" and "value" categories based on their book to market ratios, the empirical results provide a significant jump from dividend payout policy with the change of labeling. Indices help investors trade their assets without scrutinizing individual stocks. On the investor's side, "style investing" presents that investors behave with index in the stock market. On the firm's side, even though the labeling does not affect corporate condition, labeling can affect firms' dividend policy by changing investors demand to dividend. Dividend does not only depend on firms' corporate condition, but also investor sentiment.

I also provide that the other corporate policies/conditions such as investment, leverage, R&D, saving, and institutional share holdings. There is no discontinuity in other corporate conditions, besides the labeling effect itself, to explain the discontinuity of dividend policy.

Chapter 2

INVESTMENT AND DURATION OF CASH FLOW

2.1 Introduction

Investment is one of the most important activities that reflects the condition and characteristics of firms. Firms must choose both *how much to invest* and *how to finance* their investment as long as they are in the market. Firms also consider how quickly they can make a return on investment because not entire profit is generated immediately after a factory is built. As a matter of timing discrepancy between investment and project return, the idea built on investment for the timing argument is employed in the time-to-build model which is presented by Kydland and Prescott (1982). The fundamental assumption of time-to-build is that time is required to build a new project. According to the time-to-build model, omitted variables for empirical work include lagged investment and growth rate of capital stock (Tsoukalas, 2011). While the time-to-build model considers the timing issue in terms of investment, this paper examine the timing issue with regards to cash flow which a firm monitors most closely throughout the operation.

I provide a novel and intuitive explanation for investment decision by investigating firms' heterogeneity in terms of cash flow duration. Duration of cash flow is one of the most clear characteristics of a firm which is engaged in persistency of cash flow. Project duration is getting shorter and shorter over time. Thus understanding the dynamics of the duration is important and interesting to decipher the economics activities while ignoring these dynamics might lead to misspecification issues in testing the theoretical models, such as investment policy and cash flow sensitivity to investment model, which this paper deals with. Longer duration of cash flow generates higher cash flow from assets in place in the next period. In the light of this consideration, it is highly probable that the duration of cash flow has an effect on investment behavior. Firms with short cash flow duration, which expect relatively less persistency of cash flow from assets in place, might invest less since they can face solvency issue in the next period if they invest too much in current period. On the other hand, asset with short-duration project will bring immediate high return from investment; while long-duration project will make longer duration of cash flow even though it produce low return at first. Since firm's asset is the main source of cash flow, cash flow duration can be read off by directly looking into the asset. The strong correlation between cash flow and total asset supports this idea which allow to assume that the duration of cash flow embeds in a firm's asset.

I simply assume that firm's cash flow duration is also given for the new project. A firm need to decide what kind of project to undertake and how much to invest into the project. In other words, a firm decides not only how much to invest, but also what kind of project will be invested. A firm has a strategy for the investment allocation decision from various projects. Cash flow duration could be determined endogenously with investment. Here, I assume that the firm already has an investment strategy which is reflected into project duration, and this strategy is hard to be changed within short time window. Even though the duration could be changed with exogenous shock, it affect not only current cash flow but also cash flow of the future, at least the adjacent period. Therefore, it is a possible scenario that firm does not have different duration of cash flow between new investment and asset in place in a short period.

To describe duration effect, I investigate all the channel that the duration of cash flow might affect, which are expected future cash flow from assets in place, timing discrepancy between investment and project return, and cost of external finance.

First channel that duration of cash flow have an effect on is the level of cash flow that generated from assets in place. The project return decreases at a certain rate which is high when the duration is short. Cash flow generated from assets in place with relatively shorter duration is not as persistent as one with longer duration. As Goswami (2000) describes with asset maturity, a shorter duration of cash flow generates lower cash flows in the second period. Cash flow from assets in place plays an important role in investment policy, unless cash flow from new projects is substantial enough to maintain business.

Second channel that duration of cash flow affects on is cash flow that generated from new project. I assume that net present value of investment is the same, regardless of the duration, as long as amount of investment is the same. Thus shorter duration generate higher cash flow immediately after the investment. According to the time-to-build model, investment does not have any influence on production before building is completed. The longer periods of time-to-build necessitate longer periods of waiting to taste the return from investment. A similar interpretation can be applied to the duration of cash flow. Firms with shorter duration can achieve a return shortly after the investment, while firms with longer duration have to wait more to reach the break even point.

The last channel that duration of cash flow affects is cost of external finance. External finance is the factor that attracts researchers' attention for investment and cash holding policy. When duration of cash flow is short, firms have a shorter payback period for new project, and therefore they can raise external finance at lower cost. I assume that marginal cost of external finance is increasing in the amount of external finance, and investment is decreasing return to scale, while interest rate for saving is constant. In this model, firms invest in a capital asset, and raise external finance until the marginal benefit of capital equals the marginal cost of external finance. The firm will raise external funds until the marginal cost of external finance equals the marginal return on saving, which I assume to be higher than the discount rate in the model. If no financial friction occurs, reduction of external finance cost increases the amount of saving and the amount of external finance altogether. The fact that firms tend to simultaneously raise external finance and accumulate liquid assets is already empirically discovered. [1] Those three channels offset each other in the aspects of investment. Shorter duration of cash flow affects cost of external and project returns during an adjacent period in such a way as to increase investment, while it decreases cash flow from assets in place.

In this article, I empirically examine these reciprocal effects of cash flow duration on investment; Decreasing next period cash flow from existing asset versus increasing return from new investment and easiness of external finance. Using a large sample of firms between 1976 and 2011, I find a positive correlation between cash flow duration and investment behavior. Positive effect on investment supports that the cash flow duration actually has more effect on expected future cash flow from assets in place.

The model also allows me to examine firms' investment policy with market imperfection regarding the aspect of financial friction. Extensive literature examines the influence of market imperfection on corporate investment by investigating empirical data. Since the seminal study of Fazzari, Hubbard, and Peterson (1988), investment response to cash flow has been interpreted as a measure of financial friction. [2] Although several scholars posit that cash flow effect disappears, cash flow is still one

[1] Eisfeldt and Muir (2013) describe a positive correlation between cash and external financing from aggregated level and firm level data, and analyze this fact in a model with increasing marginal cost of external finance.

[2] Whether investment to cash flow sensitivity works as a measure of financial friction has been debated by a number of papers; such as measurement error in q, Poterba(1988), non-monotonicity hypothesis, Kaplan and Zingales (1997), Cleary (1999), growth effect, Alti (2003), Bushman et al (2012), inverse relationship of investment-cash flow sensitivity in financial constraints under some measures, Kaplan and Zingales (1997), Cleary (1999), and Hadlock and Pierce (2010)

financial component which a firm directly faces, and the cash flow effect is still arguable. [3] this paper shows that duration of cash flow has a positive effect on optimal investment, then one can expect financial friction to amplify the positive effect of the duration on investment. Quantity financial friction, known as credit rationing, is imposed in the model to present a market imperfection. Quality constraint embeds in the cost of external finance along with the duration of cash flow, but not as market imperfection in my model. To explore this idea, I analyze duration of cash flow as a determinant of investment decisions, along with the investment model followed by Eisfeldt and Muir (2013). I use both theoretical and empirical approaches to investigate how the heterogeneity of cash flow duration influences investment policy. Duration of cash flow shows a positive effect on optimal level of investment from an analysis through the model.

I estimate cash flow duration sensitivity of investment for various financial friction subsamples, grouped by the likelihood that firms have constrained access to external finance. For the sub-sampling, I use five alternative approaches suggested by the literature to partition the sample into unconstrained and constrained subsamples; payout policy, age, bond ratings, KZ index measure which is derived from results in Kaplan and Zingales (1997), and asset size. I find that investment to duration of cash flow for constrained subgroup is significantly different from unconstrained group which is consistent with theoretical support. However investment to cash flow sensitivity does not have robust empirical results.

The duration measure might enrich existing literature on cash holding. Han and Qiu (2007) show cash holding behavior due to precautionary saving motive, and only a constrained firm has incentive to hold cash for precautionary saving in their analysis

[3] While Erickson and Whited (2000) show that cash flow adds no significant predictive power to the investment equation, Gome (2001) provides a significance of cash flow effects as an important determinant of investment.

with cash flow volatility. While they use the cash flow volatility to investigate their analysis, this paper can provide the source of cash flow volatility which can be found in the firm itself with asset structure with duration of cash flow. Figure 2.1 illustrate the overall relationship between depreciation rate of cash flow and cash flow volatility.

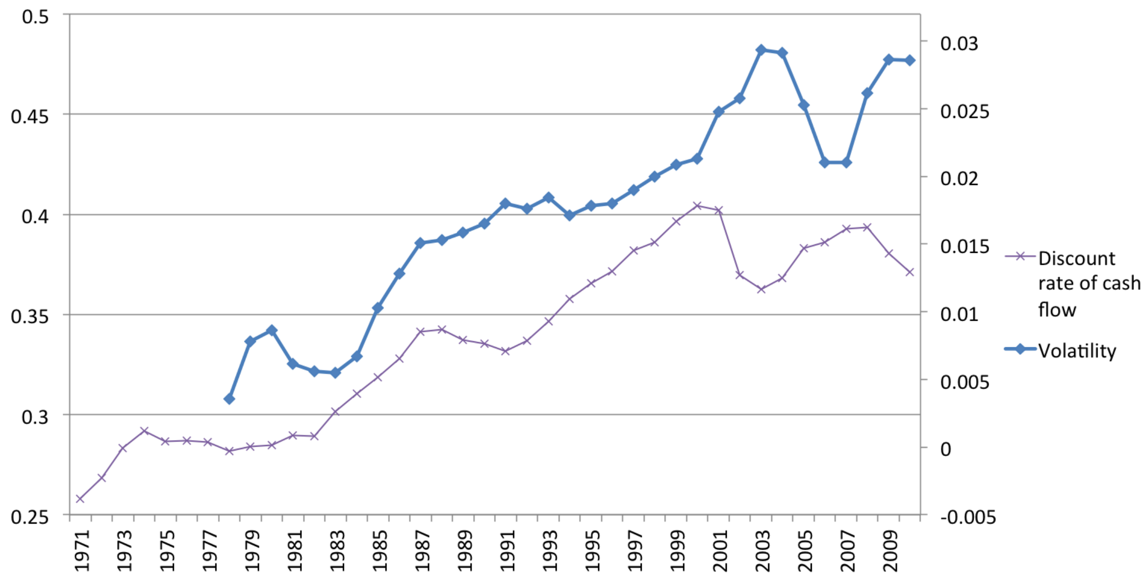

Figure 2.1: The stylized facts provides relationship between cash flow duration and cash flow volatility. Volatility measure use four years of quarterly 16 consecutive data of cash flow stream from the annual COMPUSTAT.

The rest of the paper is organized as follows: In section 2, I describe the model and discuss the solution, while in section 3, results from empirical test for assumption and model prediction are presented. Lastly, conclusion can be found at the final section.

2.2 Model

I develop a model of investment, external finance, and savings to analyze the relationship between the duration of cash flow, the financial friction, the amount of external finance raised, capital investment, and saving. The main purpose is showing the correlation between duration of cash flow and investment, and how the correlation is affected by financial friction.

2.2.1 Duration of Cash Flow

Duration of cash flow means the length of the cash flow stream generated by investment. I simply assume cash flow diminishes by δ portion at each period. Technically, the duration of cash flow with a depreciation rate is infinite, however it is proper measure to see how persistent their cash flow is from investment. For simplicity, I assume that cash flow duration does not affect the discounted present value of cash flow from an investment. Thus, discounted values of cash flow are equal per unit of investment, regardless of cash flow duration. For example, if firm A has a shorter duration of cash flow than firm B, then the cash flow depreciation rate of firm A will be higher than that of firm B, $\delta_A > \delta_B$. Cash flow from new investment at date one is $CF_{1,A}$ and $CF_{1,B}$, respectively. I assume that discounted present value of cash flow, $F(I)$, from new investment with discount rate r is the same, no matter what the depreciation rate is. By applying the perpetuity formula, the discounted present value of cash flow can be shown as $\frac{CF_{1,A}}{r+\delta_A} = F(I) = \frac{CF_{1,B}}{r+\delta_B}$. Naturally, the higher the δ, the higher the cash flow at date one, CF_1. Thus shorter duration of cash flow brings higher cash flow during at beginning stages of project.

Duration of cash flow affects a firm's condition via several channels. The first is cash flow from assets in place. Since current cash flow is also depreciated by δ portion, when the duration is short, cash flow from assets in place decreases rapidly as time goes on due to the high depreciation rate. δ exposes a negative effect on investment policy through this channel, while next two channels show the opposite.

The second channel represents that shorter duration of cash flow brings higher cash flow from a new investment at its inception than a longer one brings. I initially assume that the discounted present value of cash flow from a new investment is the same regardless of the duration. Certainly, cash flow from date one is different. From the example of discounted present value of cash flow formula above, $CF_{1,A} > CF_{1,B}$ at date one.

In the third channel, duration affects the cost of external finance. This cost depends on how much external finance is issued and how expensive it is to issue external finance. It is cheaper to issue external finance if the duration of cash flow is shorter, because shorter duration can ensure more timely payback. If the external financing interest rate is higher than the discount rate, $r_e > r$, then a firm's present values of total cash flow using external finance and internal finance are $\frac{CF_1}{r_e + \delta}$ and $\frac{CF_1}{r + \delta}$, respectively. Thus cost of external finance is calculated as the difference between these two values, which is $CF_1 \frac{r_e - r}{(r + \delta)(r_e + \delta)} = F(I) \frac{r_e - r}{r_e + \delta}$. Therefore, the cost of external finance is decreasing in δ.

2.2.2 Optimal Policy

The main goal of this model is to show how the duration of cash flow and financial friction affect investment and cash saving decisions. The model features a single levered firm with external finance, investment and saving decisions with considering duration of cash flow. In this model, a firm chooses how much to invest, I, and save, S, [4] to maximize the present value of total cash flow.

Cash flow is generated by two sources. The first source is assets in place, which generates a positive cash flow $X_t > 0$ in each period t, and the cash flow is depreciated by δ. Thus $X_t = X_{t-1}(1 - \delta)$ where δ is the depreciation rate of cash flow. The second source of cash flow is new investment, I, which generates deterministic total

[4] Eisfeldt and Muir(2013) discuss that cash and cash equivalent as liquid assets produce an interest rate which is greater than the discount rate, by considering that liquid assets may provide a hedge for investment opportunities at date one. With this setup, it is also possible to explain the positive correlation between external finance and cash saving.

discounted cash flow $F(I)$, where $F(I)$ is a standard increasing concave function with $F'(I) > 0$ and $F''(I) < 0$. Cash flow from assets in place is available from date zero, while cash flow from investment is generated from the date one after investment activity at date zero. If the total amount of investment and saving exceeds the initial cash flow, then external financing can act as an alternate source.

External finance $E = X_0 - I - S$ is defined as a shortage of investment and saving from internal funds. External financing is available only at date zero for a new investment decision. When a firm raises external finance, it absorbs the cost of external finance, $\eta(\delta)\frac{1}{2}E^2$, where $\eta(\delta)$ is level of external financing cost. $\eta(\delta)$ captures the first channel that the duration affects. Cost of external finance is decreasing in δ, so that $\eta(\delta)$ is assumed to be decreasing in δ. In the case of a perfect market, a firm can raise its external finance as much as desired by paying the external finance costs. However, an imperfect market can restrict this system.

Market friction, which reflects market imperfection, prevents a firm from accessing external financing in the model. This constraint can be written as following:

$$E = X_0 - I - S \geq -qI$$

A firm is only able to raise external finance up to its capacity for external finance, qI. This capacity is determined by the level of investment and the degree of capital market imperfection. The parameter $q \in (0,1)$ is a simple way of measuring the degree of capital market imperfection in this environment. [5] This external finance, along with cash flow from assets in place, can be invested into a project or saved as a liquid asset.

The firm must make a payment for operating costs, O, at date one which is known at data zero. If the firm can pay the operating costs at date one, then the firm can

[5] Myers and Rajan (1998), Almeida and Campello(2001) parameterize this q as a function of factors such as the liquidity/tangibility of the firm's assets and the legal environment that dictates the relations between borrowers and creditors.

earn all the cash flow generated afterwards. However, failure to pay the operating costs in full at date one results in default. The firm has three sources for paying the operating costs; cash flow from new investment, CF_1, cash flow from assets in place, $X_0(1-\delta)$, and liquid assets, $(r_l+1)S$, which come from saving at date zero where r_l is return on liquidity asset. Thus total inflow at date one is $CF_1+X_0(1-\delta)+(r_l+1)S$. Depending on the duration, this could be insufficient to pay the cost even if a new investment is highly productive. Moreover, external financing is only available at date zero, hence the operating costs payment must be made out of the firm's internal funds at date one. This gives rise to underinvestment, enabling the firm to avoid default.

The timeline of the three periods model is as follows:

At date 0, a firm chooses how much to invest, I, or save, S, with given cash flow from assets in place, X_0. If given cash flow is not enough, then external finance, E, can be raised with cost $\eta(\delta)\frac{1}{2}E^2$.

At date 1, the firm faces fixed operating costs, O, and total cash inflow from new investment, assets in place and saving. The balance must be positive, in order for the firm to survive and exploit the remaining cash flow, otherwise the firm defaults and loses future cash flow. The discounted total cash flow until date one is $E-\eta(\delta)\frac{1}{2}E^2+\frac{1}{r+1}\{CF_1+X_1+S(r_l+1)-O\}$, and it can be rewritten as follows:

$$E-\eta(\delta)\frac{1}{2}E^2+\frac{1}{r+1}\{F(I)(r+\delta)+X_0(1-\delta)+S(r_l+1)-O\}$$ [6]

At date 2, the firm expects to take all the remain value of cash flow. Expected cash flow come from two sources; $\frac{CF_2}{r+\delta}$ from new investment and $\frac{X_2}{r+\delta}$ from assets in place. These expected total cash flow sources from date two can be rewritten as follows:

$$\frac{F(I)(1-\delta)}{r+1}+\frac{X_0(1-\delta)^2}{(r+1)(r+\delta)}$$

[6]Since $\frac{CF_1}{r+\delta}=F(I)$, CF_1 can be replaced by $F(I)(r+\delta)$.

The firm maximizes the discounted present value of the total cash flow, which is the sum of the above two amounts of cash flow. For simplicity, discount rate is normalized to zero. Figure 2.2 illustrates the model's timeline.

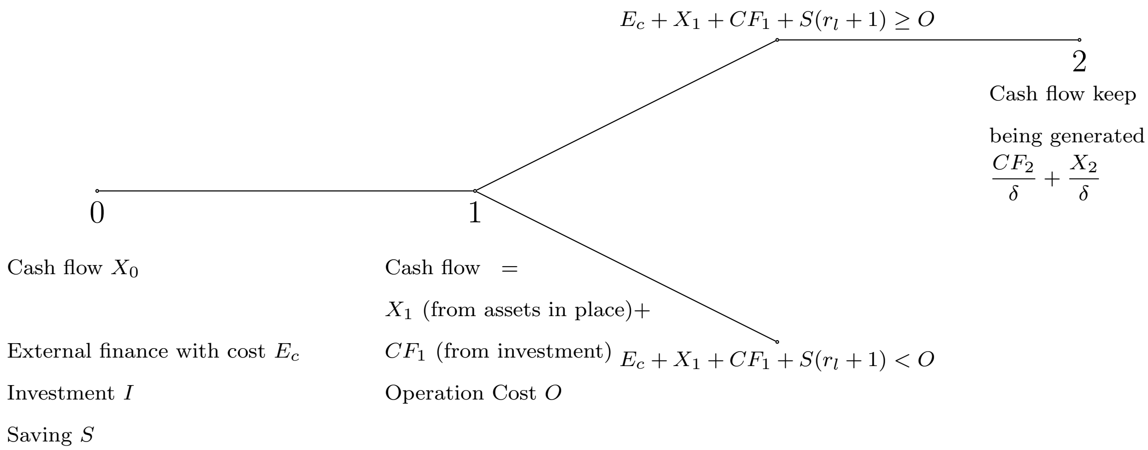

Figure 2.2: The Timeline of the Model

The firm's objective is to maximize the total cash flow subject to various financial constraints. This problem can be written as

$$\underset{\{I,S\}}{\text{Max}} \left\{ E - \eta(\delta)\frac{1}{2}E^2 + S(r_l + 1) - O + F(I) + X_0\frac{1-\delta}{\delta} \right\}$$

$$\text{st. } E - \eta(\delta)\frac{1}{2}E^2 + F(I)\delta + X_0(1-\delta) + S(r_l + 1) - O \geq 0$$

$$E = X_0 - I - S \geq -qI$$

The first budget constraint ensures firms will not default at date one with operation cost payment. The second constraint restricts the size of external finance, which is motivated from a credit rationing approach. [7]

[7] Almeida and Campello(2001) develop a model with quantity constraint on the amount of external funds that firms can raise at a given cost.

First-Best Solution

The firm's optimal investment depends on whether or not the borrowing conditions and budget conditions at date one are binding. If borrowing conditions and budget conditions are not binding, the first order condition with respect to investment, I, for interior solution is:

$$1 - \eta(\delta)(X_0 - I - S) = F'(I)$$

The first order condition with respect to saving, S, is:

$$1 - \eta(\delta)(X_0 - I - S) = r_l + 1$$

Intuitively, the first order conditions equate the marginal product of capital, the return on saving, and the marginal cost of raising external finance. Thus the amount of investment depends on the marginal product of capital and return on saving, and it is independent of the cost of external finance, η, and diminution of cash flow, δ.

$$F'(I^{FB}) = r_l + 1$$

On the contrary, the amount of external finance is decreasing in η and increasing in δ.

Second-Best Solution

Even though the financial market has no friction, first-best solution is not achieved when the budget condition is binding. The first order condition with respect to investment, I, is:

$$-1 + \eta(\delta)(X_0 - I - S) + F'(I) + \lambda\{-1 + \eta(\delta)(X_0 - I - S) + \delta F'(I)\} = 0 \quad (2.1)$$

The first order condition with respect to saving, S, is:

$$\eta(\delta)(X_0 - I - S) + r_l + \lambda\{\eta(\delta)(X_0 - I - S) + r_l\} = 0 \quad (2.2)$$

$\lambda > 0$ and $-\eta(\delta)(X_0 - I - S) = r_l$ are derived from equation (2.2). Thus first-best level of external finance is rendered achievable, while $I^* < I^{FB}$. The first part of equation (2.1) is negative, since investment cannot achieve first-best level. The second part is positive. If the firm is looking for optimal level of investment with binding condition, optimal level of investment, I^*, is located under these negative/positive conditions. These conditions are represented graphically in Figure 2.3.

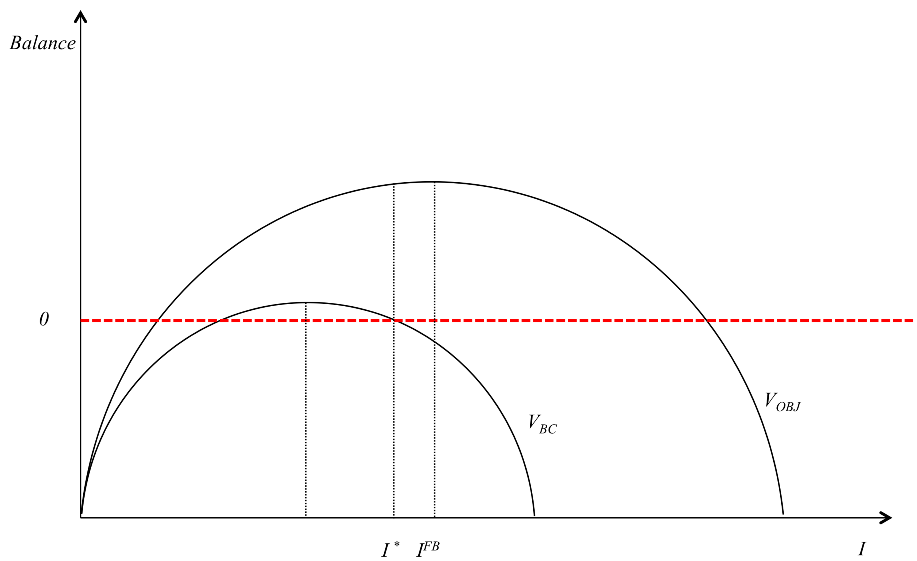

Figure 2.3: A slope of V_{OBJ} ($=FOC_{OBJ}$) is the first part and a slope of V_{BC} ($=FOC_{BC}$) is the second part of equation (2.1). If the firm is looking for an optimal level of investment with binding condition, optimal level of investment, I^*, is located under $FOC_{OBJ} > 0$ and $FOC_{BC} < 0$ condition.

Financial Constraint - Credit Rationing

Now consider market imperfection with financial friction. When the borrowing condition is binding due to financial friction, saving is determined by the respective amounts of investment and external finance, which in turn depend on size of investment, $E = X_0 - I - S = -qI$. firm's objective can be rewritten as follows:

$$\underset{\{I\}}{\text{Max}} \left\{ -qI - \eta(\delta)\frac{1}{2}(-qI)^2 + \{-O + (r_l+1)(X_0 + qI - I)\} + F(I) + X_0\frac{1-\delta}{\delta} \right\}$$
$$\text{st.} \; -qI - \eta(\delta)\frac{1}{2}(-qI)^2 + \{-O + (r_l+1)(X_0 + qI - I) + F(I)\delta + X_0(1-\delta)\} \geq 0$$

2.2.3 Implication

Optimal Investment with Cash Flow Duration

Proposition 1 *If* $X_0 > -\frac{1}{2}\eta'(\delta)E^2 + F(I)$*, then*

The equilibrium investment I^* *is decreasing in depreciation rate of cash flow,* δ

There are three major components presented by proposition 1. The external finance and the cash flow from new investment increase with higher δ, whereas the cash flow from assets in place shrinks. That is because the reduction of the external finance cost with the higher δ allows for the higher amount of external finance. Furthermore, higher δ increases cash flow from new investment, while cash flow from assets in place is dropped with δ. Thus, proposition 1 mainly illustrates that when the depreciated cash flow from assets in place is higher than those increment from the other sources, the equilibrium level of investment decreases in δ, and vice versa.

The binding budget condition implies the following comparative statistics:

$$\frac{\partial I}{\partial X_0} = \frac{2 - \eta(\delta)E - \delta}{1 - \eta(\delta)E - F'(I)\delta} > 0 \tag{2.3}$$

$$\frac{\partial I}{\partial \delta} = \frac{-\frac{1}{2}\eta'(\delta)E^2 + F(I) - X_0}{1 - \eta(\delta)E - F'(I)\delta} \tag{2.4}$$

The binding budget condition with financial constraint implies the following comparative statistics:

$$\frac{\partial I}{\partial X_0} = \frac{2 - \delta + r_l}{q + \eta(\delta)q^2 I - F'(I)\delta + (r_l+1)(1-q)} > 0 \tag{2.5}$$

$$\frac{\partial I}{\partial \delta} = \frac{-\frac{1}{2}\eta'(\delta)(qI)^2 + F(I) - X_0}{q + \eta(\delta)q^2 I - F'(I)\delta + (r_l + 1)(1 - q)} \tag{2.6}$$

Both the equation (2.3) and (2.5) have positive signs, which means that the amount of investment increases in initial cash flow because δ is not greater than 1. However, the signs of equations (2.4) and (2.6) vary with conditions. The numerator of equation (2.4) and (2.6) shows how δ change affects the balance at date one. The first part of the numerator is change of external financing cost with δ (positive). The second part is change of cash flow from new investment at date one (positive), and the third one is change of cash flow from assets in place (negative). While higher δ can bring more external finance and higher cash flow from new investment, it can also bring lower cash flow from assets in place. Empirical test may show which effect dominate in real world. The empirical result shows negative sign of δ sensitivity for investment, which indicates the existing cash flow change dominating other factors. I will show the empirical characteristics later in section 2.3.

Exogenous variation in investment with cash flow duration

Proposition 2 *When* $2\eta(\delta)qI > r_l$,
If $\frac{\partial I}{\partial X_0}$ *is decreasing in q,* $\frac{\partial I}{\partial \delta}$ *is increasing in q*

Optimal investment is restricted by depreciation rate of cash flow. If effective financial friction exists in the market, then negative effect on investment from δ should be lessen by removing financial friction and be amplified with more restriction. When the investment to cash flow sensitivity is increasing in financial friction, the investment to duration of cash flow is decreasing in financial friction. Let the denumerator of equation (2.5) to be $D > 0$; then $\frac{\partial D}{\partial q} = 2\eta(\delta)qI - r_l$. From equation (2.5), the investment to cash flow sensitivity for different level of financial friction can be measured by

$$\frac{\partial^2 I}{\partial X_0 \partial q} = \frac{-(2-\delta+r_l)(2\eta(\delta)qI - r_l)}{D^2} \tag{2.7}$$

From equation (2.6), the investment to duration of cash flow sensitivity for different level of financial friction can be measured by

$$\frac{\partial^2 I}{\partial \delta \partial q} = \frac{-\eta'(\delta)qI^2D - (-\frac{1}{2}\eta'(\delta)(qI)^2 + F(I) - X_0)(2\eta(\delta)qI - r_l)}{D^2} \tag{2.8}$$

The investment to cash flow sensitivity decreases with the capacity of external finance, $\frac{\partial^2 I}{\partial X_0 \partial q} < 0$, only if $2\eta(\delta)qI > r_l$. Thus it can be interpreted as the investment to cash flow sensitivity increase with high financial friction. The investment to δ sensitivity increase with the capacity of external finance if $2\eta(\delta)qI > r_l$. Since the investment to δ sensitivity is negative, the high financial friction emphasize the sensitivity. Contrary to$\frac{\partial^2 I}{\partial X_0 \partial q}$, it is possible that $\frac{\partial^2 I}{\partial \delta \partial q}$ consistently has a positive sign with first positive part of numerator, even if $2\eta(\delta)qI > r_l$ condition is not satisfied. In sum, the investment to duration of cash flow sensitivity has more tolerance.

2.3 Empirical Investigation

2.3.1 Empirical Expectation

The first empirical prediction is that the greater the firm's depreciation rate of cash flow, the larger the external finance. This support the characteristics of external finance cost function $\eta(\delta)$ which is assumed to be decreasing in δ. Following Almeida and Capello(2010), firms' cash flow, size, investment opportunities, preexisting stock of internal funding/wealth and their financial structure are controlled.

Second, the empirical test is required to verify the effect of δ on investment. According to the proposition 1, δ has negative effect on investment in the case that the cash flow channel dominate the other channels, and vice versa. The condition of the proposition 1 is comparison between value of cash flow and the marginal value from both of external financing cost and production. However, on the basis of the difference between total value and marginal values, one can expects negative effect from the proposition and from empirical test as well.

Third, the greater negative effect of δ on investment is expected from financially constrained firms. According to the proposition 2, it is possible that cash flow sensitivity to investment is not affected by financial constraints, but δ sensitivity have more tolerance to capture financial constraints.

2.3.2 Data

I construct the sample from surviving and non-surviving U.S. firms in the Compustat database at any time over 1976-2011. Firms are classified into industries using three-digit Standard Industrial Classification (SIC) codes. Similarly to Opler et al. (1999), utility (SIC codes 4900-4999) and financial institutes (SIC codes 6000-6999) are not included in the analysis, because investment, external financing and holding liquid asset decisions of financial firms and utilities can be restricted by other reasons such as regulations. I eliminate firm-years for which the value of asset or sales are not reported. As Almeida et al(2004), I eliminate firm-years for which cash holdings exceeded the value of total assets, those for which market capitalization was less than \$10 million (in 2006 dollars), and those displaying asset or sales growth exceeding 100%. [8] I also require that firms have at least four consecutive years of data in the sample period in order to address survivorship bias. This is also the minimum number of years required for firms to be in this analysis given the lag structure to develop cash flow volatility measure. To minimize the influence of outliers in the analysis, I winsorize variables at the top and bottom 1% levels.

[8] Almeida et al(2004) use this screen to eliminates large jumps in business fundamentals, because these rises typical indicate mergers, reorganizations, and other major corporate event

Measuring Duration of Cash Flow and δ

With strong correlation between cash flow and total asset (0.8224), it is very unlikely to disagree the claim that asset is the main source of cash flow. Goswami(2000) describes duration of cash flows on the basis of asset maturity concept which reflects that a long (short) maturity asset generates high (low) cash flow from assets in place in the second period. I assume that duration of asset is followed by duration of cash flow. When cash flow is estimated by asset with year and firm fixed effect, asset can explain 81.11% of cash flow movement.

$$Duration\ of\ cash\ flow = \frac{PPEGT}{DP}\frac{PPEGT}{AT} + \frac{ACT}{COGS}\frac{ACT}{AT}$$

Johnson(2003) defines that the maturity of fixed assets is measured as ratio of property, plant and equipment (PPEGT) over depreciation and amortization (DP), while the maturity of liquid assets is measured as ratio of current assets (ACT) over the cost of goods sold (COGS). Duration of cash flow is defined as total asset maturity which is the weighted sum of these measures where the proportion of property, plant and equipment in total assets (PPEGT/AT) is the weight for fixed assets and the proportion of current assets in total assets (ACT / AT) is the weight for liquid assets.

Non-linear transformation of this duration measure generates depreciation rate of cash flow which I use in the model. Since I assume cash flow depreciates by δ rate, I set δ to match depreciated cash flow at the duration to 10% level of initial cash flow which means $(1-\delta)^{Duration} = 0.1$. With this transformation, depreciation rate of cash flow, δ, is generated by the following formula:

$$\delta = 1 - 0.1^{(1/Duration\ of\ Cash\ Flow)}$$

Gopalan et al(2013) use the fraction of long-term assets to test that firms with more valuable long-term projects and less risky firms offer their executives longer-

Table 2.1: Summary Statistics

This table contains summary statistics for sample annual data from Compustat. All data are 2006 CPI adjusted and financial values are scaled by total asset. The table report diminution of cash flow, tangibility, Asset size, R&D, cash, cash flow, saving, cash flow volatility, capital investment, leverage, net external finance, net debt issue, net equity issue, long-term debt(more than three years), working years, number of observation and the number of firms. Each column indicate overall firms, manufacturing industry, high-tech industry(three digit SIC of 283, 357, 366, 367, 382, 384, 737), and all but high-tech industry. Every variable is winsorized top and bottom by 1%.

	Overall	Manufacturing	High-tech	Non High-tech
τ	0.3423	0.3294	0.4044	0.2924
	(0.2271)	(0.194)	(0.1949)	(0.1825)
PPE	0.321	0.2804	0.2095	0.315
	(0.2226)	(0.1643)	(0.1336)	(0.1667)
Q	2.424	2.4678	3.1221	2.1446
	(2.4282)	(2.4168)	(2.9585)	(2.0216)
Size	2026.289	2083.313	1431.411	2401.877
	(6824.303)	(6923.838)	(5984.385)	(7318.27)
R&D	0.0327	0.045	0.1026	0.0176
	(0.0694)	(0.0769)	(0.1051)	(0.0337)
Cash	0.1415	0.1437	0.242	0.0968
	(0.1798)	(0.1831)	(0.2418)	(0.1216)
Saving	0.0039	0.0045	0.0066	0.0035
	(0.1057)	(0.1074)	(0.1512)	(0.0782)
Cash Flow	0.0735	0.0712	0.0417	0.0853
	(0.1376)	(0.1398)	(0.1947)	(0.1008)
Volatility	0.0185	0.0186	0.0266	0.0141
	(0.0406)	(0.0409)	(0.0437)	(0.0385)
CAPX	0.0774	0.0643	0.0639	0.0645
	(0.084)	(0.0616)	(0.0675)	(0.0586)
Leverage	0.4191	0.4045	0.293	0.4591
	(0.3072)	(0.293)	(0.2925)	(0.2773)
Net External	0.0323	0.0279	0.0497	0.0179
	(0.1415)	(0.1377)	(0.1804)	(0.1115)
Net Debt Issue	0.0171	0.0136	0.0141	0.0134
	(0.0994)	(0.0919)	(0.0989)	(0.0883)
Net Equity Issue	0.0155	0.0146	0.0355	0.0051
	(0.1013)	(0.1036)	(0.1503)	(0.0712)
Debt 3yr	0.5072	0.5129	0.4084	0.5618
	(1.6182)	(0.5167)	(0.6808)	(0.4092)
Age	12.8434	14.3657	11.8345	15.6002
	(11.2164)	(11.9323)	(10.0113)	(12.5814)
No. of Obs.	146146	78950	25916	53034
Unique	13564	6519	2512	4007

duration pay contracts. They define the long-term asset as the ratio of book value of property plant and equity plus goodwill over non-cash total assets. The correlation of between long-term measure and the duration of cash flow is 0.6659. The robust tests are performed with this long-term asset measure, and, as expected, The tests show consistent result with the duration of cash flow.

Summary Statistics

Table 2.1 contains summary statistics for sample annual data from Compustat. All data are 2006 CPI adjusted and financial values are scaled by total asset. The table report depreciation rate of cash flow, cash flow, and other financial values. Each column indicate overall firms, manufacturing industry, high-tech industry (three digit SIC codes 283, 357, 366, 367, 382, 384), and manufacturing but high-tech industry. Of greater interest, the average value of δ is the highest in high-tech industry which has fast technology cycle in the market, δ in high-tech industry is 0.4044 which is higher than 0.2924 in non high-tech industry, so that duration of cash flow in high-tech industry is much shorter than one in other industry. Net external finance in high-tech industry is roughly 2.8 times higher than non high tech industry (0.0497 and 0.0179, respectively.) This is consistent with model prediction because shorter duration of cash flow would decrease cost of external finance.

2.3.3 External Finance with Duration of Cash Flow

Prior to test the model, this section supports the channel of external finance which is assumed to have positive relationship with the duration of cash flow from the model. Since δ leads the higher amount of external finance via cost of external finance, the empirical model for external financing specifies δ. The empirical model for external finance also consists of firm size, cash flow and investment opportunities based on Almeida and Campello(2010). The model is as follows:

$$\begin{aligned} Issuance\ of\ Ext.\ Finance_{i,t} =& \beta_0 + \beta_1 \delta_{i,t} + \beta_2 Investment_{i,t} + \beta_3 Cash\ Flow_{i,t} \\ & + \beta_4 Q_{i,t-1} + \beta_5 Size_{i,t} + \epsilon_{i,t} \end{aligned} \tag{2.9}$$

I focus on the effect of δ on the issuance of external financing which is captured by β_1. According to the model, cost of external finance, $\frac{1}{2}\eta(\delta)(qI)^2$ depends on δ, investment and level of financial friction. To control economies of scale for external finance and financial friction, natural log of book value is included in the baseline specification as *Size*. Q captures information about the investment opportunities which denote market to book value. While Almeida and Campello(2010) use net external finance for the empirical test to provide evidence on the relation between internal fund and external financing for constrained and unconstrained firms, I investigate empirical model with issuance of external finance to verify δ effects on cost of external finance. It is possible to address an idea that this investigation can be biased due to repurchasing of external finance. However, even if net external finance substitutes the issuance of external finance in the test, the results are consistent. Almeida and Campello(2010) extend their regression model with cash reserve, inventory and tangibility to control other investment and liquidity demand. I borrow this extension for the second regression model. On the top of this model, I consider firm structure by controlling leverage and the age of the firms.

Table 2.2 presents the result of the estimation from three external finance regression models based on equation (2.9). Left panel of the Table 2.2 shows the test result when the dependent variable is issuance of external finance and the right hand side panel shows the identical test with net external finance as a dependent variable. These two results are consistent. Depreciation rate of cash flow, δ, has positive effect on both issuance of external finance and net external finance sections for all models (0.0505 to 0.0766) which means that firm with shorter duration access more external finance. Positive effect of δ on net external financing support that cost of external finance $\eta(\delta)$ is decreasing function of δ.

Table 2.2: External Finance with Duration of Cash Flow

This table contains linear regression result for issuance of external finance and net external finance which consists of equity issue and debt issue. δ has positive effect on issuance of external finance and net external finance for all section. Since external finance can be affected by several firm characteristics, I control firm's other specifics such as tangibility, leverage, working years, cash reserve, and firm size. All data are from the annual COMPUSTAT. The sample period is 1976 through 2011. Net external financing increase in δ which support that cost of external finance $\eta(\delta)$ is decreasing function of δ. The estimations include year fixed effect and firm fixed effect. The associated standard errors are reported as heteroskedasticity-robust standard errors in parentheses.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

	Issuance of External Financing			Net External Financing		
	Ext	Ext	Ext	NetExt	NetExt	NetExt
δ	0.0505***	0.0766***	0.0746***	0.0542***	0.0718***	0.0711***
	(0.0111)	(0.0134)	(0.0132)	(0.0062)	(0.0060)	(0.0060)
CAPX	0.8323***	0.8235***	0.8007***	0.7993***	0.7929***	0.7850***
	(0.0150)	(0.0171)	(0.0174)	(0.0102)	(0.0109)	(0.0110)
Cash Flow	-0.2253***	-0.1445***	-0.0691***	-0.2352***	-0.1813***	-0.1554***
	(0.0137)	(0.0140)	(0.0154)	(0.0114)	(0.0112)	(0.0121)
Q	0.0063***	0.0067***	0.0079***	0.0058***	0.0057***	0.0061***
	(0.0006)	(0.0007)	(0.0007)	(0.0005)	(0.0005)	(0.0005)
Size	0.0124***	0.0125***	0.0103***	0.0140***	0.0163***	0.0155***
	(0.0023)	(0.0026)	(0.0026)	(0.0010)	(0.0012)	(0.0012)
Cash Reserve		-0.1699***	-0.1344***		-0.0672***	-0.0555***
		(0.0097)	(0.0097)		(0.0061)	(0.0063)
Inventory		0.0754***	0.0794***		0.0977***	0.0990***
		(0.0226)	(0.0223)		(0.0086)	(0.0087)
PPE		0.0782***	0.0601***		0.0516***	0.0455***
		(0.0154)	(0.0153)		(0.0076)	(0.0077)
Leverage			0.1399***			0.0466***
			(0.0080)			(0.0038)
Age			0.0034***			0.0001
			(0.0003)			(0.0001)
Const	-0.0674***	-0.1120***	-0.1738***	-0.1109***	-0.1834***	-0.1989***
	(0.0126)	(0.0173)	(0.0169)	(0.0064)	(0.0084)	(0.0083)
No. of Obs.	117657	100992	100791	110075	94757	94598
R-Squared	0.081	0.082	0.096	0.185	0.183	0.188

2.3.4 *Optimal Investment with Duration of Cash Flow*

I begin my analysis by investigating whether δ can capture the cross-sectional difference in investment decision. Firm's investment decision from duration of cash flow depends on how much the duration affects cost of external finance, cash flow from new investment at date one, and cash flow from assets in place. Proposition 1 explains the relationship between the duration and investment decision within endogeneity-free setup. Table 2.3 contains regression result of the baseline model with fixed effects which invigorate the argument. The baseline empirical model (2.10) is followed by investment, external finance and cash saving model which I propose below.

$$Investment_{i,t} = \beta_0+\beta_1\delta_{i,t}+\beta_2 Q_{i,t-1}+\beta_3 cash\ flow_{i,t}+\beta_4 Net\ Ext.\ finance_{i,t}+\epsilon_{i,t} \quad (2.10)$$

The regression model is extended to manage potential concerns about model specification. I control firm's other specifics such as tangibility, leverage, and firm size. δ is a measure of depreciation rate of cash flow which reflect duration of asset. However duration of asset may affected by tangibility of asset. Thus δ may indirectly capture effect of tangibility to external finance. Leverage has the same concern to external finance. Size is one of the main characteristics of firm which possibly affects all the existing components from economy of scale. By controlling these factors, I can expect to capture more accurate effect from existing variables.

$$\begin{aligned} Investment_{i,t} =& \beta_0 + \beta_1 \delta_{i,t} + \beta_2 Q_{i,t-1} + \beta_3 Cash\ Flow_{i,t} + \beta_4 Net\ Ext.\ Finance_{i,t} \\ &+ \beta_5 Size_{i,t} + \beta_6 Leverage_{i,t} + \beta_7 Tangibility_{i,t-1} + \epsilon_{i,t} \end{aligned} \tag{2.11}$$

Regressions contain time fixed effect, time and industry fixed effects, and time and firm fixed effects respectively in each column. These fixed effects can take care of the potential technological shocks, which imbed into time, industry, or firm itself.

Result of regression model (2.10) and model (2.11) is reported in Table 2.3. The coefficient of δ in Table 2.3 consistently shows negative sign(-0.1115 to -0.0076) with 1% of significant level , so one can conclude that duration of cash flow have an effect more on existing cash flow change than on the other factors. This empirical evidence support the condition of proposition 1. By controlling other effects which may correlated with existing variables, it shows clear result as baseline model reports with stronger coefficient values. With year and firm fixed effects, coefficients of δ has higher values (-0.0911 to -0.0750), while other coefficients have similar coefficient value.

Table 2.3: Investment Decision

This table displays results for OLS estimations of following baseline and extended regression:
$Investment_{i,t} = \beta_0 + \beta_1\delta_{i,t} + \beta_2 Q_{i,t-1} + \beta_3 Cash\ flow_{i,t} + \beta_4 Net\ Ext.\ finance_{i,t} + \epsilon_{i,t}$
$Investment_{i,t} = \beta_0 + \beta_1\delta_{i,t} + \beta_2 Q_{i,t-1} + \beta_3 Cash\ Flow_{i,t} + \beta_4 Net\ Ext.\ Finance_{i,t} + \beta_5 Size_{i,t} + \beta_6 Leverage_{i,t} + \beta_7 Tangibility_{i,t-1} + \epsilon_{i,t}$
All data are from the annual COMPUSTAT. The sample period is 1976 through 2011. The estimations include year fixed effect and firm fixed effect. The associated standard errors are reported as heteroskedasticity-robust standard errors in parentheses.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

	Baseline			Extended		
(Fixed Effect)	Year	Year/Industry	Year/Firm	Year	Year/Industry	Year/Firm
δ	-0.1114***	-0.0829***	-0.0750***	-0.0085***	-0.0277***	-0.0911***
	(0.0018)	(0.0039)	(0.0027)	(0.0020)	(0.0048)	(0.0033)
Q	0.0036***	0.0038***	0.0043***	0.0045***	0.0043***	0.0043***
	(0.0002)	(0.0005)	(0.0002)	(0.0002)	(0.0005)	(0.0002)
Cash Flow	0.1856***	0.1695***	0.1333***	0.1675***	0.1637***	0.1365***
	(0.0044)	(0.0183)	(0.0039)	(0.0041)	(0.0204)	(0.0042)
Net Ext. Finance	0.2357***	0.2213***	0.1881***	0.2119***	0.2105***	0.1871***
	(0.0046)	(0.0286)	(0.0041)	(0.0042)	(0.0284)	(0.0040)
Size				-0.0025***	-0.0017***	0.0037***
				(0.0002)	(0.0005)	(0.0007)
Leverage				0.0017	0.0036	0.0075***
				(0.0012)	(0.0027)	(0.0018)
PPE				0.1531***	0.1075***	-0.0455***
				(0.0034)	(0.0107)	(0.0054)
Const	0.0762***	0.0448***	0.0764***	0.0116***	0.0005	0.0747***
	(0.0016)	(0.0025)	(0.0072)	(0.0021)	(0.0059)	(0.0082)
No. of Obs.	101879	101879	101879	101706	101706	101706
R-Squared	0.325	0.418	0.261	0.407	0.444	0.265

Robust Test with Alternative Measure

The measure of the cash flow duration is derived from asset maturity. Thus the duration of cash flow can be alternatively measured by looking characteristics of asset itself. For example, long-term asset which is defined by Gopalan et al (2013) can explain the duration of asset, so I substitutes δ to long term asset for robustness test. Since δ and long-term asset has opposite direction in the sense of investigating asset maturity, expected sign from robust test is also opposite. Positive values for the coefficient of long-term asset are expected, while δ has negative effect on investment. Regression model for this test is the same as regression model (2.11), but δ is

Table 2.4: Investment Regressions - Robust Test with Alternative Measure

This table displays results of δ and cash flow from linear regressions of following model:
$Investment_{i,t} = \beta_0 + \beta_1 \delta_{i,t}(or\ Long\ term\ asset_{i,t}) + \beta_2 Q_{i,t-1} + \beta_3 Cash\ flow_{i,t} + \beta_4 Net\ Ext.\ finance_{i,t} + \epsilon_{i,t}$
$Investment_{i,t} = \beta_0 + \beta_1 \delta_{i,t}(or\ Long\ term\ asset_{i,t}) + \beta_2 Q_{i,t-1} + \beta_3 Cash\ Flow_{i,t} + \beta_4 Net\ Ext.\ Finance_{i,t} + \beta_5 Size_{i,t} + \beta_6 Leverage_{i,t} + \beta_7 Tangibility_{i,t-1} + \epsilon_{i,t}$
All data are from the annual COMPUSTAT. The sample period is 1988 through 2011. The estimations include year fixed effect and firm fixed effect. The associated standard errors are reported as heteroskedasticity-robust standard errors in parentheses.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

Panel A. δ		Basic			Extended	
(Fixed Effect)	Year	Year/Industry	Year/Firm	Year	Year/Industry	Year/Firm
δ	-0.1023***	-0.0723***	-0.0557***	-0.0046***	-0.0207***	-0.0700***
	(0.0020)	(0.0048)	(0.0027)	(0.0014)	(0.0053)	(0.0033)
Q	0.0034***	0.0046***	0.0062***	0.0053***	0.0054***	0.0060***
	(0.0003)	(0.0008)	(0.0004)	(0.0002)	(0.0006)	(0.0004)
Cash Flow	0.1572***	0.1381***	0.0937***	0.1305***	0.1259***	0.0905***
	(0.0047)	(0.0172)	(0.0039)	(0.0031)	(0.0184)	(0.0040)
Net Ext. Finance	0.1975***	0.1813***	0.1445***	0.1713***	0.1704***	0.1462***
	(0.0054)	(0.0296)	(0.0044)	(0.0038)	(0.0289)	(0.0044)
Size				-0.0019***	-0.0012**	0.0033***
				(0.0001)	(0.0006)	(0.0008)
Leverage				-0.0110***	-0.0074**	-0.0063***
				(0.0009)	(0.0030)	(0.0020)
PPE				0.1552***	0.1106***	-0.0465***
				(0.0022)	(0.0128)	(0.0067)
Const	0.0764***	0.0421***	0.0516***	0.0114***	-0.0044	0.0505***
	(0.0017)	(0.0032)	(0.0015)	(0.0017)	(0.0066)	(0.0053)
No. of Obs.	62914	62914	62914	62777	62777	62777
R-Squared	0.298	0.405	0.224	0.392	0.435	0.228

Panel B. Longterm		Basic			Extended	
(Fixed Effect)	Year	Year/Industry	Year/Firm	Year	Year/Industry	Year/Firm
Longterm	0.1433***	0.1173***	0.0989***	0.0737***	0.0711***	0.1362***
	(0.0029)	(0.0061)	(0.0043)	(0.0024)	(0.0102)	(0.0056)
Q	0.0045***	0.0045***	0.0068***	0.0047***	0.0050***	0.0064***
	(0.0003)	(0.0007)	(0.0004)	(0.0002)	(0.0006)	(0.0004)
Cash Flow	0.1565***	0.1438***	0.0992***	0.1453***	0.1391***	0.1015***
	(0.0048)	(0.0171)	(0.0042)	(0.0034)	(0.0194)	(0.0044)
Net Ext. Finance	0.1914***	0.1800***	0.1470***	0.1779***	0.1759***	0.1516***
	(0.0054)	(0.0300)	(0.0048)	(0.0041)	(0.0300)	(0.0048)
Size				-0.0025***	-0.0020***	-0.0048***
				(0.0002)	(0.0005)	(0.0009)
Leverage				-0.0071***	-0.0039	-0.0041*
				(0.0010)	(0.0034)	(0.0022)
PPE				0.0981***	0.0767***	-0.0879***
				(0.0025)	(0.0189)	(0.0075)
Const	-0.0187***	-0.0432***	-0.0136***	-0.0071***	-0.0337***	0.0258***
	(0.0013)	(0.0053)	(0.0026)	(0.0015)	(0.0054)	(0.0060)
No. of Obs.	56795	56795	56795	56605	56605	56605
R-Squared	0.357	0.434	0.231	0.411	0.449	0.243

substituted to long-term asset. The Regression model is as follows:

$$\begin{aligned} Investment_{i,t} =& \beta_0 + \beta_1 Long\text{-}term_{i,t} + \beta_2 Q_{i,t-1} + \beta_3 Cash\ Flow_{i,t} + \beta_4 Net\ Ext.\ Finance_{i,t} \\ & + \beta_5 Size_{i,t} + \beta_6 Leverage_{i,t} + \beta_7 Tangibility_{i,t-1} + \epsilon_{i,t} \end{aligned} \tag{2.12}$$

Since variable goodwill which is a component to generate long term asset measure is available from 1988, Table 2.4 contains results with observation after 1988. As expected, the coefficients of long-term asset consistently shows positive values in Table 2.4. One interesting finding is that cash flow after 1988 does not explain investment as much as before which support disappearance of investment to cash flow sensitivity literatures. [9]

2.3.5 Market Imperfection with Duration of Cash Flow

Financial Constraint Criteria

- Scheme #1: Payout ratio

  I rank firms based on their payout ratio in each fiscal year in the data and assign to the financially constrained (unconstrained) group those firms in the bottom (top) three deciles of the annual payout distribution. I compute the payout ratio by scaling dividends plus stock buybacks minus stock issues. As argued by Fazzari et al. (1988), firms with zero dividend payouts are more likely to face binding constraints than firms paying high dividends. [10]

- Scheme #2: Firm size

[9] chen et al (2012) address the disappearance of investment-cash flow effect as time goes, the disappearance exists even in financial crisis which is considered as high financial friction period. Tsoukalas(2011) shows that cash flow effect largely disappears by controlling for time to build

[10] Moyen (2004) shows that low dividend ratios may come up with high cash flow sensitivities even if they are unconstrained by suggesting omitted variable issue with respect to debt financing. Because unconstrained firms can attain more leverage, amount of dividends as a fraction of their assets would be smaller than that of constrained firms

Firm size has been used as a proxy for access to external finance in a number of studies (Kim et al., 1998). I split firms into large and small size groups based on average asset size during the sample period. I assign to the financially constrained (unconstrained) group those firms in the bottom (top) three deciles of the annual asset size distribution.

- Scheme #3: Age of firm

  I assign firms as mature if it has more than 15 working years after the year it first appear in Compustat with a stock price. Firm age has been used as a proxy for the presence of financing frictions in a number of recent studies(Brown and Peterson, 2011). Hadlock and Pierce (2010) argue that the age and size of the firm are relatively exogenous firm characteristics to identify constrained firms.

- Scheme #4: Bond rating

  I split firms based on whether or not a bond rating is reported in Compustat. Financially unconstrained firms are those whose bonds have been rated during the sample period.

- Scheme #5: KZ index

  I construct an index of firm financial constraints following Lamont, Polk and Saa-requejo (2001) which is based on results in Kaplan and Zingales (1997). Firms are separated by following KZ index.

$$\begin{aligned} \mathit{KZ\ index} = &-1.0019(\mathit{Cash\ Flow}) + 0.2826(Q) + 3.1392(\mathit{Leverage}) \\ &- 39.3678(\mathit{Dividends}) - 1.3148(\mathit{Cash\ Holdings}) \end{aligned}$$

  Firms in the bottom (top) three deciles of the KZ index ranking are considered financially unconstrained (constrained).

Baseline Investment Regressions by Financial Constraint Criteria

I experiment a model with an interaction term that allows the effect of δ to vary with market friction. The empirical model is as following:

$$\begin{aligned} Investment_{i,t} =& \beta_0 + \beta_1\delta_{i,t} + \beta_2 Q_{i,t-1} + \beta_3 Cash\ flow_{i,t} + \beta_4 Net\ Ext.\ finance_{i,t} \\ & + \beta_5\, \text{II} + \beta_6(\delta_{i,t} \times \text{II}) + \epsilon_{i,t} \end{aligned} \tag{2.13}$$

where II = 1 if a firm is financially constrained, 0 if unconstrained. Model (2.13) is a linear measure of the influence of financial friction on investment δ sensitivity, and its interaction term makes the interpretation of the estimated coefficients more comprehensible. Since $(\beta_1 + \beta_6 \text{II})$ capture the effect of δ on investment, one have to read off $(\beta_1 + \beta_6)$ to assess the effect of δ for the financially constrained firms, and β_1 only for unconstrained firms. This interaction form has applied to the extended model (2.11) as following:

$$\begin{aligned} Investment_{i,t} =& \beta_0 + \beta_1\delta_{i,t} + \beta_2 Q_{i,t-1} + \beta_3 Cash\ Flow_{i,t} + \beta_4 Net\ Ext.\ Finance_{i,t} \\ & + \beta_5 Size_{i,t} + \beta_6 Leverage_{i,t} + \beta_7 Tangibility_{i,t-1} \\ & + \beta_8\, \text{II} + \beta_9(\delta_{i,t} \times \text{II}) + \epsilon_{i,t} \end{aligned} \tag{2.14}$$

Results of regression model (2.13) and model (2.14) is reported in Table 2.5 by financial constraints criteria. Each panel A and panel B reports regression results of model (2.13) and model (2.14) respectively. Panel A which shows baseline regression presents negative coefficient value for δ with 1% significant level (-0.0605 to -0.0442). This result is amplified from the test with extended model in panel B (-0.0925 to -0.0660) and both panel shows that all financial friction but the size magnify the negative effect of δ on investment (-0.0084 to -0.0381). These significant effect between unconstraint and constraint firms is consistent with proposition 2.

Table 2.5: Investment Regressions by Financial Constraint Criteria-Baseline Regression

This table displays results of δ and cash flow from linear regressions of following models:
Panel A : $Investment_{i,t} = \beta_0 + \beta_1 \delta_{i,t} + \beta_2 Q_{i,t-1} + \beta_3 Cash\ flow_{i,t} + \beta_4 Net\ Ext.\ finance_{i,t} + \beta_5\, \text{II} + \beta_6 (\delta_{i,t} \times \text{II}) + \epsilon_{i,t}$
Panel B : $Investment_{i,t} = \beta_0 + \beta_1 \delta_{i,t} + \beta_2 Q_{i,t-1} + \beta_3 Cash\ Flow_{i,t} + \beta_4 Net\ Ext.\ Finance_{i,t} + \beta_5 Size_{i,t} + \beta_6 Leverage_{i,t} + \beta_7 Tangibility_{i,t-1} + \beta_8\, \text{II} + \beta_9 (\delta_{i,t} \times \text{II}) + \epsilon_{i,t}$
All data are from the annual COMPUSTAT. The sample period is 1976 through 2011. The estimations include year fixed effect and firm fixed effect. The associated standard errors are reported as heteroskedasticity-robust standard errors in parentheses.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

Panel A. δ Effect with Baseline Regression

	Payout	Size	Age	Bond rate	KZ index
δ	-0.0605***	-0.0516***	-0.0502***	-0.0543***	-0.0442***
	(0.0043)	(0.0125)	(0.0042)	(0.0062)	(0.0053)
Cash Flow	0.1185***	0.1251***	0.1297***	0.1295***	0.1307***
	(0.0041)	(0.0048)	(0.0037)	(0.0037)	(0.0049)
Q	0.0032***	0.0035***	0.0033***	0.0033***	0.0023***
	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0002)
Net Ext. finance	0.1690***	0.1742***	0.1815***	0.1815***	0.1911***
	(0.0044)	(0.0052)	(0.0038)	(0.0038)	(0.0052)
Constraint	0.0023	-0.0030	0.0099***		0.0389***
	(0.0022)	(0.0073)	(0.0019)		(0.0029)
Constraint	-0.0084*	-0.0185	-0.0316***	-0.0381***	-0.0251***
× δ	(0.0044)	(0.0132)	(0.0049)	(0.0076)	(0.0053)
Const	0.0533***	0.0652***	0.0621***	0.0696***	0.0455***
	(0.0023)	(0.0050)	(0.0025)	(0.0022)	(0.0033)
No. of Obs.	73748	61460	109869	109869	60792
R-Squared	0.236	0.243	0.252	0.252	0.257

Panel B. δ Effect with Extended Regression

	Payout	Size	Age	Bond rate	KZ index
δ	-0.0847***	-0.0925***	-0.0723***	-0.0800***	-0.0660***
	(0.0045)	(0.0061)	(0.0037)	(0.0037)	(0.0041)
Cash Flow	0.1270***	0.1335***	0.1394***	0.1391***	0.1349***
	(0.0047)	(0.0056)	(0.0043)	(0.0042)	(0.0053)
Q	0.0033***	0.0037***	0.0034***	0.0034***	0.0019***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Net Ext. finance	0.1751***	0.1849***	0.1885***	0.1885***	0.2018***
	(0.0047)	(0.0056)	(0.0041)	(0.0041)	(0.0055)
Size	0.0039***	0.0047***	0.0032***	0.0034***	0.0040***
	(0.0008)	(0.0011)	(0.0007)	(0.0007)	(0.0010)
Leverage	0.0085***	0.0079***	0.0065***	0.0068***	-0.0171***
	(0.0021)	(0.0024)	(0.0018)	(0.0018)	(0.0024)
PPE	-0.0616***	-0.0593***	-0.0452***	-0.0462***	-0.0782***
	(0.0066)	(0.0071)	(0.0055)	(0.0054)	(0.0078)
Constraint	0.0025	0.0021	0.0110***		0.0522***
	(0.0021)	(0.0066)	(0.0015)		(0.0032)
Constraint	-0.0087**	0.0077	-0.0332***	-0.0266***	-0.0324***
× δ	(0.0039)	(0.0079)	(0.0034)	(0.0059)	(0.0054)
Const	0.0902***	0.0786***	0.0773***	0.0840***	0.0823***
	(0.0111)	(0.0137)	(0.0082)	(0.0083)	(0.0103)
No. of Obs.	67804.000	56639.000	101706.000	101706.000	55703.000
R-Squared	0.249	0.259	0.265	0.263	0.275

Robust Test for the Model with Financial Friction

I now investigate robustness check with long-term asset measure from Gopalan et al (2013) for the model in financial friction criteria. Baseline model (2.13) and extended regression model (2.14) which controls additional size, leverage and tangibility effect are tested within two financial friction group. Gopalan et al (2013) use goodwill to generate the long-term measure, which is available from 1988. Thus, the sample period of this test is limited after 1988. In Table 2.6, I report in two panels for each regression model. Table 2.6 also displays significant effect of long-term assets which is consistent with Table 2.5 result. Constraint dummy $\times$ Long-term asset presents the effect of financial friction to the sensitivity of investment to long-term asset. Overall, the sensitivities are significantly positive and follow model prediction in all financial friction criteria while it shows not significant coefficient with size criteria.

Subsample Regressions by Financial Constraint Criteria

Investment to cash flow sensitivity is interpreted as financial fiction, since Fazzari, Hubbard, and Petersen (1988) find out a positive sensitivity of investment to cash flow. As it is shown in previous Tables, cash flow increase investment activity. Sensitivity of investment to cash flow and sensitivity of investment to duration of cash flow can be described from the regression results of equation (2.10). Table 2.7 summaries the regression result of model (2.10) and model (2.11) in each financial constraint subsample in panel A and panel B, respectively. A total of 20 estimated equations is reported in the table (two panels $\times$ five constraints criteria $\times$ two constraints categories). Table 2.7 displays significant difference of the investment to duration of cash flow sensitivity between unconstraint and constraint firm. The sensitivity is more stable than the sensitivity of investment to cash flow which is expected from

Table 2.6: Investment Regressions by Financial Constraint Criteria-Alternative measure

This table displays results of δ and cash flow from linear regressions of following models:
Panel A : $Investment_{i,t} = \beta_0 + \beta_1 Longterm_{i,t} + \beta_2 Q_{i,t-1} + \beta_3 Cash\ flow_{i,t} + \beta_4 Net\ Ext.\ Finance_{i,t} + \beta_5\ \text{II} + \beta_6(\delta_{i,t} \times \text{II}) + \epsilon_{i,t}$
Panel B : $Investment_{i,t} = \beta_0 + \beta_1 Longterm_{i,t} + \beta_2 Q_{i,t-1} + \beta_3 Cash\ Flow_{i,t} + \beta_4 Net\ Ext.\ Finance_{i,t} + \beta_5 Size_{i,t} + \beta_6 Leverage_{i,t} + \beta_7 Tangibility_{i,t-1} + \beta_8\ \text{II} + \beta_9(\delta_{i,t} \times \text{II}) + \epsilon_{i,t}$
All data are from the annual COMPUSTAT. The sample period is 1988 through 2011. The estimations include year fixed effect and firm fixed effect. The associated standard errors are reported as heteroskedasticity-robust standard errors in parentheses.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

Panel A. Longterm Asset Effect with Baseline Regression

	Payout	Size	Age	Bond rate	KZ index
Longterm	0.0902***	0.0835***	0.0816***	0.0893***	0.0585***
	(0.0056)	(0.0081)	(0.0048)	(0.0047)	(0.0057)
Cash Flow	0.0944***	0.0975***	0.1006***	0.1002***	0.0954***
	(0.0044)	(0.0053)	(0.0039)	(0.0039)	(0.0053)
Q	0.0042***	0.0042***	0.0043***	0.0043***	0.0028***
	(0.0006)	(0.0007)	(0.0006)	(0.0006)	(0.0006)
Net Ext. Finance	0.1312***	0.1327***	0.1412***	0.1412***	0.1467***
	(0.0050)	(0.0057)	(0.0045)	(0.0045)	(0.0060)
Constraint	-0.0073***	-0.0105	-0.0121***		0.0104***
	(0.0020)	(0.0119)	(0.0022)		(0.0031)
Constraint	0.0165***	0.0188	0.0255***	0.0251***	0.0387***
× Longterm	(0.0056)	(0.0121)	(0.0054)	(0.0092)	(0.0089)
Const	-0.0048	-0.0010	0.0322***	0.0239***	-0.0067**
	(0.0032)	(0.0065)	(0.0032)	(0.003)	(0.0033)
No. of Obs.	42618	34646	61373	61373	33562
R-Squared	0.213	0.206	0.219	0.219	0.219

Panel B. Longterm Asset Effect with Extended Regression

	Payout	Size	Age	Bond rate	KZ index
Longterm	0.1354***	0.1489***	0.1237***	0.1269***	0.0886***
	(0.0071)	(0.0095)	(0.0061)	(0.0061)	(0.0076)
Cash Flow	0.1018***	0.1031***	0.1062***	0.1057***	0.0983***
	(0.0052)	(0.0059)	(0.0046)	(0.0046)	(0.0057)
Q	0.0042***	0.0047***	0.0045***	0.0045***	0.0028***
	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Net Ext. Finance	0.1441***	0.1494***	0.1538***	0.1539***	0.1655***
	(0.0055)	(0.0063)	(0.0049)	(0.0049)	(0.0067)
Size	-0.0061***	-0.0049***	-0.0047***	-0.0048***	-0.0041***
	(0.0011)	(0.0015)	(0.0009)	(0.0010)	(0.0013)
Leverage	-0.0030	-0.0062**	-0.0045**	-0.0048**	-0.0219***
	(0.0026)	(0.0029)	(0.0022)	(0.0022)	(0.0029)
PPE	-0.1060***	-0.1123***	-0.0888***	-0.0900***	-0.1202***
	(0.0092)	(0.0102)	(0.0075)	(0.0075)	(0.0110)
Constraint	-0.0081***	-0.0180	-0.0112***		0.0148***
	(0.0021)	(0.0141)	(0.0024)		(0.0034)
Constraint	0.0160***	-0.0053	0.0217***	0.0331***	0.0620***
× Longterm	(0.0059)	(0.0132)	(0.0058)	(0.0106)	(0.0104)
Const	0.0408***	0.0791***	0.0346***	0.0278***	0.0370***
	(0.0072)	(0.0122)	(0.0063)	(0.0061)	(0.0081)
No. of Obs.	39006	31822	56605	56605	30587
R-Squared	0.238	0.240	0.240	0.240	0.250

Table 2.7: Investment Regressions by Financial Constraint Criteria

This table displays results of δ and cash flow from linear regressions of following models:
Panel A : $Investment_{i,t} = \beta_0 + \beta_1 \delta_{i,t} + \beta_2 Q_{i,t-1} + \beta_3 Cash\ flow_{i,t} + \beta_4 Net\ Ext.\ Finance_{i,t} + \beta_5\ \text{II} + \beta_6 (\delta_{i,t} \times \text{II}) + \epsilon_{i,t}$.
Panel B : $Investment_{i,t} = \beta_0 + \beta_1 \delta_{i,t} + \beta_2 Net\ Ext.\ Finance_{i,t} + \beta_3 Cash\ flow_{i,t} + \beta_4 Size_{i,t} + \beta_5 Q_{i,t-1} + \beta_6 Leverage_{i,t} + \beta_7 Tangibility_{i,t-1} + \epsilon_{i,t}$.
A total of 20 estimated equations is reported in the table (two panels × five constraints criteria × two constraints categories). All data are from the annual COMPUSTAT. The sample period is 1976 through 2011. The estimations include year fixed effect and firm fixed effect. The associated standard errors are reported as heteroskedasticity-robust standard errors in parentheses.
***, ** and * indicate statistical significance at the 1%, 5% and 10% (two-tail) test levels, respectively.

Panel A. Baseline Regression

	Payout Ratio		Size		Years		Bond rate		KZ index	
	Unconstraint	Constraint	Unconstraint	Constraint	Unconstraint	Constraint	Unconstraint	Constraint	Unconstraint	Constraint
δ	-0.0733***	-0.0687***	-0.0479***	-0.0685***	-0.0584***	-0.0870***	-0.0543***	-0.0925***	-0.0387***	-0.0915***
	(0.0049)	(0.0078)	(0.0126)	(0.0053)	(0.0034)	(0.0111)	(0.0063)	(0.0045)	(0.0032)	(0.0066)
Cash Flow	0.1421***	0.1082***	0.2062***	0.0903***	0.1298***	0.1181***	0.1167***	0.1383***	0.0754***	0.1754***
	(0.0079)	(0.0048)	(0.0099)	(0.0053)	(0.0071)	(0.0040)	(0.0050)	(0.0055)	(0.0047)	(0.0087)
No. of Obs.	33867.000	39881.000	36438.000	25022.000	38822.000	71047.000	52343.000	57526.000	29893.000	30899.000
R-Squared	0.224	0.237	0.315	0.187	0.231	0.244	0.253	0.258	0.169	0.344

Panel B. Extended Regression

	Payout Ratio		Size		Years		Bond rate		KZ index	
	Unconstraint	Constraint	Unconstraint	Constraint	Unconstraint	Constraint	Unconstraint	Constraint	Unconstraint	Constraint
δ	-0.0801***	-0.1108***	-0.0662***	-0.1076***	-0.0637***	-0.1444***	-0.0640***	-0.1222***	-0.0439***	-0.1327***
	(0.0062)	(0.0053)	(0.0059)	(0.0072)	(0.0043)	(0.0048)	(0.0039)	(0.0056)	(0.0038)	(0.0086)
Cash Flow	0.1570***	0.1125***	0.2099***	0.0988***	0.1318***	0.1260***	0.1255***	0.1503***	0.0842***	0.1753***
	(0.0087)	(0.0056)	(0.0109)	(0.0064)	(0.0076)	(0.0047)	(0.0057)	(0.0065)	(0.0049)	(0.0094)
No. of Obs.	32313.000	35491.000	34597.000	22042.000	37104.000	64602.000	48814.000	52892.000	27689.000	28014.000
R-Squared	0.228	0.262	0.319	0.231	0.239	0.276	0.263	0.278	0.173	0.371

proposition 2. Among five criteria, only two criteria, bond rate and KZ index, displays investment to cash flow sensitivity increment with friction, while duration of cash flow sensitivity has emphsized with friction consistently in four criteria except payout ratio. For example, coefficient of τ is negative and it is emphasized with more financial friction firm size criteria with baseline model, from -0.0479 to -0.0685. However, coefficient of cash flow is smaller with financial friction from 0.2062 to 0.0903, which suppose to be increased if it truly reflects financial friction.

2.4 Conclusion

In this paper, I provide the implication of cash flow duration and investment interaction for understanding stylized facts of empirical capital structure, which finding is that shorter cash flow duration lessen investment activity. From the model depicting that firm optimally invest in production with firm specific cash flow duration, I analyze that even in the absence of financing constraints, it is possible to observe positive investment-cash flow sensitivities. More importantly, firms with a shorter cash flow duration tend to retrench investment unless new investment has substantially large return. This result is driven by the firms' tendencies of operating cost to cash flow from asset in place rather than external finance or return from new investment.

By analyzing the model with additional financing constraint, I show that the cash flow duration and investment relationship is amplified with the level of financial constraint. This also provides an explanation on why the young firms invest more than the old ones do. Young firmd usually faces financial constraints. When young firms encounter increment of duration of cash flow with their growth, more investment will be made, and financial constraints amplify this investment. In addition, I confirm that it is possible the cash flow sensitivity to investment does not clearly show the constraint. Therefore, this paper can provide analysis of investment policy model through cash flow duration effect with financial constraint.

REFERENCES

"How to Depreciate Property–Section 179 Deduction, MACRS, Listed Property", IRS (2012).

Acharya, V., S. A. Davydenko and I. A. Strebulaev, "Cash Holdings and Credit Risk", Review of Financial Studies **25**, 12, 3572–3609 (2012).

Almeida, H. and M. Campello, "Financial Constraints and Investment-Cash Flow Sensitivities: New Research Directions", SSRN Electronic Journal (2002).

Almeida, H. and M. Campello, "Financial Constraints, Asset Tangibility, and Corporate Investment", Review of Financial Studies **20**, 5, 1429–1460 (2007).

Almeida, H. and M. Campello, "Financing Frictions and the Substitution between Internal and External Funds", Journal of Financial and Quantitative Analysis **45**, 03, 589–622 (2010).

Almeida, H., M. Campello and M. S. Weisbach, "The cash flow sensitivity of cash", The Journal of Finance **59**, 4, 1777–1804 (2004).

Almeida, H., M. Campello and M. S. Weisbach, "Corporate financial and investment policies when future financing is not frictionless", Journal of Corporate Finance **17**, 3, 675–693 (2011).

Baker, M. and J. Wurgler, "A Catering Theory of Dividends", The Journal of Finance **59**, 3, 1125–1165 (2004a).

Baker, M. and J. Wurgler, "Appearing and disappearing dividends: The link to catering incentives", Journal of Financial Economics **73**, 2, 271–288 (2004b).

Barberis, N. and A. Shleifer, "Style investing", Journal of Financial Economics **68**, 2, 161–199 (2003).

Berger, P. G., E. Ofek and I. Swary, "Investor valuation of the abandonment option", Journal of Financial Economics **42**, 2, 257–287 (1996).

Bloom, H. S., "Modern regression discontinuity analysis", Journal of Research on Educational Effectiveness **5**, 1, 43–82 (2012).

Bolton, P., H. Chen and N. Wang, "A unified theory of Tobin's q, corporate investment, financing, and risk management", The Journal of Finance **66**, 5, 1545–1578 (2011).

Bond, S. and C. Meghir, "Dynamic investment models and the firm's financial policy", The Review of Economic Studies **61**, 2, 197–222 (1994).

Boyer, B. H., "Style-Related Comovement: Fundamentals or Labels?", The Journal of Finance **66**, 1, 307–332 (2011).

Brav, A., J. R. Graham, C. R. Harvey and R. Michaely, "Payout policy in the 21st century", Journal of Financial Economics **77**, 3, 483–527 (2005).

Bushman, R., A. Smith and F. Zhang, "Investment-cash flow sensitivities are really investment-investment sensitivities", Working Papar (2011).

Chen, H. J. and S. J. Chen, "Investment-cash flow sensitivity cannot be a good measure of financial constraints: Evidence from the time series", Journal of Financial Economics **103**, 2, 393–410 (2012).

Crane, A. D., S. Michenaud and J. P. Weston, "The Effect of Institutional Ownership on Payout Policy: Evidence from Index Thresholds", Working Papar, Rice Univercity (2014).

Cuñat, V., M. Gine and M. Guadalupe, "The Vote Is Cast: The Effect of Corporate Governance on Shareholder Value", The Journal of Finance **67**, 5, 1943–1977 (2012).

Custodio, C. and M. A. Ferreira, "Generalists versus specialists: Lifetime work experience and CEO pay", Available at SSRN 1785943 (2012).

Custódio, C., M. A. Ferreira and L. Laureano, "Why are US firms using more short-term debt?", Journal of Financial Economics (2012).

Deangelo, H., L. Deangelo and R. M. Stulz, "Dividend policy and the earned/contributed capital mix: a test of the life-cycle theory", Journal of Financial Economics (2006).

Eisfeldt, A. and T. Muir, "Aggregate Issuance and Savings Waves", Available at SSRN 1984063 (2013).

Eisfeldt, A. L. and A. A. Rampini, "Financing shortfalls and the value of aggregate liquidity", Duke University Fuqua School of Business Working Paper. http://faculty. fuqua. duke. edu/areas/finance/SG. papers/WP (2009).

Erickson, T. and T. M. Whited, "Measurement error and the relationship between investment and q", Journal of Political Economy **108**, 5, 1027–1057 (2000).

Erickson, T. and T. M. Whited, "Treating Measurement Error in Tobin's q", Review of Financial Studies **25**, 4, 1286–1329 (2012).

Fama, E. F. and K. R. French, "Disappearing dividends: changing firm characteristics or lower propensity to pay?", Journal of Financial Economics **60**, 1, 3–43 (2001).

Fazzari, S. M., R. G. Hubbard and B. C. Petersen, "Financing Constraints and Corporate Investment", (1987).

Franklin, A. and R. Michaely, *Payout policy* (Handbook of the Economics of Finance, 2003).

Froot, K. A., D. S. Scharfstein and J. C. Stein, "Risk managements coordinating corporate investment and financing policies", The Journal of Finance **48**, 5, 1629–1658 (1993).

Gomes, J. F., "Financing investment", American Economic Review pp. 1263–1285 (2001).

Gomes, J. F., L. Kogan and M. Yogo, "Durability of Output and Expected Stock Returns", Journal of Political Economy **117**, 5, 941–986 (2009).

Gopalan, R., T. T. Milbourn, F. Song and A. V. Thakor, "Duration of Executive Compensation", Journal of Finance (2013).

Goswami, G., "Asset maturity, debt covenants, and debt maturity choice", Financial Review **35**, 4, 51–68 (2000).

Grinstein, Y. and R. Michaely, "Institutional Holdings and Payout Policy", The Journal of Finance **60**, 3, 1389–1426 (2005).

Grullon, G. and R. Michaely, "Dividends, Share Repurchases, and the Substitution Hypothesis", The Journal of Finance **57**, 4, 1649–1684 (2002).

Hadlock, C. J. and J. R. Pierce, "New Evidence on Measuring Financial Constraints: Moving Beyond the KZ Index", Review of Financial Studies **23**, 5, 1909–1940 (2010).

Han, S. and J. Qiu, "Corporate precautionary cash holdings", Journal of Corporate Finance **13**, 1, 43–57 (2007).

Hayashi, F., "Tobin's marginal q and average q: A neoclassical interpretation", Econometrica: Journal of the Econometric Society pp. 213–224 (1982).

Hennessy, C. A. and T. M. Whited, "How costly is external financing? Evidence from a structural estimation", The Journal of Finance **62**, 4, 1705–1745 (2007).

Himmelberg, C. P. and B. C. Petersen, "R & D and internal finance: A panel study of small firms in high-tech industries", The Review of Economics and Statistics pp. 38–51 (1994).

Hoberg, G. and N. R. Prabhala, "Disappearing Dividends, Catering, and Risk", The Review of Financial Studies **22**, 1, 79–116 (2009).

Imbens, G. and K. Kalyanaraman, "Optimal Bandwidth Choice for the Regression Discontinuity Estimator", The Review of Economic Studies **79**, 3, 933–959 (2012).

Jagannathan, M., C. P. Stephens and M. S. Weisbach, "Financial flexibility and the choice between dividends and stock repurchases", Journal of financial Economics **57**, 3, 355–384 (2000).

Johnson, S. A., "Debt maturity and the effects of growth opportunities and liquidity risk on leverage", Review of Financial Studies (2003).

Kaplan, S. N. and L. Zingales, “Do investment-cash flow sensitivities provide useful measures of financing constraints?”, The Quarterly Journal of Economics **112**, 1, 169–215 (1997).

Kim, C.-S., D. C. Mauer and A. E. Sherman, “The determinants of corporate liquidity: Theory and evidence”, Journal of Financial and Quantitative Analysis **33**, 3 (1998).

Kydland, F. E. and E. C. Prescott, “Time to build and aggregate fluctuations”, Econometrica: Journal of the Econometric Society pp. 1345–1370 (1982).

Lamont, O., C. Polk and J. Saá-Requejo, “Financial constraints and stock returns”, Review of Financial Studies (2001).

Lee, D. S., “Randomized experiments from non-random selection in U.S. House elections”, Journal of Econometrics **142**, 2, 675–697 (2008).

Lee, D. S. and T. Lemieux, “Regression Discontinuity Designs in Economics”, Journal of Economic Literature **48**, 2, 281–355 (2010).

Lintner, J., “Distribution of incomes of corporations among dividends, retained earnings, and taxes”, The American Economic Review (1956).

Lucas, R. E., Jr and E. C. Prescott, “Investment under uncertainty”, Econometrica: Journal of the Econometric Society pp. 659–681 (1971).

Lyandres, E., “Costly external financing, investment timing, and investment–cash flow sensitivity”, Journal of Corporate Finance **13**, 5, 959–980 (2007).

Majd, S. and R. S. Pindyck, “Time to build, option value, and investment decisions”, Journal of Financial Economics **18**, 1, 7–27 (1987).

Mao, L. and Y. Tserlukevich, “Repurchasing Debt”, Working paper (2014).

Massa, M. and L. Zhang, “Cosmetic mergers The effect of style investing on the market for corporate control”, Journal of Financial Economics **93**, 3, 400–427 (2009).

Meneghettia, C. and R. Williamsb, “Fortune favors the bold”, eurofidai.org (2013).

Michaely, R. and C. Vincent, “Do Institutional Investors Influence Capital Structure Decisions?”, Available at SSRN 2021364 (2013).

Milne, A. and A. E. Whalley, “‘Time to build, option value and investment decisions’: a comment”, Journal of Financial Economics **56**, 2, 325–332 (2000).

Minton, B. A. and C. Schrand, “The impact of cash flow volatility on discretionary investment and the costs of debt and equity financing”, Journal of Financial Economics **54**, 3, 423–460 (1999).

Moore, J. and N. Kiyotaki, “Credit Cycles”, Journal of Political Economy **105**, 2 (1997).

Moyen, N., "Investment–cash flow sensitivities: Constrained versus unconstrained firms", The Journal of Finance **59**, 5, 2061–2092 (2004).

Skinner, D. J., "The evolving relation between earnings, dividends, and stock repurchases", Journal of Financial Economics **87**, 3, 582–609 (2008).

Tsoukalas, J. D., "Time to build captal: Revisiting investment-cash-flow sensitivities", Journal of Economic Dynamics and Control **35**, 7, 1000–1016 (2011).

Whited, T. M., "External finance constraints and the intertemporal pattern of intermittent investment", Journal of Financial Economics **81**, 3, 467–502 (2006).

Yoshikawa, H., "On the 'q' Theory of Investment", American Economic Review **70**, 4, 739–743 (1980).

Zhou, C., "Time-to-build and investment", Review of Economics and Statistics **82**, 2, 273–282 (2000).

APPENDIX A

INTERNAL VALIDITY TEST FOR CHAPTER 1

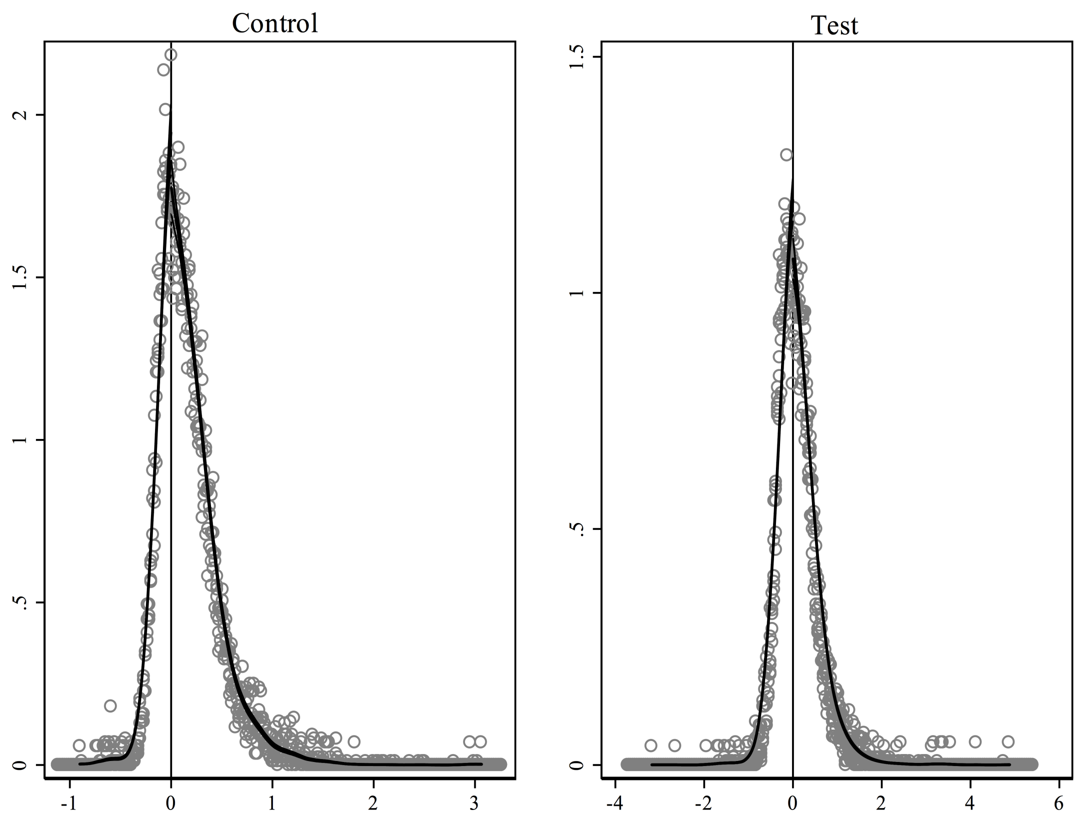

Figure A.1: Internal Validity - Density Test

APPENDIX B

DEFINITION OF MAIN VARIABLES FOR CHAPTER 2

Table B.1: Definition of Main Variables

	Chapter 1
Dividend Payout	Dividend per Share / Earning per Share (excluding extraordinary items), %
Dividend Yield	Dividend per Share / Price Close, %
Repurchases	Purchase of Common and Preferred Stock / Total Assets, %
Net Repurchases	Treasury Stock / Total Assets, % *If Treasury stock is not used for 2 years, then* Max {0, (Purchase - Sale of Common and Preferred Stock) / Total assets}, %
Growth Rate	(Total Assets - Total Assets$_{t-1}$) / Total Assets$_{t-1}$, %
ROA	Income Before Extraordinary Items / Total Assets, %
Investment	Capital Expenditures / Total Assets, %
R&D	Research and Development Expense / Total Assets, %
Leverage	Long-Term Debt / Total Debt, %
Saving	(Cash and Short-Term Investments - Cash and Short-Term Investments$_{t-1}$)/ Total Assets$_{t-1}$, %
Institutional Holdings	Sum of Institutional Shares Holdings from 13F filing / Shares Outstanding, %
Employment growth	(Employees - Employees$_{t-1}$) / Employees$_{t-1}$, %
	Chater 2
Cash Assets	Cash and Short-term Investments / Total Assets$_{t-1}$
Investment	Capital Expenditures / Total Assets$_{t-1}$
Cash Flow	Earnings before Extraordinary Items and Depreciation / Total Assets$_{t-1}$
Q	A proxy for investment opportunities computed as (AT + (CSHO $\times$ PRCC_f) - CEQ- TXDITC) / AT
Net Debt Issue	(Long-Term Debt Issuance - Long-Term Debt Reduction) / Total Assets$_{t-1}$
Net Equity Issue	(Sale of Common and Preferred Stock - Purchase of Common and Preferred Stock) / Total Assets$_{t-1}$
Net External Finance	Net Debt Issue + Net Equity Issue
Long-term Assets	(Book Value of Property Plant and Equity + Goodwill) / Non-cash Total Assets