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Essays on information asymmetry and the firm

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ESSAYS ON INFORMATION ASYMMETRY AND THE FIRM

by

Miaomiao Yu

An Abstract

Of a thesis submitted in partial fulfillment
of the requirements for the Doctor of
Philosophy degree in Business Administration
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The University of Iowa

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Thesis Supervisors: Professor Matthew T. Billett
Associate Professor Jon A. Garfinkel

ABSTRACT

This thesis comprises of three chapters. The first essay is coauthored with Professor Matthew T. Billett and is titled 'Asymmetric Information and Open Market Share Repurchases.' The second essay is join work with Professor Matthew T. Billett and Professor Jon A. Garfinkel and is titled 'The Effect of Asymmetric Information on Product Market Outcomes'. The third essay is sole-authored and is titled 'Crash Risk and Firms' Cash Policies'.

Chapter one reveals cross sectional differences in undervaluation by combining open market share repurchase (OMR) announcements with asymmetric information. We find that opaque firms experience significantly larger abnormal returns than transparent firms upon an OMR. Following Ikenberry, Lakonishok and Vermaelen (1995), we strategy the sample by book-to-market, which may relate to undervaluation, and examine the effect of firm opacity within book-to-market groupings. High book-to-market opaque firms experience average three-day market-adjusted returns of 5.05% compared to 1.86% for high book-to-market transparent firms. We also document significantly positive long run post-announcement returns for opaque firms, but not for transparent firms. Our results suggest undervaluation motive for OMRs is concentrated in opaque firms, and that undervaluation due to asymmetric information attenuates at the announcement of OMRs.

Chapter two explores how asymmetric information in financial markets affects outcomes in product markets. Given endogeneity concerns, we study firms in industries that experience deregulatory shocks. Post-deregulation, firms with greater opacity about their financial condition lose market share to their industry rivals. We further show that opaque firms have lower capital raising activity after deregulation. We conclude that asymmetric information in financial markets is an important determinant of product market outcomes.

Chapter three examines the effect of crash risk on firms' cash policies. We find high crash risk firms which experience large negative stock returns over the fiscal year or show large conditional negative return skewness tend to hold more cash than low crash risk firms. The phenomena are more pronounced for financial constraint firms and small firms. In addition, we show that the marginal value of cash for high crash risk firms is lower compared to low crash risk firms. Based on our findings, we argue that crash risk has been taken into account when firms make their cash decisions.

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CERTIFICATE OF APPROVAL

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PH.D. THESIS

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To my family

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I appreciate all the help and support from my professors, family and friends.

ABSTRACT

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CHAPTER 1
ASYMMETRIC INFORMATION AND OPEN MARKET SHARE REPURCHASES

1.1 Introduction

The question of whether OMR announcements reveal undervaluation has been a long standing question in the theoretical and empirical literature. While numerous studies theorize such a relation can exist, empirical studies have not found strong evidence in OMR announcement returns. Chan, Ikenberry, and Lee (2004), henceforth CIL, state: "…focusing only on the initial announcement return, we find limited support for the mispricing hypothesis…" (p. 462).[1] This is perhaps even more surprising in light of the magnitude of the post-announcement excess returns, which average over 18% over the subsequent three years according to CIL (2004). If markets indeed perceive undervaluation, then we might expect the large long-run returns to be incorporated, to a greater degree, at the OMR announcement, or at least we would expect determinants of the long run returns to also influence the announcement returns; however, Ikenberry, Lakonishok, and Vermaelen (1995), henceforth ILV, find this is not the case. ILV (1995) use book-to-market to separate "value" stocks from "glamour" stocks with the notion that undervaluation is more likely to occur in value stocks. Consistent with undervaluation they find higher long-run post-OMR announcement excess returns to value firms (34.29% over three years). However, they find no difference in the OMR announcement returns.

One possible reason for this discrepancy, pointed out by CIL (2004), is that tests based on metrics like book-to-market assume mispricing is identifiable from public

[1] They and others recognize the positive average announcement returns are consistent with undervaluation; however, other motives, such as increasing leverage and disbursing excess cash, can also enhance firm value and predict positive wealth effects.

information; but mispricing may also be driven by private information.[2] If mispricing is driven by private information, in addition to or rather than public information, then we would expect the wealth effects of OMRs to be more pronounced for relatively opaque firms. The intuition is as follows. Given asymmetric information can lead to misvaluation, and recognizing that undervalued (but not overvalued) firms will conduct OMRs renders the empirical prediction that the shareholder wealth effect to OMR announcements should increase in the degree of a firm's information asymmetry.

We explore how measures of asymmetric information combine with open market share repurchase (OMR) announcements to reveal undervaluation. If managers with positive private information use OMRs to mitigate undervaluation, then we would expect this undervaluation motive to be concentrated in relatively opaque firms. Consistent with this notion, we find the wealth effects at the OMR announcement are more than twice as large for opaque firms than for transparent firms.

To measure asymmetric information, we adopt a novel approach used by Lee and Masulis (2009) who examine a similar issue for SEOs. Lee and Masulis (2009) argue the typical proxies for asymmetric information (Tobin's Q, size, stock return volatility, components of the bid-ask spread, analyst forecast dispersion, etc.) may have multiple interpretations. They instead focus on a measure of the quality of reported financial information, accruals quality. Financial statements are important sources for outside investors to value the firm. Unlike abnormal accruals which can capture managerial manipulation, accrual quality measures the degree to which economic, industry, firm

[2] Peyer and Vermaelen (2009) also use public information to measure potential undervaluation. They construct an index measure based on book-to-market, size, prior returns, and the stated purpose of the repurchase in press releases to construct an undervaluation index. They find this measure correlates with OMR wealth effects at both the long and short horizon. As we discuss below, we add to this literature by focusing on the information content of private, rather than public, information.

shocks as well as manager discretion drive volatility of the firm's fundamental accounting information.

Lee and Masulis (2009) argue that when accounting information quality is low (i.e., high fundamental information volatility), investors will have more difficulty making value inferences. However, in these circumstances, management likely has additional information beyond that contained in the accounting statements:

> Because managers have better internal sources of information, financial accounting statement quality is unlikely to cause a similar rise in manager uncertainty, implying that this rise in uncertainty represents an asymmetric information effect. (Lee and Masulis (2009) p. 444)

It is important to note that accrual quality is not specifically designed to capture asymmetric information, yet a number of studies use it to proxy for information asymmetry in both accounting and finance (see Francis et al. (2005), Aboody, Hughes and Liu (2005), Lee and Masulis (2009)). Accrual quality measures volatility in unexplained accruals (i.e. the volatility of the residuals from accrual regressions) that can result from earnings manipulation, complicated transactions (like foreign exchange transactions, mergers and acquisitions, restructurings, etc.), firm, industry, and market wide shocks, operating cyclicality, and GAAP accounting choices. What makes this measure useful as a proxy for asymmetric information is the notion that complexity in the financial statements likely makes the information gap between insiders and outsiders more pronounced.

We begin by showing circumstances under which the degree of undervaluation inferred at an OMR announcement increases in asymmetric information (see section 2). Next, using a sample of 4,047 announcements of OMRs from 1981-2007, we examine the relation between abnormal returns around OMR announcements and accrual quality, our proxy for asymmetric information. We find that relatively opaque firms experience an

average market-adjusted three-day return that is 1.61% higher than that for relatively transparent firms.[3]

We further stratify the sample on book-to-market, following ILV (1995). For the low book-to-market tercile, those unlikely to be undervalued, we find no difference between the abnormal returns of the transparent and opaque groups. However, among those firms more likely to be undervalued, the high book-to-market group, we find opaque firms earn substantially higher abnormal returns (5.05%) than transparent firms (1.86%). These results suggest the role of asymmetric information in revealing undervaluation compliments the findings of ILV (1995) and suggests both public and private information are important in revealing undervaluation.

We also examine the relation between our proxy for asymmetric information and long-run stock returns. We find that opaque firms have significant positive long run abnormal returns, but transparent firms do not. We conduct numerous additional tests including multivariate regressions that control for firm, industry, and market characteristics. For example we include firm size, leverage, percent of shares sought, return volatility, governance controls, and industry and year effects, as well as additional controls. We directly control for earnings management by including positive and negative abnormal accruals. We also explore alternative channels that may link accrual quality and wealth effects, such as agency concerns. In all of these tests, we continue to find support for the notion that undervaluation revealed at the announcement of an OMR increases in the asymmetric information. Overall our results indicate undervaluation driven by private information motivates OMRs and the revelation of such information is incorporated by investors at announcement, but not completely given the positive long-run post announcement returns.

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[3] Ho, Liu, and Ramanan (1997) relate asymmetric information, measured by analyst forecast dispersion, to OMR announcement returns but find no significant relation.

1.2 Hypothesis development

The intuition behind our tests relating asymmetric information to undervaluation revealed at OMRs is based on two key assumptions. First, we argue that the degree of private information held by managers is likely related to the degree of potential misvaluation (either over or undervaluation) in the stock market. Second, managers of undervalued firms are more likely to engage in OMRs, all else equal, than managers with overvalued stocks. If these two assumptions hold true, then the magnitude of the price increase will depend on the degree of asymmetric information.[4] For a firm where there is little asymmetric information, the value inference will be relatively minor, but in the case where asymmetric information between insiders and outsiders is severe we would expect to see large price changes.

We formalize this intuition with a simple model. We assume managers have information set denoted I, and value the firm as the sum of expected discounted future cash flows conditional on the information set I: expressed as $P_m = E(md|I) = E(c_m|I)$, where $P_m$is managers' understanding of firm value, m is the discount rate and d is firm's future cash flows. We define c_m as the discounted future cash flows (i.e. $c_m = md$). We also assume that the conditional discounted future cash flows follows normal distribution i.e. $c_m|I \sim N(u_m, \sigma_m^2)$. For simplicity, and without loss of generality, we consider the special case where $\sigma_m = 0$, which means mangers know the future cash flow with certainty.[5] If asymmetric information about future cash flows exists, which means

[4] Note that if either of these assumptions is not true, then we would expect to find no relation between asymmetric information and OMR announcement effects. For example, if managers of overvalued firms also engage in OMRs then the market may not make any valuation inferences. See John and Sundaram (2010) for a discussion on the theoretical requirements for signaling model equilibrium to hold.

[5] This is for simplicity in exposition and notation. In the general case where $\sigma_m > 0$, the comparative statics and testable implications are all in the same direction as in the special case of $\sigma_m = 0$.

outside investors do not have as much information as managers, then investors have information set I', defined as a subset of managers' information set I. Investors form their expectations of firm's discounted future cash flows based on all the available information I', i.e. $P_i = E(md|I') = E(c_i|I')$. We assume investors' beliefs about the value of discounted future cash flows are normally distributed, and the market price is determined by the representative investor's expectation. Last, we assume the dispersion of the distribution of investor's beliefs is an increasing function of information asymmetry.

$$C_i|\, I' \sim N\,(u, \sigma^2)$$

$$\mu = P_{MKT}$$

$$\sigma = f(\text{information\_asymmetry})$$

where the random variable $c_i|\, I'$ represents investor's beliefs about firm's discounted future cash flows conditional on information set I', μ is the mean of the distribution of beliefs which is equal to the market price, P_{MKT}, and σ is the standard deviation of the distribution of beliefs.

Now presume the manager observes that the stock is undervalued, $P_{MKT} < P_m$, and announces an OMR program, and investors update their beliefs. If investors take the OMR as credible information of undervaluation, they will assign a zero probability to the cases where the discounted future cash flows is below the current market price.[6] In other words, conditional on the repurchase announcement, all beliefs about firm's discounted future cash flows are shifted to the right hand side of the market price. The truncated normal distribution is formed accordingly. This updating process generates a conditional distribution of investors' beliefs and results in a new expected value correspondingly. The new expected value is the price that the representative investor would form based on

[6] All results hold as long as investors reduce the probability mass in the region $P_i < P_{MKT}$, i.e., in the case where the manager has imperfect information, $\sigma_m > 0$ or when investors are not certain the firm's stock is undervalued and only partially adjust their distribution of beliefs.

the repurchase announcement. This leads to a new market price P'_{MKT} , which is derived by the following:

$$E\left(c_i\middle|I',(c_i>P_{MKT})\right)=\int_{-\infty}^{+\infty} f\left(c_i\middle|I',(c_i>P_{MKT})\right)c_i dc_i=P_{MKT}+\frac{2\sigma}{\sqrt{2\pi}}=P'_{MKT} \quad (1.1)$$

The above equation shows that the new market price is an increasing function of standard deviation of the original distribution of investors' beliefs (σ). The repurchase announcement return is therefore:

$$AR=\frac{P'_{MKT}-P_{MKT}}{P_{MKT}}=\frac{2\sigma}{\sqrt{2\pi}u} \quad (1.2)$$

where AR is the announcement return.

Fig. 1 illustrates our hypothesis by examining the effect of an OMR on two firms, with a high and low degree of investor uncertainty. The price change occurs by moving from the mean of the unconditional distribution (solid line) to the mean of the conditional distribution (dotted line). We see the firm with a high degree of investor uncertainty (the firm with the large initial variance), experiences a larger price change than the otherwise identical low variance firm.

We relax the assumption of $\sigma_m = 0$ (i.e., that mangers know the future cash flows with certainty), and assume managers' conditional distribution of discounted future cash flows follows normal distribution with mean μ_m and standard deviation $\sigma_m > 0$. We then simulate the distribution of investor beliefs conditional on an OMR announcement as follows. First, we assume investors' unconditional beliefs are normally distributed with mean and standard deviation μ_{Low} and σ_{Low} and μ_{High} and σ_{High} for firms with low and high information asymmetry, where $\sigma_{Low} < \sigma_{High}$. Upon an OMR announcement, investors infer $\mu_{Low} < \mu_m$, in the case of firms with low information asymmetry. They update their beliefs, and their conditional distribution reflects this new information. We simulate this

conditional distribution as follows. 1) Upon the OMR announcement, investors take a draw, $a1$, from their unconditional distribution, $N(\mu_{Low}, \sigma_{Low})$. 2) They then take a draw, $m1$, from the estimated managers distribution of beliefs $N(a1, \sigma_m)$. If this second draw is less than the pre-OMR price, $m1 \leq \mu_{Low}$, they redraw until the draw exceeds μ_{Low} (i.e. they redraw conditional on the knowledge that $\mu_{Low} \leq \mu_m$). Once the draw meets the criteria $m1 > \mu_{Low}$, they have an estimate of the manager's distribution that is conditioned on $\mu_{Low} \leq \mu_m$, distributed $N(m1, \sigma_m)$. 3) Now the investor draws from this conditional distribution to get a sample observation from the manager's inferred distribution. Infinitely repeating steps 1) through 3) reveals the investors' conditional distribution, with mean equal to the new price.

To operationalize this procedure we set investors' unconditional distribution to be $N(0, 0.5)$ for low asymmetry firms and $N(0, 1)$ for high asymmetry firms. We further assume manager's beliefs are distributed $N(\mu_m, 0.25)$. We repeat steps 1) to 3) 100,000 times to generate the data series, where the mean of the data will be the new market price. Fig. 2 illustrates the simulated conditional distributions and compares them with their unconditional counterpart. High information asymmetry is represented by the black curves and low information asymmetry by the red curves. The solid lines are the unconditional distribution and the dashed are the conditional distributions. Consistent with the simplified case, the price change (shift in the mean from unconditional to conditional distribution) for high information asymmetry firms is greater than the price change for low information asymmetry firms around the OMR announcement. This leads to our main hypothesis:

Hypothesis: If the OMR is motivated by undervaluation, then the announcement return increases in asymmetric information.

1.3 Sample and variable description

Our repurchase sample is from Security Data Company's (SDC) Mergers and Acquisitions database. We select the deal type as repurchases and sample period from 1981 to 2007.[7] We exclude announcements in the last calendar quarter of 1987. Following Lie (2005), we further exclude repurchase announcements categorized as self-tender offers or block repurchases. We then exclude financial firms and utility firms, SIC codes of 4800-4829, 4910-4949 and 6000-6999, and firms with a stock price less than one dollar in the repurchase announcement month. Stephens and Weisbach (1998) point out that SDC may double count the same repurchase announcement if the announcement is reported by different media outlets on different days. Lie (2005) finds that actual repurchases generally last for two fiscal quarters, the announcement quarter and the subsequent fiscal quarter (see also Gong, Louis and Sun (2008)). We therefore eliminate subsequent share repurchase announcements that occur in the same fiscal quarter or the fiscal quarter following a prior announcement. In addition, we require our sample firms have necessary CRSP and COMPUSTAT data to calculate three day market-adjusted and size and book-to-market adjusted announcement returns.

Imposing these requirements results in a sample of 5,680 open market share repurchase announcements. After we require data to calculate accruals quality, our measure of asymmetric information, we are left with a final sample of 4,047 observations when we use the "balance sheet" approach to measure accruals quality and 2,850 observations when we use the "cash flow" approach to measure accruals quality (we discuss the merits, details and data requirements of both approaches below). All variables are expressed in real values in 2007 dollars using the Consumer Price Index, and all of the final calculated variables based on accounting items are winsorized at the 1% and 99% level.

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[7] SDC provides repurchase data starting from 1980, and in 1980 there is only 1 event, and in 1981 there are 9 events.

Table 1 presents the repurchase announcements by year and by the 49 Fama-French 49 industry classifications.[8] A large proportion of OMRs were announced in the 1990s, and the trend appears to slow in the 2000s. OMRs peak in 1998 with 459 announcements. The lowest industry representation is in the precious metals industry where only two firms announce OMRs, USMX INC. and Vista Gold Corp.[9] The top three industries in are retail (290), computer software (289) and electronic equipment (281).

1.3.1 Announcement returns

To measure the wealth effects at the OMR announcements we compute three-day (-1, +1) and five-day (-2, +2) market-adjusted returns and size and book-to-market adjusted returns centered on the announcement date. We define market-adjusted returns as compounded daily returns for the repurchase firm minus the compounded daily returns of the value-weighted market index. We compute size and book-to-market adjusted announcement returns, by subtracting the cumulative daily returns of a size and book-to-market matched portfolio from the cumulative return for the repurchase firm. We compute the repurchase firm's book-to-market using the book value of equity as of the fiscal year end prior to the repurchase, year t-1, and divide that by its market value of equity as of December of year t-1. We calculate size as the market value of equity at the end of June of year t. At the end of each June, we assign repurchase firms a matching portfolio based on the book-to-market and size breakpoints (downloaded from Kenneth French's website) and obtain the benchmark returns from July of year t to June of year t+1.

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[8] Figures reported are for the larger sample where we require accruals quality based on the balance sheet approach. The time and industry distribution is similar when we use the cash flow approach.

[9] USMX INC announced an OMR in August 1994 and Vista Gold Corp in May 1992.

1.3.2 Accruals quality

We follow Lee and Masulis (2009) who use the modified Dechow and Dichev (2002) model (hereafter DD) as applied in Francis et al. (2005) to measure accruals quality. This method first requires expressing total current accruals as a function of operating cash flows, change in sales, and PP&E, and results in the following equation:

$$TCA_{j,t} = c + \emptyset_1 CFO_{j,t-1} + \emptyset_2 CFO_{j,t} + \emptyset_3 CFO_{j,t+1} + \emptyset_4 \Delta Sales_{j,t} + \emptyset_5 PPE_{j,t} + v_{j,t} \quad (1.3)$$

where $TCA_{j,t}$ is total current accruals for firm j in year t. For the balance sheet approach: $TCA_{j,t} = \Delta CA_{j,t} - \Delta CL_{j,t} - \Delta Cash_{j,t} + \Delta STDEBT_{j,t}$, CA = current assets (ACT), CL = current liabilities (LCT), $Cash$ = cash and short term investments (CHE), $STDEBT$ = debt in current liabilities (DLC), $CFO_{j,t}$ is firm j's cash flow from operations in year t, $CFO_{j,t} = IB_{j,t} - TA_{j,t}$, IB =net income before extraordinary items (IB), $TA_{j,t} = \Delta CA_{j,t} - \Delta CL_{j,t} - \Delta Cash_{j,t} + \Delta STDEBT_{j,t} - DEPN_{j,t}$, $DEPN$ =depreciation and amortization (DP**)**, $\Delta Sales_{j,t}$=$Sales_{j,t} - Sales_{j,t-1}$, $Sales_{j,t}$= sales revenue for firm j in year t (SALE), $PPE_{j,t}$=total property plant and equipment for firm j in year t (PPENT).

All of the variables are scaled by the average value of total assets computes as the average of total assets at the beginning and at the end of the year t. We then estimate equation (3) by running separate industry-year regressions for each industry with at least 20 firms in that given year.[10] We then take a given firm's specific residuals from five industry-year regressions from years t-4 to t and define accruals quality as the standard deviation of those residuals. A lower standard deviation of residuals corresponds to higher accrual quality.

[10] The industry definition is based on the Fama and French 49-industry categories.

Lee and Masulis (2009) argue that accounting information quality, measured by accruals quality, is a good proxy for information asymmetry between managers and outside investors. They argue that for outside investors, financial statements are the primary information source to learn about firm performance, and that accruals quality measures the clarity of the information contained in firms' financial statements.

There are several advantages of this information asymmetry measure relative to other measures found in the literature. First, it is not influenced by stock market microstructure and trading activity. Second, accounting information quality is a clear and more focused measure compared to firm characteristics proxies, like firm size. Third, analyst based measures tend to exclude a large fraction of firms with little or no analyst coverage. Moreover, in contrast to earnings management measures, accrual quality reflects both the intentional misstatements and unintentional errors resulting from management lapses and environmental uncertainty (Francis et al. (2005)). Both intentional and unintentional errors contribute to the misunderstanding of financial statements by investors (see Lee and Masulis (2009) for more discussion of accrual quality measure).

So what exactly does accruals quality capture? Accruals quality will be affected by managerial discretion as well as by whether the firm engages in complicated transactions, like mergers and acquisitions, restructurings, and foreign exchange and cross border transactions. Ashbaugh-Skaife et al (2008) show accrual quality is determined by the strength/weakness of the firm's internal controls as well as on business fundamentals and operating characteristics, GAAP accounting choices, accounting conservatism, and auditor quality.[11]

[11] Much of the accounting literature on accruals quality tries to methodologically isolate the managerial discretion component to see whether managers are intentionally manipulating the accounting information. We control for managerial manipulation and governance in our tests as well as use different accruals quality measures to better insure we capture the effect of asymmetric information.

In addition to managerial choices in reporting, accruals quality can also be influenced by complicated transactions (like mergers & acquisitions, restructuring, foreign transactions) that also create volatility in financial reporting over time. This has led the literature to develop two ways of estimating accruals quality: the first uses balance sheet information to estimate the above regressions while the second uses information from the cash flow statement. The balance sheet approach was first used in the accounting literature and results in a measure that captures volatility in accruals due to both managerial choices as well the aforementioned complicated transactions. However, to better isolate the effect of earnings management, Hribar and Collins (2002) propose the cash flow approach, which better isolates the effect of managerial choices and is more immune to the effects from complicated transactions.

Hribar and Collins (2002) document evidence that mergers and acquisitions, divestitures and foreign currency translations unduly affect balance sheet data, and estimated accruals based on the balance sheet approach will reflect these transactions in addition to earnings management. They propose the cash flow approach which is not distorted by these non-operating events and better isolates discretionary earnings management. For our purposes this distinction between the balance sheet approach and cash flow statement approach will be useful. Accrual quality based on the balance sheet approach captures asymmetric information stemming from both complicated business transactions as well as from managerial discretion. Using the cash flow approach, we can better isolate the effects of managerial discretion. This allows us to compare and contrast the results from the two approaches to gauge the effect of asymmetry information arising from complicated business transactions.

These types of complicated transactions likely play a large role in the degree of information asymmetry. For example, we find that during the OMR announcement year 20 percent of our repurchase sample firms engage in mergers and acquisitions, 6 percent engage in divestitures, and 7 percent have foreign currency translations in the year of

repurchase.[12] When we extend the time period to the four years prior to repurchase (we need data from year t to year t-4 to calculate the accrual quality for repurchase announcement year), 97 percent of the firms engage in mergers and acquisitions, 21 percent engage in divestitures, and 37 percent report foreign currency translations.

In using both approaches we encounter one data issue that further restricts our sample. The necessary cash flow statement data is available only since 1988. Given we need 6 years of data to estimate accruals quality (four yearly industry regressions using explanatory variables lagged up to two years) this approach limits our analysis to the period starting in 1993, and results in a sample size 2,850 (compared to 4,047 for the balance sheet approach).

Table 2 reports the descriptive statistics for our whole repurchase sample as well as the characteristics comparing results for opaque firms and transparent firms. We label accruals quality *Opacity* given asymmetric information should be increasing in accruals quality. We sort firms into three groups by *Opacity* and define the opaque firms as firms belonging to the top tercile and transparent firms as firms belonging to bottom tercile. We see many firm characteristics differ between the two groups. Size has been used as a proxy for asymmetric information. Table 2 shows that opaque firms are small relative to transparent firms. Opaque firms have higher cash holdings and Tobin's q, but lower leverage and capital expenditures than transparent firms. Opaque firms experience higher asset growth and sales growth. However, the higher sales growth does not associate with higher profits (ROA) or operating cash flows. Return volatility, another proxy for information asymmetry used in finance literature, is also larger for opaque firms. The share turnover variable indicates that the shares of opaque firms trade more frequently than transparent firms. One major concern is that our measure of opaqueness may be

[12] We base this statement on analysis of our sample following the definitions of mergers and acquisitions, divestitures and foreign currency translations in Hribar and Collins (2002).

correlated with poor governance and bad managers. Using the BCF entrenchment index created by Bebchuk, Cohen and Ferrell (2009), we see no meaningful differences between the BCF Index of opaque and transparent firms.

1.4 Empirical results

We next explore the wealth effects at the announcement of the open market repurchase. Table 3 reports the average daily abnormal returns and average cumulative abnormal returns for 5 days before and 5 days after the OMR announcements. Market-adjusted returns are reported in panel A and size and book-to-market adjusted returns are reported in panel B. Like prior studies, we see the average market-adjusted cumulative return is positive on the announcement date for the whole sample, as well as for the opaque and transparent sub-samples. The average market-adjusted announcement day return is 2.37% for opaque firms and 1.07% for transparent firms. The cumulative returns for opaque firms and transparent firms show that opaque firms generally have more negative returns prior to the repurchase announcement, and more positive cumulative returns after. The 11 day market-adjusted cumulative return for opaque firms is 2.1%, higher than the 1.45% for transparent firms. Size and book-to-market adjusted returns in panel B show similar results. Overall, these results support the undervaluation hypothesis that announcement returns will be increasing in the degree of asymmetric information.

1.4.1 Univariate tests

We next explore how transparency and other firm characteristics interact. We examine the announcement wealth effects for opaque firms and transparent firms within samples stratified by size, book-to-market, governance, and repurchase characteristics. The results from these univariate comparisons are contained in Table 4. Given the repurchase may be related to poor prior returns, we follow prior studies and focus on the

shorter event windows and report 3-day and 5-day abnormal returns using both the market-adjusted and size and book-to-market adjusted returns. Table 4 reports the univariate tests results for our whole sample and for numerous subsamples. In Panel A we see the market-adjusted three-day return averages 2.94% for opaque firms and 1.33% for transparent firms. The difference between the opaque and transparent firms' announcement returns is 1.60%, statistically significant at the one percent level. We see similar results using the 5-day windows, and when we use size and book-to-market adjusted returns.

These results support the undervaluation hypothesis and are consistent with Zhang (2006). Zhang (2006) denotes that information uncertainty exacerbates misvaluation and presents evidence that market reacts strongly around earnings announcement dates for firms with high levels of information uncertainty. Last these findings provide evidence symmetric to that of Lee and Masulis (2009). They find opaque firms experience more negative returns when the firm announces a seasoned equity offering, while we find they earn more positive returns at the announcement of retiring shares.

As we saw in Table 2, many firm characteristics also differ for opaque and transparent firms. In panels B through H of Table 4, we further stratify the sample based on firm characteristics to see *Opacity*'s affect within the subgroups. Size has been used as a proxy for information asymmetry in the share repurchases literature with mixed results (ILV (1995), Dittmar (2000), Kahle (2002), and Billett and Xue (2007)). In Panel B, we classify firms into big firms and small firms, and then examine the announcement returns for transparent and opaque firms within sizes groups. We define big firms as those with a market capitalization in the pre-announcement month above the 25^{th} percentile of all firms on the NYSE, otherwise the firm is defined as a small firm. Looking at the subsample sizes we see big firms are disproportionately comprised of transparent firms with 1,055 transparent firms and 588 opaque firms. We find just the opposite for small firms where there are 294 transparent firms and 761 opaque firms. Though not directly

reported, we see that the announcement reaction is larger for small firms (3.68%) than for large firms (1.13%), consistent with the prior literature.[13]

So what is the additional effect of our transparent/opaque groupings within size groupings? For big firms the opaque group has an average abnormal return of 1.50% compared to 0.93% for transparent firms. The difference, 0.56%, is significant at 10 percent level. However, within small firms the effect of *Opacity* is much more pronounced. Within small firms group, opaque firms earn 4.05% three-day returns, while transparent firms earn 2.73%, with a difference of 1.32% significant at the one percent level. The difference rises to 1.95% when we look at the average 5-day abnormal return.

We next turn to book-to-market groupings. ILV (1995) use book-to-market ratio as a measure of potential undervaluation. They argue that OMR by high book-to-market firms are more likely motivated by undervaluation and low book-to-market firms are more likely motivated by other reasons. However, they do not find evidence that the market reacts differently for firms with high versus low book-to-market ratios. In contrast, when they examine long-run post-announcement stock returns, they find the last quintile of book-to-market firms (value firms) experiences positive long-run abnormal returns for up to four years after the repurchase announcement. ILV (1995) interpret the findings as market under reaction to OMRs.

To see how book-to-market interacts with our measure of firm opacity we categorize firms based on their book-to-market ratio. We define high book-to-market (value stocks) as the top third and low book-to-market (glamour stocks) as the bottom third. The results are reported in Panel C. We see that, in general, high book-to-market firms earn greater abnormal announcement returns than low book-to-market firms (this is

[13] $3.68\% = 761/(761+294)\ 4.05\% + 294/(761+294)\ 2.73\%, 1.13\% = 588/(588+1055)\ 1.50 + 588/(588+1055)\ 0.93\%$

confirmed in Appendix Table A.1 and A.2 and further discussed below).[14] We also see in Panel C that the influence of *Opacity* is only found with value firms (high book-to-market). We see within the high book-to-market group 3-day market-adjusted returns for opaque firms average 5.05%, while the average for transparent firms is 1.86%. The difference of 3.02% is statistically and highly economically significant. The results are similar across all four abnormal announcement return measures. In contrast, we see no significant differences in the abnormal returns of opaque and transparent firms for the low book-to-market firms. This suggests undervaluation inferences may depend on the combination of public measures of misvaluation (book-to-market) and *Opacity*.

Peyer and Vermaelen (2009) re-examine the role of undervaluation in OMRs by constructing an Undervaluation Index (U-Index). Their U-Index combines size, book-to-market, previous 6-months return and whether the stated motivation in the press release suggests undervaluation as a motive. A higher U-Index, indicates the more likely the OMR is motivated by undervaluation. They find that the long-run abnormal returns following OMRs are much larger for high U-Index firms and that much of the explanatory power of this measure is due to the component related to pre-repurchase announcement returns.

We adopt an approximation to the measure of Peyer and Vermaelen, U-Index, to capture multiple public sources of information about undervaluation to explore the role of asymmetric information's in revealing private information within the firms the U-Index would categorize as likely to be undervalued. We follow Peyer and Vermaelen (2009) to calculate the U-Index with the exception that we lack the stated motive from the press releases (which are hand collected).[15] We compute the U-Index as the sum of ranks

[14] The ILV (1995) sample stops in 1990. Including more recent repurchase announcements results in higher announcement returns for high book-to-market firms.

[15] They report the CARs in the event month for various motives in their Table 6. While there may be significant long-run return differences for their motive categories, they report little variation in CARs based on the announcement month, (0, 0).

based on book-to-market, size and past returns quintiles. We rank repurchase firms' by book-to-market, size, past returns within all Compustat/CRSP firms with available data. Size is computed as stock price multiplied by shares outstanding the month prior to the repurchase announcement. Book-to-market is defined as book value of equity divided by market value of equity at the fiscal year-end prior to the repurchase announcement. Past returns are calculated as the cumulative raw returns from 126 trading days before the repurchase announcement up to 5 days before the announcement date. The ranks are assigned values of 1-5 where 5 is the smallest size, the highest book-to-market, and the lowest past returns quintile. Finally, we sort the sample into terciles based on this U-Index and then compare the wealth effects of opaque and transparent firms within the high and low U-Index groups. The results are reported in Panel D of Table 4.

The results show that, within firms more likely to be undervalued (High U-Index), opaque firms experience 2.49% higher three-day market-adjusted return to transparent firms. For the low U-Index group, opaque firms show 0.37% higher announcement returns compared to transparent firms, which is insignificant. Moreover, the difference between opaque and transparent firms for the low U-Index group is insignificant for the five-day CARs. These results suggest asymmetric information plays an important role in revealing undervaluation that is complimentary to measures of undervaluation that are based on publicly available information.

We next examine the influence of asymmetric information within groupings based on governance. If high accrual quality is simply the result of good governance then the more positive returns to low quality (high information asymmetry) firms may be due to the fact repurchases by entrenched managers are more value enhancing. We sort firms into two groups based on the entrenchment index created by Bebchuk, Cohen and Ferrell (2009), BCF index. They select six provisions most related to firm value from the 24 provisions in GIM's governance index (Gompers, Ishii, Metrick, 2003). The good governance firms are firms with below the median BCF index and bad governance firms

are defined as those with BCF index above the sample median. The adoption of BCF index restricts our sample period to 1990-2007, which reduces the statistical power of our tests for the governance sub-samples.

We see in Panel E the return differences between opaque firms and transparent firms are only statistically significant within the good governance firms. For good governance firms, three-day market-adjusted return to opaque firms is 1.85% and to transparent firms is 1.02%. Their difference is statistically significantly at five percent level. For bad governance firms, the announcement returns are not significantly different between opaque firms and transparent firms. The results are consistent with the notion that poor governance firms may have different motives than undervaluation or are less credible in conveying undervaluation.

The next two panels of Table 4 examine the influence of the sequencing of a repurchase announcement and the actual shares repurchased. Jagannathan and Stephens (2003) find that announcements of subsequent repurchases are met with smaller announcement returns. They argue that less-frequent repurchase programs are more likely motivated by undervaluation and subsequent repurchase programs are probably due to alternative motives. In order to examine whether information asymmetry only plays a role in the infrequent repurchase announcements, we conduct univariate tests within initial repurchase announcements and subsequent repurchase announcements, respectively. We define initial announcements as the first repurchase program initiated in three years, and following announcements as the subsequent repurchase program by firms which also announced repurchases within the last three years.

Our results are consistent with findings in Jagannathan and Stephens (2003) in that following announcements exhibit weaker market reactions than initial announcements. However, within both initial announcements and following announcements groups, opaque firms obtain significantly higher announcement returns than transparent firms. Specifically, the difference of three-day market-adjusted returns to

initial announcements between opaque firms and transparent firms is 1.83% and the difference to following announcements is 1.12%.

There is no requirement that OMR announcements must actually result in the repurchasing of shares. Stephens and Weisbach show that the announcement returns increase in the subsequent actual repurchases that take place, perhaps indicating the more credible repurchase announcements result in higher announcement returns. To see if this influences the impact of asymmetric information we examine the abnormal announcement returns within carry-through programs and non-carry-through programs in Panel G. Gong, Louis, Sun (2008) define carry-through announcements as those where the dollar value of repurchases in the announcement fiscal quarter and subsequent fiscal quarter exceeds 1 percent of the firm's market value of equity. We find significant differences in the announcement reactions of opaque and transparent firms for both groups.

Our last test in Table 4 may be the most important, given our measure of information asymmetry. Gong, Louis and Sun (2008) find that post-repurchase abnormal returns relate to pre-repurchase downward earnings manipulation. Given such manipulation would lead to an increase in the accruals quality measure; it is possible that our results are driven by managers manipulating earnings downward prior to the repurchase, as supported by Gong, Louis and Sun. However, this channel would not explain results within the firms with upward, rather than downward, recent earnings management. To check this we group firms into two categories based on the sign of performance-adjusted quarterly abnormal accruals: positive performance-adjusted quarterly abnormal accruals indicate upward management and negative performance adjusted quarterly abnormal accruals indicate downward management. We construct our measures following Gong, Louis and Sun (2008). Specifically, we calculate performance-adjusted quarterly abnormal accrual by estimating quarterly abnormal accruals using

residuals from the model in Gong, Louis and Sun (2008).[16] We calculate total accruals in Gong, Louis and Sun (2008)'s quarterly abnormal accruals model using data from the cash flow statement (earnings before extraordinary items minus operating cash flows (IBC-OANCF)). For each industry (two-digit SIC code) quarter, we sort firms into five groups based on return on assets from the same quarter in the prior year. Performance-adjusted quarterly abnormal accruals for each firm are calculated as the firm's quarterly abnormal accruals minus the median of quarterly abnormal accruals for its performance matched peer group.

We then split the sample into positive and negative performance-adjusted abnormal accruals subgroups. If our results are driven by downward earnings manipulation then we should not see any effects from opacity in the positive abnormal accruals group (where firms are not manipulating earnings downward). In contrast we find the opposite. The effect of opacity is strong in both groups. Although the difference in OMR announcement returns between opaque firms and transparent firms is slightly bigger in negative group than the difference in returns in positive group, we find opaque firms earn 1.43% higher OMR announcement returns than transparent firms in the group of positive performance-adjusted quarterly abnormal accruals. Thus it does not appear that earning manipulation is driving the effect of *Opacity* on OMR announcement returns.

To summarize the results from Table 4, we examine the influence of asymmetric information within groupings based on characteristics found to be important in the literature. We find asymmetric information has pronounced effects within these groupings, suggesting the role of asymmetric information is not subsumed by any one factor. However, we have yet to control for all of these factors, and others,

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[16] $TA_i = \sum_{j=1}^{4} \lambda_{j-1} Q_{j,i} + \lambda_4 \Delta SALE_i + \lambda_5 \mathrm{PPE}_i + \lambda_6 LTA_i + \lambda_7 ASSET_i + \varepsilon_i$, where TA represents total accruals; Q is a dummy variable. It is equal to one, if the fiscal quarter is j. Otherwise, it is equal to zero; ΔSALE is the quarterly change of sales; PPE is property, plant and equipment at the beginning of the quarter; LTA is the lagged total accruals; ASSET is total assets at the beginning of the quarter.

simultaneously. We next attempt this by examining the announcement returns in a multivariate setting.

1.4.2 Multivariate tests

We run multivariate regressions to test whether opaque firms experience higher abnormal announcement returns than transparent firms after controlling for other factors found to be important determinants in the literature. We regress the three-day market-adjusted return or three-day size and book-to-market adjusted returns on the following:

Opacity is our information asymmetry measure, which is estimated by the standard deviation of residuals from equation (3) during years t-4 to t.

Log(size) is the logarithm of the market value of equity, computed as stock price multiplied by shares outstanding in the month prior to the repurchase announcement. Size (*Log (total assets)*) is measured by the logarithm of total book value of assets (AT) from the fiscal year end prior to the repurchase announcement. It has been shown that large firms earn higher abnormal announcement returns.

Cash holdings are the cash and short-term investments (CHE) scaled by total assets. Firms conducting repurchases with large cash holdings are more likely to distribute excess cash with the purpose of reducing agency conflicts. This may generate positive announcement returns.

Book-to-market is defined as book value of equity divided by market value of equity at the fiscal year-end prior to the repurchase announcement. Book-to-market has been used as a proxy for undervaluation in ILV (1995). Additionally, *book-to-market* may capture the firm's investment opportunities given its high degree of correlation with *Tobin's q* (total assets minus book value of common equity (CEQ) plus market value of common equity divided by total assets). Kahle (2002) uses Tobin's q as a proxy for investment opportunities. If firms have more investment opportunities, they are less likely to distribute cash to shareholders. Billett and Xue (2007) also find the negative association between market-to-book ratio and the propensity to actually repurchase. The negative relation between market-to-book ratio and announcement returns is documented in Grullon and Michaely (2004). Based on the existing empirical evidence, we expect book-to-market is positively related to announcement returns.

Capital expenditures are capital expenditures (CAPX) scaled by total assets at the end of fiscal year prior to the repurchase announcement. Higher investment expenditures indicate that firms have more investment opportunities relative to lower capital

expenditure firms. We suspect firms with high capital expenditure are growing firms and appear to have higher risk in the future. Contrary, firms with low capital expenditure are probably entering into the mature stage denoted by share repurchases. These firms may experience risk decline in the post-announcement period, which causes the higher announcement returns compare to high capital expenditure firms (Grullon and Michaely, 2004). If this is the case, we expect the negative relationship between capital expenditures and abnormal announcement returns.

Leverage is the summation of long term debt (DLTT) and short term debt (DLC) scaled by total assets. Firms with low leverage may repurchase shares outstanding to adjust their leverage ratio.

Return volatility is measured by the standard deviation of daily stock returns over the period of (-90, -11) prior to the announcement date (date 0).

Share turnover is the average daily trading volume during the period of (-90, -11) divided by the shares outstanding of the last trading day prior to the repurchase announcement. Return volatility and share turnover are following Lee and Masulis (2009). Return volatility is used to capture the volatility of firms' economic fundamentals. The effect could be weakened by the market fluctuation. Share turnover is used to capture the liquidity of firms' stocks, which may affect repurchase announcement returns as well.

Percent sought is the percentage of shares the firms seek to repurchase, which is provided by SDC. According to the price pressure hypothesis, if the demand curve is downward sloping, then the higher the percent sought, the higher the announcement returns. This phenomenon should be more pronounced for firms with inelastic demand curve (Corwin, 2003). The empirical evidence for repurchases is shown in Grullon and Michaely (2002, 2004), who find that the percentage of shares authorized to repurchase is positively related to announcement returns. However, Stephens and Weisbach (1998) argue that the announcement returns are not affected by the percent sought but the expectation of actual share repurchases.

BCF index is the index created by Bebchuk, Cohen and Ferrell (2009). After including the governance factor, our sample size is reduced by more than half. We suspect that if repurchases programs conducted by bad governance firms are attributable to bad economic reasons, and then the market should react adversely surrounding the repurchase announcement. If bad governance firms use share repurchase to distribute excess cash, then we expect the market should react favorably due to the reduction of agency conflicts. It is still an empirical question how market reacts to repurchase announcement by firms with different governance mechanism. Wu and Ze (2010) using Taiwan data show that firms with better corporate governance experience more favorable market reaction towards

repurchase announcement. They explain in the way that the good governance lends the credibility to OMRs announcement.

Abnormal accruals are estimated using the Jones model calculated at the end of fiscal year prior to the repurchase announcement.[17] Large positive or negative accruals may indicate earnings management so we sort abnormal accruals into three categories: the top group has the dummy variable *Abnormal accruals_high* equal one, and zero else. If the firm belongs to the bottom group, then *Abnormal accruals_low* equals one, and zero otherwise.

Past returns is calculated as the cumulative raw returns from 126 trading days before the repurchase announcement up to 5 days before the announcement date. Given that prior studies find the wealth effects of OMRs tend to be larger following a period of poor stock returns, we expect *Past Returns* to have a positive relation to announcement returns.

Quarterly abnormal accruals are estimated as the average of abnormal accruals in the repurchase announcement quarter and the quarter prior to the announcement. The abnormal accruals used to define quarterly abnormal accruals are residuals from the model in Gong, Louis and Sun (2008). We calculate the total accruals in their model by earnings before extraordinary items minus operating cash flows (IBC-OANCF) using the data from cash flow statement.

Performance adjusted quarterly abnormal accruals are estimated following Gong, Louis and Sun (2008). For each industry (two-digit SIC code) quarter, we sort firms into five groups based on return on assets from the same quarter in the last year. Performance adjusted quarterly abnormal accruals for each firm are calculated by firm's quarterly abnormal accruals minus the median of quarterly abnormal accruals for the matched peer group.

Cash flow volatility is computed as the standard deviation of the past five years operating cash flows. Operating cash flow is defined as operating income before depreciation (OIBDP) scaled by average assets ((assets t+ assets t-1)/2).

Governance proxies use data from ExecuComp. *CEO pay slice* is calculated by CEO's total compensation to the sum of the top five executives' total compensation (Bebchuk, Cremers, and Peyer (2010)). *CEO ownership* is the shares owned by CEO divided by firm's shares outstanding. *Chairman* is a dummy variable. If CEO is also the chairman of the board, then it is equal to one, otherwise it is equal to zero.

[17] Abnormal accruals are the residuals estimated by Jones (1991) model $Accruals_{i,t} = \alpha + \beta_1 \Delta Sales_{i,t} + \beta_2 * PPE_{i,t} + \epsilon_{i,t}$. We run the regression for each industry-year and make sure each industry-year has at least 20 observations.

Table 5 presents the multivariate regression results with based on 3-day market-adjusted returns in Panel A and 3-day size and book-to-market adjusted returns in Panel B. We forgo discussion of Panel B given the results are qualitatively similar. The first column of panel A provides the results when we include *Opacity* and year and industry fixed effects only. The coefficient on *Opacity* is 0.23 and statistically significant at the one percent level. This is also highly economically significant. Increasing *Opacity* from one standard deviation below the mean to one above the mean increases the resulting abnormal return by 1.65%. After including more controls, in specifications 2-4, we see opacity remains statistically significant at the five percent level. Doing the same one standard deviation below to one above calculation shows the associated increase in the abnormal return ranges from 0.95% to 1.10%. Thus, regardless of the controls we continue to find asymmetric information plays an important role.

For the control variables, we find *Past returns* has a negative and significant coefficient in all three specifications. We find *Log(size)* has no significant impact on announcement returns, unlike in the univariate case. We also find the coefficient on book-to-market is insignificant in all specifications. *Return volatility* has a strong positive relation to abnormal announcement returns suggesting investor uncertainty plays an important role in determining the OMR announcement returns that differs from that of *Opacity*. *Share turnover* is significantly negatively related to repurchase announcement returns.

In order to control for the effect of earnings manipulation, we add abnormal accruals and quarterly abnormal accruals respectively in the model. Abnormal accruals are calculated by annual data at the end of fiscal year prior to the repurchase announcement. We find a negative and significant coefficient on *Abnormal accruals*. It indicates the lower the abnormal accruals, the higher the announcement returns. We also find a negative and significant coefficient on *Abnormal accruals_high* suggesting firms with large positive abnormal accruals elicit tempered reactions at the OMR

announcement. We see no significant relation for large negative accruals (*Abnormal accruals_low* has an insignificant coefficient).

To see if abnormal accruals closer to the repurchase announcement date are important we next control for quarterly abnormal accruals and performance adjusted quarterly abnormal accruals. The results are shown in column one in Panel C for three-day market adjusted returns. The coefficient on *Opacity* remains significantly positive. Thus, earnings manipulation prior to the OMR announcement does not seem to be driving our results on *Opacity*. We next control for governance characteristics.

Wu and Ze (2010) find that OMRs by well governed firms are more welcomed by the market. In order to further differentiate the effect of asymmetric information on announcement returns from the effect of governance, we use several governance proxies such as *BCF index*, *CEO pay slice*, *CEO ownership* and *Chairman* as controls in our regression model. In columns 2-6 of panel C, we show that after control for *BCF index*, the significance of *Opacity* becomes weaker, but remains statistically significant at the 10 percent level. *BCF index* carries a negative and insignificant coefficient. However all results from this specification must be considered unreliable given the regression model results in an insignificant F-test (p-value=0.39). Thus, we also use *CEO pay slice*, *CEO ownership* and *Chairman* as governance controls in our specifications. *CEO ownership* carries a positive and significant coefficient on OMR announcement returns. *Opacity* still shows significant positive effect on announcement returns, after controlling for these alternative measures of governance. However, the P-values of F-test in regressions which includes governance proxies are between 3 percent and 10 percent, likely due to the reduction in the sample size form the increased data requirements. In Panel D, we apply the same tests in Panel C to three-day size and book-to-market adjusted returns, the results are similar.

The results from the multivariate regressions suggest that while governance and earnings management indeed influence the market's reaction to OMRs, the effect of

Opacity remains significant. Overall the multivariate results are consistent with the univariate results and support the notion that asymmetric information combines with OMR announcements to reveal private information that conveys undervaluation.

1.4.3 Sources of asymmetric information

As mentioned in section 3.2., accruals quality can be estimated using data from the statement of cash flows or from the balance sheet. Accruals from the balance sheet will contain the influence of discretionary accruals as well as from complicated business transactions, such as restructurings, mergers, acquisitions, and foreign transactions. The cash flow statement accruals information, on the other hand, only reflects the influence of operating activity, and hence discretionary choices, on accruals. Under the cash flow approach the resulting accruals quality measure is argued to be relatively immune to complicated business transactions.

In this section we examine the announcement reaction to OMRs using both approaches to see how these two different types of asymmetric information influence the market's response. We estimate accruals quality using two approaches balance sheet approach and cash flow approach, then sort firms into three groups by balance-sheet accruals quality and cash-flow accruals quality independently. This sorting renders four groups of firms: opaque-opaque firms, opaque-transparent firms, transparent-opaque firms and transparent-transparent firms, where the first category is defined by balance-sheet accruals quality and the second category by the cash-flow accruals quality measure.

The three-day and five-day abnormal announcement returns for these four groups are reported in Table 6. Firms defined as opaque firms by both approaches have the highest announcement abnormal returns, 3.22%, while the corresponding abnormal announcement return for transparent-transparent firm is 1.36%. The difference is 1.86%, which is statistically and economically significant. Interestingly, the firms defined as opaque firms by balance sheet approach and transparent by the cash flow approach earn

2.81% three-day market-adjusted returns. To the extent this sorting isolates high asymmetric information firms where the source of asymmetric information is driven by complicated transactions (rather than managerial discretion), these results suggest the market reaction depends on the complicated nature of the accounting information and less so on discretionary managerial manipulation that may affect accruals quality. The size and book-to-market adjusted returns and five-day abnormal announcement returns all show the similar results.

1.4.4 Post-announcement long run returns and operating performance

As demonstrated by numerous studies, OMRs associate with positive long run returns. Dividing the sample of OMR firms into "glamour" and "value" firms using book-to-market, ILV (1995) find the post OMR returns are pronounced in "value" firms, consistent with undervaluation. We examine the post OMR stock returns using similar groupings as in the section examining announcement returns.

Table 7 reports the one-year and two-year post-repurchase announcement abnormal returns. Because repurchase events are clustered in time, we adopt the calendar-time approach to diminish the cross-sectional correlation of events. We categorize OMR firms as opaque and transparent as above and sort the OMR firms into monthly calendar time portfolios over the 1 or 2 years subsequent to the OMR announcement. We then compute long run abnormal returns using both a portfolio matching approach as well as an asset pricing model approach. For the portfolio matching approach, we calculate size and book-to-market adjusted monthly returns for each firm using Fama-French size and book-to-market benchmark portfolios. Then we compute the average abnormal return for the opaque and transparent portfolios each month. We report the mean abnormal return for the time series of monthly abnormal portfolio returns in Panel A of Table 7. For the asset pricing model approach, we compute monthly portfolio returns by averaging the risk-free rate adjusted returns of the firms in the portfolio for each month. We then run

time-series regressions for the monthly risk-free rate adjusted returns of each portfolio using the Fama-French three-factor model and Carhart (1997) four-factor model. The intercepts of the regression are the abnormal returns reported in Panel B of Table 7.

The results in Table 7 show that opaque firms have significant positive abnormal returns following repurchase announcements, while transparent firms do not. This suggests that the long-run returns are in the same direction as the announcement returns, and suggests that undervaluation driven by private information may be only partially revealed at announcement.

We further stratify the firms into "value" and "glamour" stocks as in ILV (1995) and by asymmetric information. The finding that opaque firms associate with positive long run returns while the transparent firms do not appears in both the value and glamour groupings. At first this may seem at odds with ILV (1995), however, this appears to be due to different sample periods. Unlike ILV (1995) we find no difference in the long run returns of glamour and value firms. We also find OMR announcement returns to value stocks are significantly higher than glamour stocks (see Appendix Table A), while ILV find no such differences.

In order to clarify 1) whether the stronger market reaction to opaque firms around repurchase announcements due to the prospect of future performance improvements; and 2) whether the long run positive abnormal returns for opaque firms are due to undervaluation rather than post-announcement operating performance improvement, we follow Lie (2005)'s matching procedure to examine the yearly operating performance after repurchase announcement for opaque firms and transparent firms. The matching firms used to calculate industry-adjusted performance are chosen by non-sample firms with the same industry and closest size (measured by total book value of assets) to their respective sample firms. The matching firms used to calculate performance-adjusted operating performance are chosen as follows. First, we choose the non-sample firms in the same industry, and having operating performance (book-to-market ratio) within ±20%

of the sample firms at the announcement year when operating performance (book-to-market ratio) is greater than 5% or within ±0.01 when the operating performance (book-to-market ratio) is less than 5%. If no firm satisfies the above criteria, we relax the industry to a single digit. After that, we choose the matching firms which have the closest value of $|\text{operating performance}_t\text{-operating performance}_{t-1}|+|\text{operating performance}|_t$ to our sample firms', where year t is the repurchase announcement year. If the performance in year t-1 is missing, we set the condition as the second term only (see Lie (2005)). The performance-adjusted performance is the paired difference between operating performance of sample firms and operating performance of their respective control firms.

Table 8 reports the post-repurchase announcement operating performance for opaque firms and transparent firms. We provide the unadjusted values as well as industry-adjusted and performance-adjusted values. The operating performance is measured by operating income before depreciation scaled by average net assets. It is interesting to see that transparent firms actually experience positive performance-adjusted operating performance improvement following repurchase announcement, while opaque firms do not. Specifically, from the announcement year to the future three years, transparent firms show statistically significant positive change of operating performance and show better operating performance than opaque firms, although many of the differences are not statistically significant. The findings do not support the argument that the positive abnormal announcement returns for opaque firms is due to future performance improvements. In addition, the insignificant post-announcement operating performance for opaque firms suggests that the long run positive abnormal returns are not due to improved post-announcement operating performance. In contrast, transparent firms show improved operating performance after repurchase announcement.

We also report all of our empirical results measuring accruals quality, *Opacity*, based on the cash flow approach (see Appendix B). In general we find qualitatively similar results, but they tend to be dampened when compared to the results using balance

sheet approach. This is expected given the cash flow approach omits the influence of complicated transactions that likely heighten the information asymmetric between insiders and outside investors.

1.5 Conclusion

We examine the undervaluation motive for OMRs. We test the undervaluation motive by relating the undervaluation revealed by repurchase to information asymmetry and predict that higher information asymmetry firms should experience higher abnormal announcement returns. We use a novel information asymmetry measure put forth by Lee and Masulis (2009), which measures the accounting information quality. Because financial statements are a primary source for investors to learn about the financial condition of the firm, the transparency of the accounting statement information likely corresponds to the degree of information asymmetry between insiders and outside investors.

Using this measure we show that high information asymmetry (opaque) firms have more pronounced announcement effects compared to low information asymmetry (transparent) firms. Moreover, our tests suggest this relation is not simply capturing governance and/or earnings management. Our findings add to the existing literature which has supported the undervaluation motive by examining public measures of undervaluation (such as past returns and book-to-market) by showing how private information can be revealed using OMRs along with asymmetric information. Thus, combining the results of past studies and this study suggests both public information and private information are important in identifying misvaluation revealed at OMRs.

Table 1.1 Sample distribution

Year	N			Industry		N	Industry		N
1981	6	2001	120	1	Agriculture	10	23	Automobiles and Trucks	106
1982	17	2002	103	2	Food products	132	24	Aircraft	41
1983	67	2003	72	4	Beer & Liquor	8	27	Precious Metals	2
1984	204	2004	130	6	Recreation	36	28	Non-Metallic and Industrial Metal Mining	17
1985	57	2005	153	7	Entertainment	45	30	Petroleum and Natural Gas	165
1986	65	2006	133	8	Printing and Publishing	87	32	Communication	46
1987	40	2007	185	9	Consumer Goods	150	33	Personal Services	53
1988	75			10	Apparel	91	34	Business Services	193
1989	151	Total	4047	11	Healthcare	58	35	Computer Hardware	183
1990	211			12	Medical Equipment	158	36	Computer software	289
1991	87			13	Pharmaceutical products	177	37	Electronic Equipment	281
1992	148			14	Chemicals	139	38	Measuring and Control Equipment	128
1993	148			15	Rubber and plastic products	56	39	Business Supplies	130
1994	198			16	Textiles	45	40	Shipping Containers	4
1995	207			17	Construction Materials	101	41	Transportation	124
1996	280			18	Construction	27	42	Wholesale	184
1997	268			19	Steel Works Etc	69	43	Retail	290
1998	459			20	Fabricated products	15	44	Restaurants, Hotels, Motels	146
1999	286			21	Machinery	170	49	Others	11
2000	177			22	Electrical Equipment	80	Total		4047

Note: Distribution of sample of open market share repurchase announcement by year and industry. The observations are excluded 1) the announcement is defined as self-tender offer or block repurchase in SDC, 2) stock price in the repurchase announcement month is less than one dollar, 3) the firm is a financial or utility firm (SIC code 4800-4829, 4910-4949, 6000-6999), 4) the firm lacks data on CRSP or Compustat to calculate 3 days announcement return and accruals quality, 4) the announcement happens within the same fiscal quarter or the following fiscal quarter, 5) the announcement is in the last quarter of 1987 (October, November, December). The industry is based on the 49 industry definition from Kenneth French's website.

Table 1.2 Descriptive statistics

	Whole sample		Opaque firms		Transparent firms		Difference (High-Low)
Variable	N	Mean	N	Mean	N	Mean	
Opacity	4047	0.05	1349	0.08	1349	0.02	0.07***
Past returns (%)	4021	-2.70	1344	-5.74	1339	-0.15	-5.59***
Log(size)	4040	13.26	1348	12.38	1347	14.00	-1.62***
Book to market	4037	0.57	1343	0.57	1348	0.58	-0.01
Cash holdings	4047	0.15	1349	0.20	1349	0.10	0.10***
Capital expenditures	4004	0.07	1335	0.06	1334	0.08	-0.02***
Leverage	4047	0.18	1349	0.16	1349	0.21	-0.05***
Return volatility	4046	0.03	1349	0.03	1348	0.02	0.01***
Share turnover	4046	5.67	1349	6.61	1348	4.49	2.12***
Percent sought	2504	8.39	869	8.93	799	7.73	1.20***
BCF Index	1853	2.22	458	2.22	726	2.21	0.01
Log (total assets)	4047	6.56	1349	5.62	1349	7.39	-1.77***
Tobin's q	4045	2.01	1349	2.16	1347	1.82	0.34***
ROA	4047	0.13	1349	0.12	1349	0.13	-0.01**
Assets Turnover	4047	1.33	1349	1.42	1349	1.25	0.17***
Cash flow volatility	4047	0.13	1349	0.14	1349	0.13	0.01**
Free cash flow	4047	0.09	1349	0.08	1349	0.10	-0.02***

Note: The table presents descriptive statistics for sample firms that announce open market share repurchases between 1981 and 2007. It also shows the descriptive statistics for opaque firms relative to transparent firms. We sort sample firms into three groups based on accruals quality. Opaque firms are firms are belonging to the top tercile, while transparent firms are belonging to the bottom tercile. All the following variables are calculated using the fiscal year end data preceding the announcement year t. ***Accruals quality*** is measured by the standard deviation of firm's residuals from equation (3) across five years t-4 to t. ***Log(size***) is the logarithm of the size which is computed by stock price multiplied by shares outstanding in the month prior to the repurchase announcement. ***Past returns*** is calculated as the cumulative raw returns from 126 trading days before the repurchase announcement up to 5 days before the announcement date.). ***Book-to-market*** is defined as book value of equity divided by market value of equity at the fiscal year-end prior to the repurchase announcement. ***Cash holdings*** are the cash and short-term investments (CHE) scaled by total assets. ***Capital expenditures*** are capital expenditures (CAPX) scaled by total assets. ***Leverage*** is the summation of long term debt (DLTT) and short term debt (DLC) scaled by total assets. ***Return volatility*** is measured by the standard deviation of daily stock return over the period of (-90, -11) prior to the announcement date (date 0). ***Share turnover*** is the average daily trading volume during the period of (-90, -11) divided by the shares outstanding of the last trading day prior to the repurchase announcement. The data used to calculate Return volatility and Share turnover are from CRSP database. ***Percent sought*** is the percentage of shares the firms seek to repurchase, which is provided by SDC. ***BCF index*** is entrenchment index created by Bebchuk, Cohen and Ferrell (2004). They select six provisions that are more related to firm value from 24 provisions in GIM's governance index (Gompers, Ishii, Metrick, 2003). ***Log (total assets)*** is the log of total book value of assets (AT). ***Tobin's q*** is total assets, minus total book value of common equity(CEQ), plus market value of common equity(PRCC_F*CSHO), divided by total assets. ***ROA*** is measured by operating income after depreciation scaled by last year's total assets ($OIADP_t$ / AT_{t-1}). ***Assets Turnover*** is sales divided by total assets. ***Cash flow volatility*** is computed by the standard deviation of past five years operating cash flows. Operating cash

flow is defined as operating income before depreciation (OIBDP) scaled by average assets ((assets $_t$+ assets $_{t-1}$)/2). ***Free cash flow*** is measured by operating income before depreciation (OIBDP) – interest expense (XINT) – (income taxes (TXT) - change in deferred tax & invest tax credit ($TXDITC_t$ -$TXDITC_{t-1}$)) – dividend-preferred (DVP) – dividend-common (DVC). All the dollar values are converted to 2007 values using the consumer price index and all the accounting variables are winsorized at the 1% and 99% level.

Table 1.3 Abnormal returns and cumulative abnormal returns around open market share repurchases

	Abnormal Return	Cumulative Abnormal Return	Abnormal Return		Cumulative Abnormal Return	
	Whole		Opaque firms	Transparent firms	Opaque firms	Transparent firms
Panel A Market adjusted return						
N	4047	4047	1349	1349	1349	1349
-5	-0.27	-0.27	-0.63	-0.04	-0.63	-0.04
-4	-0.26	-0.40	-0.49	-0.04	-0.86	-0.05
-3	-0.15	-0.39	-0.34	-0.05	-0.85	-0.07
-2	-0.18	-0.49	-0.11	-0.07	-0.89	-0.11
-1	-0.30	-0.72	-0.41	-0.20	-1.20	-0.27
0	1.56	0.79	2.37	1.07	1.10	0.77
1	0.78	1.41	1.10	0.55	2.00	1.19
2	0.20	1.54	0.15	0.17	2.10	1.29
3	0.22	1.64	0.21	0.17	2.18	1.39
4	0.10	1.68	0.11	0.11	2.20	1.45
5	-0.06	1.64	-0.16	0.01	2.10	1.45
Panel B Size and Book-to-Market adjusted return						
-5	-0.26	-0.26	-0.59	-0.05	-0.59	-0.05
-4	-0.25	-0.38	-0.47	-0.01	-0.82	-0.04
-3	-0.11	-0.35	-0.24	-0.04	-0.76	-0.05
-2	-0.12	-0.42	-0.05	-0.05	-0.77	-0.09
-1	-0.27	-0.63	-0.35	-0.19	-1.03	-0.24
0	1.57	0.89	2.39	1.06	1.28	0.80
1	0.79	1.52	1.11	0.56	2.18	1.22
2	0.18	1.63	0.15	0.15	2.29	1.31
3	0.22	1.73	0.23	0.15	2.37	1.39
4	0.16	1.80	0.17	0.15	2.43	1.48
5	-0.03	1.78	-0.11	0.02	2.35	1.48

Note: This table reports the market adjusted return (Panel A) and size and Book-to-Market adjusted return (Panel B) for ten days before and ten days after the open market shares repurchase announcement (-5, +5), where day 0 is the announcement day. The table reports the daily return as well as the cumulative return starting from ten days prior to the announcement for the whole sample firms and subsample firms of opaque firms and transparent firms. Opaque firms include firms which belong to the last tercile and transparent firms include firms which belong to the first tercile. Market adjusted return is the return of firm j subtracted the value-weighted market return including distribution. Size and Book-to-Market adjusted return is the return of firm j subtracted the size and Book-to-Market benchmark return downloaded from Kenneth French's website. Following Fama and French portfolio methodology, the size and Book-to-Market portfolio is formed at the end of each June and the repurchases announced during the period of July to June of the following year are assigned to this portfolio.

Table 1.4 Univariate tests for opaque firms and transparent firms

			Market adjusted return		Size and Book-to-Market adjusted return	
		N	3 days (-1, +1)	5 days (-2, +2)	3 days (-1, +1)	5 days (-2, +2)
Panel A. Whole Sample						
	Opaque firms	1349	2.94***	2.99***	3.00***	3.09***
	Transparent firms	1349	1.33***	1.38***	1.33***	1.39***
	Difference (High-Low)		1.61***	1.60***	1.67***	1.70***
Panel B. By Size						
Big firms						
	Opaque firms	588	1.50***	1.33***	1.49***	1.34***
	Transparent firms	1055	0.93***	1.12***	0.93***	1.09***
	Difference (High-Low)		0.56*	0.21	0.56*	0.25
Small firms						
	Opaque firms	761	4.05***	4.27***	4.17***	4.44***
	Transparent firms	294	2.73***	2.32***	2.77***	2.44***
	Difference (High-Low)		1.32**	1.95***	1.39***	1.99***
Panel C. By Book-to -Market						
High Book-to-Market						
	Opaque firms	465	5.05***	5.34***	5.04***	5.38***
	Transparent firms	457	1.86***	1.83***	1.86***	1.86***
	Difference (High-Low)		3.20***	3.51***	3.18***	3.52***
Low Book-to-Market						
	Opaque firms	453	1.54***	1.35***	1.63***	1.49***
	Transparent firms	424	0.94***	0.94***	0.89***	0.87***
	Difference (High-Low)		0.60	0.41	0.74	0.62

Table 1.4 Continued

Panel D. By Past Returns						
High Past Returns						
	Opaque firms	501	1.84***	1.78***	1.82***	1.80***
	Transparent firms	394	0.84***	0.83***	0.80***	0.81***
	Difference (High-Low)		1.00**	0.95*	1.02**	0.99**
Low Past Returns						
	Opaque firms	572	4.01***	4.10***	4.12***	4.28***
	Transparent firms	350	2.58***	2.63***	2.67***	2.73***
	Difference (High-Low)		1.43***	1.47**	2.49***	1.55**
Panel E. By U-Index						
High U-Index						
	Opaque firms	536	5.19***	5.67***	5.32***	5.82***
	Transparent firms	246	2.70***	2.60***	2.76***	2.67***
	Difference (High-Low)		2.49***	3.07***	2.56***	3.15***
Low U-Index						
	Opaque firms	445	0.93***	0.71*	0.96***	0.73***
	Transparent firms	710	0.57***	0.74***	0.54***	0.69***
	Difference (High-Low)		0.37	-0.03	0.42	0.04
Panel F. By Governance (BCF index)						
Good governance firms						
	Opaque firms	524	1.85***	1.82***	1.84***	1.85***
	Transparent firms	516	1.02***	1.09***	1.06***	1.10***
	Difference (High-Low)		0.82**	0.72*	0.78**	0.75*

Table 1.4 Continued

Bad governance firms						
	Opaque firms	403	1.28***	1.27***	1.30***	1.27***
	Transparent firms	410	0.84***	0.97***	0.86***	1.00***
	Difference (High-Low)		0.44	0.30	0.43	0.27
Panel G. By announcement sequence						
Initial announcement						
	Opaque firms	909	3.23***	3.26***	3.33***	3.42***
	Transparent firms	798	1.40***	1.51***	1.44***	1.54***
	Difference (High-Low)		1.83***	1.76***	1.88***	1.88***
Following announcement						
	Opaque firms	440	2.34***	2.42***	2.33***	2.40***
	Transparent firms	551	1.22***	1.21***	1.17***	1.16***
	Difference (High-Low)		1.12***	1.21***	1.16***	1.24***
Panel H. By carry-through or non-carry-through announcements						
Carry-through announcement						
	Opaque firms	556	2.86***	2.70***	2.99***	2.90***
	Transparent firms	536	1.25***	1.36***	1.31***	1.43***
	Difference (High-Low)		1.61***	1.34***	1.68***	1.48***
Non-carry-through announcements						
	Opaque firms	664	2.99***	3.16***	2.99***	3.16***
	Transparent firms	673	1.37***	1.28***	1.34***	1.25***
	Difference (High-Low)		1.62***	1.88***	1.65***	1.91***
Panel I. By Performance adjusted quarterly abnormal accruals						

Table 1.4 Continued

Positive Performance adjusted quarterly abnormal accruals					
Opaque firms	510	2.69***	2.55***	2.78***	2.64***
Transparent firms	452	1.26***	1.40***	1.23***	1.34***
Difference (High-Low)		1.43***	1.15**	1.55***	1.30**
Negative Performance adjusted quarterly abnormal accruals					
Opaque firms	839	3.09***	3.26***	3.13***	3.36***
Transparent firms	897	1.36***	1.37***	1.38***	1.41***
Difference (High-Low)		1.73***	1.89***	1.75***	1.95***

Note: This table presents the univariate test results for whole sample firms and subsample firms based on three categorizing ways. In order to compare the returns between opaque firms and transparent firms, we sort sample firms into three groups according to accruals quality. Opaque firms and transparent firms are belonging to top tercile and bottom tercile respectively. Opaque firms mean firms having high information asymmetry, while Transparent firms means firms having low information asymmetry. We report 3 days returns (-1, +1) and 5 days returns (-2, +2) around the open market shares repurchase announcement and test the return difference between opaque firms and transparent firms. Both market adjusted return and size and Book-to-Market adjusted return comparing results are reported. We define the big firms as those market capitalizations of the pre-announcement month above the 25th percentile of NYSE firms and the remaining firms in the sample are the small firms. For by book-to-market analysis, we sort firms into three groups based on book-to-market ratio. The last group is defines as high book-to-market portfolio and the first group is defined as low book-to-market portfolio. For past returns analysis, we sort past returns into three groups. Low past returns group includes firms having the lowest past returns and High past returns group includes firms having the highest past returns. Past returns is calculated as the cumulative raw returns from 126 trading days before the repurchase announcement up to 5 days before the announcement date.). We basically follow Peyer and Vermaelen (2008) to calculate the U-Index. We rank repurchase firms' book-to-market (size, past returns) into quintiles within all Compustat (CRSP) firms which have available data in that year (month, same time period). Size is computed by stock price multiplied by shares outstanding in the month prior to the repurchase announcement. Book-to-market is defined as book value of equity divided by market value of equity at the fiscal year-end prior to the repurchase announcement. Past returns are calculated by the accumulative raw returns from 126 trading days before the repurchase announcement up to 5 days before the announcement date. Once we get the ranks for size, book-to-market and past returns, first, we assign the points for ranks 1-5, 5 points to firms which have the smallest size (highest book-to-market, lowest past returns); 1 point to firms which have the biggest size (lowest book-to-market, highest past returns). Second, we add the size score, book-to-

market score, past returns score together to get the U-Index. Finally, we rank firms' U-index into terciles. High U-Index group includes firms which have the highest U-Index, while Low U-Index group includes firms which have the lowest U-Index. The governance grouping is based on BCF index. We sort firms into two groups and define good governance firms as those belonging to the bottom group, bad governance firms as those belonging to the top group. Last, we test return difference for opaque firms and transparent firms within initial announcement sample and following announcement sample respectively. The following announcements are defined as announcements of firms which also announce the repurchase in the previous three years. The initial announcements are those without announcements from the same firm in the prior three years. We define the carry-through announcements as the dollar value of repurchases in the announcement fiscal quarter and subsequent fiscal quarter greater than 1 percent of the market value of the firm. The repurchase value is based on the purchase of common and preferred stock (PRSTKCY) in Compustat quarterly database. This variable provides the value of year-to-date. Thus, we subtract the last quarter value to obtain the value of purchase of common and preferred stock for a given quarter. Quarterly abnormal accruals are estimated by the average of abnormal accruals in the repurchase announcement quarter and the quarter prior to the announcement. The abnormal accruals used to define quarterly abnormal accruals are residuals from the model in Gong, Louis and Sun (2008). We calculate the total accruals in their model by earnings before extraordinary items minus operating cash flows (IBC-OANCF) using the data from cash flow statement. Performance adjusted quarterly abnormal accruals are estimated following Gong, Louis and Sun (2008). For each industry (two-digit SIC code) quarter, we sort firms into five groups based on return on assets from the same quarter in the last year. Performance adjusted quarterly abnormal accruals for each firm are calculated by firm's quarterly abnormal accruals minus the median of quarterly abnormal accruals for the group it belongs to. We categorize firms into two groups based on the sign of performance adjusted quarterly abnormal accruals: positive performance adjusted quarterly abnormal accruals and negative performance adjusted quarterly abnormal accruals.

Table 1.5 Multivariate tests for the impact of information asymmetry

Panel A: 3 days (-1, +1) Market adjusted return

	1	2	3	4
Opacity	0.230***	0.130**	0.151**	0.152**
	[5.46]	[2.07]	[2.10]	[2.12]
Past returns		-0.017**	-0.019**	-0.019**
		[-2.07]	[-2.20]	[-2.20]
Log (size)		-0.001	-0.002	-0.002
		[-0.60]	[-0.70]	[-0.70]
Book-to-Market		0.007	0.007	0.007
		[0.54]	[0.40]	[0.40]
Cash holdings		-0.001	-0.019	-0.019
		[-0.09]	[-1.10]	[-1.10]
Capital expenditures		-0.059*	-0.059	-0.059
		[-1.73]	[-1.35]	[-1.35]
Leverage		0.017	0.017	0.017
		[0.88]	[0.71]	[0.72]
Return volatility		1.182***	1.075***	1.073***
		[5.62]	[4.47]	[4.46]
Share turnover		-0.001*	-0.001	-0.001
		[-1.81]	[-1.41]	[-1.40]
Percent sought		0.0003*	0.0004*	0.0004*
		[1.83]	[1.77]	[1.77]
Cash flow volatility		0.005	-0.007	-0.007
		[0.14]	[-0.17]	[-0.16]
Quarterly abnormal accruals			-0.106**	
			[-2.12]	
Performance adjusted quarterly abnormal accruals				-0.100**
				[-2.02]
Intercept	0.010	-0.024	-0.017	-0.018
	[0.95]	[-0.62]	[-0.36]	[-0.38]
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Number of observations	4047	2442	1727	1727
Adjusted R^2 (%)	2.14	8.27	8.21	8.18
P-value (F)	<0.000	<0.000	<0.0001	<0.0001

Table 1.5 Continued

Panel B: 3 days (-1,+1) market adjusted returns

	1	2	3	4	5
Opacity	0.155**	0.148*	0.301***	0.270***	0.284***
	[2.17]	[1.69]	[3.06]	[2.83]	[3.14]
Past returns	-0.019**	-0.002	-0.013	-0.010	-0.013
	[-2.29]	[-0.16]	[-1.27]	[-1.03]	[-1.34]
Log (size)	-0.001	-0.001	0.001	0.000	-0.001
	[-0.60]	[-0.78]	[0.73]	[-0.09]	[-0.46]
Book-to-Market	0.008	0.015*	0.027***	0.024***	0.022***
	[0.45]	[1.79]	[3.35]	[3.15]	[2.74]
Cash holdings	-0.018	0.003	-0.018	-0.030	-0.024
	[-1.04]	[0.13]	[-0.62]	[-1.12]	[-0.94]
Capital expenditures	-0.064	-0.062	0.045	-0.012	0.014
	[-1.45]	[-1.12]	[0.74]	[-0.19]	[0.23]
Leverage	0.017	0.002	-0.016	-0.011	-0.023
	[0.73]	[0.17]	[-0.97]	[-0.67]	[-1.40]
Return volatility	1.086***	0.394	0.208	0.164	0.056
	[4.55]	[0.96]	[0.54]	[0.42]	[0.15]
Share turnover	-0.001	-0.0005	-0.0001	0.0002	0.0001
	[-1.40]	[-0.97]	[-0.19]	[0.28]	[0.19]
Percent sought	0.0003*	0.0002	0.0002	0.0002	0.0002
	[1.68]	[1.06]	[1.18]	[0.87]	[1.20]
Cash flow volatility	-0.003	0.041	-0.002	-0.002	-0.011
	[-0.07]	[1.08]	[-0.04]	[-0.04]	[-0.23]
Performance adjusted quarterly abnormal accruals		-0.174**	-0.164**	-0.181**	-0.159**
		[-2.28]	[-2.06]	[-2.22]	[-1.98]
Performance adjusted quarterly abnormal accruals(Low)	0.009*				
	[1.94]				
Performance adjusted quarterly abnormal accruals(High)	-0.001				
	[-0.14]				
BCF Index		-0.002			
		[-1.28]			
CEO pay slice			0.0001		
			[0.64]		
CEO ownership				0.001**	
				[2.09]	
Chairman					0.008
					[1.60]
Intercept	-0.023	-0.108***	-0.153***	-0.131***	-0.128***
	[-0.48]	[-3.24]	[-3.95]	[-3.70]	[-3.67]
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Number of observations	1726	842	786	812	866
Adjusted R^2 (%)	8.38	0.31	2.92	2.76	1.88
P-value (F)	<0.0001	0.393	0.032	0.036	0.088

Note: This table reports the regression results for the impact of information asymmetry on the 3 days market adjusted return (Panel A) and size and Book-to-Market adjusted return (Panel B) around the open market shares repurchase announcement. ***Accruals quality*** is measured by the standard deviation of firm's residuals from equation (?) across five years t-4 to t. ***Past returns*** is calculated as the cumulative raw returns from 126 trading days before the repurchase announcement up to 5 days before the announcement date.). ***Log(size***) is the logarithm of the size which is computed by stock price multiplied by shares outstanding in the month prior to the repurchase announcement. ***Book-to-market*** is defined as book value of equity divided by market value of equity at the fiscal year-end prior to the repurchase announcement. ***Cash holdings*** are the cash and short-term investments (CHE) scaled by total assets. ***Capital expenditures*** are capital expenditures (CAPX) scaled by total assets. ***Leverage*** is the summation of long term debt (DLTT) and short term debt (DLC) scaled by total assets. ***Return volatility*** is measured by the standard deviation of daily stock return over the period of (-90, -11) prior to the announcement date (date 0). ***Share turnover*** is the average daily trading volume during the period of (-90, -11) divided by the shares outstanding of the last trading day prior to the repurchase announcement. The data used to calculate Return volatility and Share turnover are from CRSP database. ***Percent sought*** is the percentage of shares the firms seek to repurchase, which is provided by SDC. ***Abnormal accruals*** are estimated by Jones model and the variables in the model are constructed using the financial data at the end of the fiscal year prior to the repurchase announcement date. We sort abnormal accruals into three categories. If the firms belong to the top group then ***Abnormal accruals_high*** is one, otherwise it is zero. If the firms belong to the bottom group then ***Abnormal accruals_low*** is one, otherwise it is zero. ***Quarterly abnormal accruals*** in our regression are estimated by the average of abnormal accruals in the repurchase announcement quarter and the quarter prior to the announcement. The abnormal accruals used to define quarterly abnormal accruals are residuals from the model in Gong, Louis and Sun (2008). We calculate the total accruals in their model by earnings before extraordinary items minus operating cash flows (IBC-OANCF) using the data from cash flow statement. ***Performance adjusted quarterly abnormal accruals*** are estimated following Gong, Louis and Sun (2008). For each industry (two-digit SIC code) quarter, we sort firms into five groups based on return on assets from the same quarter in the last year. Performance adjusted quarterly abnormal accruals for each firm are calculated by firm's quarterly abnormal accruals minus the median of quarterly abnormal accruals for the group it belongs to. ***Cash flow volatility*** is computed by the standard deviation of past five years operating cash flows. Operating cash flow is defined as operating income before depreciation (OIBDP) scaled by average assets ((assets $_t$+ assets $_{t-1}$)/2). ***BCF index*** is entrenchment index created by Bebchuk, Cohen and Ferrell (2004). They select six provisions that are more related to firm value from 24 provisions in GIM's governance index (Gompers, Ishii, Metrick, 2003). ***CEO pay slice*** is calculated by CEO's total compensation to the sum of the top five executives' total compensation (Billett, Garfinkel and Jiang (2010)). ***CEO ownership*** is the shares owned by CEO divided by firm's shares outstanding. If CEO is also the chairman of the board, then ***Chairman*** is equal to one, otherwise it is equal to zero. The governance measures of CEO pay slice, CEO ownership and Chairman are using the data from EXecuComp. Year fixed effect and industry fixed effect are included in all of the regressions. The white's heteroskedasticity-consistent t statistics are reported in brackets. ***, ** and * represent 1%, 5%, 10% significance respectively.

Table 1.6 The value effect by different information sources

		Balance Sheet Approach					
		Market adjusted return					
		3 days (-1, +1)			5 days (-2, +2)		
		Opaque firms	Transparent firms	Difference	Opaque firms	Transparent firms	Difference
Cash Flow Approach	Opaque firms	3.22 (N=614)	1.82 (N=85)	1.40*	3.31 (N=614)	1.95 (N=85)	1.36*
	Transparent firms	2.81 (N=67)	1.36 (N=609)	1.45*	2.75 (N=67)	1.51 (N=609)	1.24
	Difference	0.41	0.46	1.86***	0.57	0.44	1.80***
		Size and Book-to-Market adjusted return					
		3 days (-1, +1)			5 days (-2, +2)		
		Opaque firms	Transparent firms	Difference	Opaque firms	Transparent firms	Difference
Cash Flow Approach	Opaque firms	3.29 (N=614)	1.86 (N=85)	1.42**	3.40 (N=614)	2.05 (N=85)	1.35
	Transparent firms	2.67 (N=67)	1.36 (N=609)	1.32	2.86 (N=67)	1.51 (N=609)	1.35
	Difference	0.61	0.51	1.93***	0.54	0.54	1.89***

Note: This table reports the 3 days (-1, +1) and 5 days (-2, +2) market adjusted return and size and Book-to-Market adjusted return for firms assigned in Opaque firms and Transparent firms portfolios using balance sheet approach and cash flow approach to measure accruals.

Table 1.7 Post -announcement abnormal returns

Panel A		1-year	2-year
Portfolio matching approach			
Size and Book-to-Market adjusted return			
whole sample		0.20**	0.24***
Opaque firms		0.26*	0.35***
Transparent firms		0.06	0.13
Asset pricing model approach			
Abnormal return by three-factor model			
whole sample		0.17	0.22**
Opaque firms		0.13	0.27*
Transparent firms		0.04	0.10
Abnormal return by four-factor model			
whole sample		0.39***	0.42***
Opaque firms		0.40**	0.50***
Transparent firms		0.21	0.29**

Panel B		1-year	2-year
Portfolio matching approach			
Size and Book to market adjusted return			
Value stocks		0.26**	0.28**
	Opaque firms	0.39*	0.50***
	Transparent firms	0.17	0.22
Glamour stocks		0.39**	0.36**
	Opaque firms	0.54**	0.50***
	Transparent firms	0.09	-0.02
Asset pricing model			
Abnormal return by three-factor model			
Value stocks		0.34**	0.34***
	Opaque firms	0.48*	0.58***
	Transparent firms	0.17	0.21

Table 1.7 Continued

Glamour stocks		0.28	0.26
	Opaque firms	0.30	0.28
	Transparent firms	0.12	-0.03
Abnormal return by four-factor model			
Value stocks		0.55***	0.51***
	Opaque firms	0.72***	0.76***
	Transparent firms	0.31	0.38**
Glamour stocks		0.47***	0.43***
	Opaque firms	0.65***	0.58***
	Transparent firms	0.23	0.09

Note: This table reports the monthly abnormal returns following open market share repurchase announcement according to the calendar time approach. We form the opaque firm portfolio (transparent firm portfolio) based on whether the firms within last 1 year (or 2 years) conduct the repurchases and have high information asymmetry (low information asymmetry). We use two approaches to estimate the future monthly abnormal returns. One is portfolio matching approach and the other is asset pricing model approach. For the portfolio matching approach, we calculate the excess returns by subtracting the size and book-to-market benchmark return from individual firm's return and then compute the average return of opaque firm portfolio (transparent firm portfolio) for each month. It gives us a time series abnormal returns for each portfolio. The mean of the time series returns is shown in the following table. For the asset pricing model approach, first, we calculate the risk-free rate adjusted return for each individual firm. Then we compute the average of risk-free rate adjusted return for each portfolio (opaque firms or transparent firms). Last, we run the time-series regression for the monthly risk-free rate adjusted returns of each portfolio using Fama French three-factor model and Carhart (1997) four-factor model. The abnormal returns shown below are represented by the intercept of the regressions.

Table 1.8 Post-announcement operating performances

	Unadjusted			Industry-adjusted			Performance-adjusted		
Years	N	Mean	Median	N	Mean	Median	N	Mean	Median
Opaque Firms									
0	1349	0.174***	0.169***	1349	0.098***	0.025***	1349	0.012***	0.002***
1	1349	0.150***	0.157***	1251	0.064***	0.020***	1334	0.016*	0.006*
2	1217	0.129***	0.149***	1025	0.059***	0.009**	1175	0.008	0.007
3	1113	0.124***	0.142***	877	0.063***	0.010	1051	0.021*	-0.003
0 to +1	1349	-0.024***	-0.010***	1251	-0.012	-0.006	1334	0.005	0.003
0 to +2	1217	-0.044***	-0.019***	1025	-0.012	-0.008	1175	-0.003	0.001
0 to +3	1113	-0.047***	-0.026***	877	0.010	-0.006	1051	0.011	-0.002
Transparent Firms									
0	1349	0.202***	0.187***	1349	0.038***	0.024***	1349	0.004***	0.002***
1	1349	0.193***	0.180***	1285	0.039***	0.026***	1338	0.022***	0.009***
2	1236	0.188***	0.178***	1106	0.035***	0.025***	1209	0.016***	0.013***
3	1151	0.186***	0.177***	972	0.036***	0.028***	1106	0.026***	0.017***
0 to +1	1349	-0.009***	-0.004***	1285	0.002	-0.001	1338	0.019***	0.005***
0 to +2	1236	-0.015***	-0.008***	1106	-0.002	0.002	1209	0.012***	0.008***
0 to +3	1151	-0.016***	-0.011***	972	-0.003	0.001	1106	0.022***	0.015***
Difference (High-Low)									
0		-0.028***	-0.019***		0.060***	0.001		0.008**	0.000
1		-0.043***	-0.023***		0.025	-0.006		-0.006	-0.004
2		-0.059***	-0.029***		0.024	-0.016		-0.008	-0.006*
3		-0.062***	-0.035***		0.027	-0.018**		-0.005	-0.020**
0 to +1		-0.016***	-0.006**		-0.014	-0.004**		-0.013	-0.002*
0 to +2		-0.029***	-0.011***		-0.010	-0.010**		-0.015	-0.007**
0 to +3		-0.031***	-0.015***		0.013	-0.007		-0.011	-0.017**

Note: This table reports post-repurchase announcement operating performance for opaque firms and transparent firms. The definition of operating performance follows Lie (2005). It is measured as operating income before depreciation (OIBDP) scaled by average of net assets $((AT\text{-}CHE)_t+(AT\text{-}CHE)_{t-1})/2$. The operating income measure is winsorized at 1% and 99% level. The adjusted performance shown in the table is the pair-wise adjusted performance, which is computed by each individual firm's operating performance subtracting the matched firm's performance. The non-repurchase matching firms used to calculate industry-adjusted performance are chosen by the same industry and closest size (measured by total book value of assets) to their respective sample firms. The matching firms used to calculate performance-adjusted operating performance are decided as follows. First, we choose the non-sample firms in the same industry, and having operating performance (book-to-market ratio) within ±20% of the sample firms at the announcement year when operating performance (book-to-market ratio) is greater than 5% or within ±0.01 when the operating performance (book-to-market ratio) is less than 5%. If there is no matching firm satisfying the above criteria, then we release the industry condition to one SIC code and the operating performance and market-to-book condition. After that, we choose the matching firms which have the closest value of $|\text{operating performance}_t\text{-operating performance}_{t-1}|+|\text{operating performance}|_t$ to our sample firms, where year t is the repurchase announcement year. If the performance in year t-1 is missing, we set

the condition as the second term only (see Lie (2005)). The performance-adjusted performance is the paired difference between operating performance of sample firms and operating performance of their respective control firms. 0 to +1 means the change of operating performance between future 1 year and announcement year. 0 to +2 and 0 to +3 are defined in the same way. N is the number of observations. The mean difference tests are conducted by t test and the median difference tests are conducted by Wilcoxon Two-sample test. ***, ** and * represent 1%, 5%, 10% significance respectively.

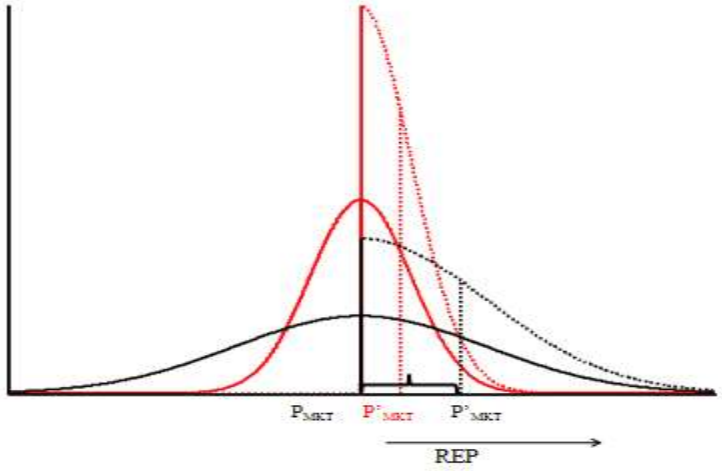
Table 1.9 Alternative measures of asymmetric information

	1	2	3	4	5	6	7
Analyst forecast dispersion	0.478*		0.537*				
	1.82		1.93				
Log(number of analysts)		0.004	0.004				
		0.98	0.92				
Comparability4				-0.004		-0.002	
				-1.11		-0.49	
Comparability10					-0.005*		-0.003
					-1.69		-1.01
Opacity			0.190**			0.207**	0.203**
			2.37			2.55	2.50
Past returns	-0.013*	-0.011	-0.014*	-0.025***	-0.026**	-0.027***	-0.027***
	-1.67	-1.43	-1.77	-2.59	-2.62	-2.71	-2.72
Log (size)	0.0004	-0.002	0.000	-0.001	-0.001	0.000	0.000
	0.28	-0.72	0.06	-1.10	-1.09	0.01	0.02
Book-to-Market	0.033***	0.034***	0.032***	0.028***	0.028***	0.027***	0.027***
	4.65	4.67	4.13	3.18	3.15	2.89	2.86
Cash holdings	-0.005	-0.004	-0.004	-0.005	-0.005	-0.007	-0.007
	-0.27	-0.20	-0.23	-0.26	-0.28	-0.41	-0.42
Capital expenditures	-0.028	-0.036	-0.023	-0.045	-0.044	-0.033	-0.032
	-0.69	-0.89	-0.51	-0.92	-0.90	-0.66	-0.64
Leverage	-0.009	-0.005	-0.004	-0.008	-0.009	-0.006	-0.007
	-0.62	-0.39	-0.25	-0.58	-0.63	-0.41	-0.45
Return volatility	0.634**	0.686**	0.604*	0.817***	0.800***	0.900***	0.889***
	2.04	2.14	1.80	3.63	3.53	3.90	3.83
Share turnover	-0.000	-0.000	-0.000	0.000	0.000	0.000	0.000
	-0.27	-0.45	-0.67	0.00	0.01	-0.44	-0.43
Percent sought	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.76	0.78	0.65	1.55	1.52	1.38	1.35
Cash flow volatility	0.007	0.004	-0.001	0.001	0.001	-0.013	-0.012
	0.19	0.11	-0.03	0.03	0.02	-0.37	-0.36
Performance adjusted quarterly abnormal accruals	-0.103**	-0.105**	-0.1067**	-0.093**	-0.095**	-0.084*	-0.085*
	-2.28	-2.35	-2.09	-2.07	-2.10	-1.78	-1.80
Intercept	-0.022	-0.004	-0.037	-0.031	-0.032	-0.070*	-0.071
	-0.86	-0.13	-1.18	-0.93	-0.96	-1.68	-1.72
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1428	1428	1272	1358	1358	1224	1224
Adjusted R^2 (%)	2.28	2.06	2.67	11.50	11.59	12.16	12.20
P-value (F)	0.005	0.009	0.003	<0.0001	<0.0001	<0.0001	<0.0001

Note: This table reports the results of effect of alternative measures of asymmetric information on OMR announcement returns. The dependent variable is three day market adjusted returns. We employ analyst forecast dispersion, logarithm of number of analysts, comparability measures as alternative measures of information asymmetry. Forecast dispersion and number of analysts' data are from IBES unadjusted Summary History file. Analyst forecast dispersion is the standard deviation of analysts' current year EPS

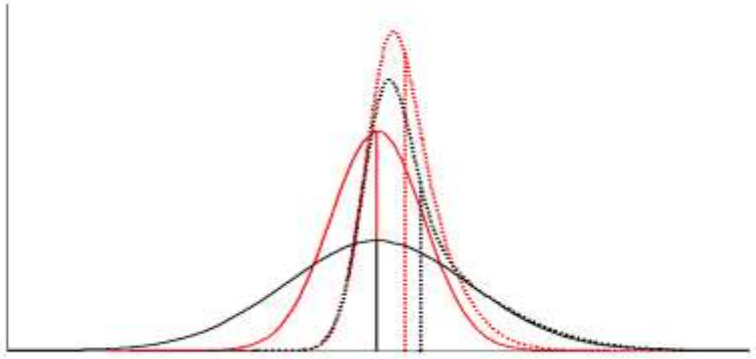
forecasts prior to repurchase announcement date, scaled by the price at the end of the forecast fiscal year. Log(number of analysts) is the logarithm of number of analysts following the company prior to the repurchase announcement date. Both Comparability measures are constructed by Franco, Kothair and Verdi (2011). They estimate the model Earnings=a+b*Returns separately for firm i and firm j using past 16 quarters of data, then use the estimated parameters a and b of firm i and returns of firm i to predict the earnings of firm i and the estimated parameters a and b of firm j and returns from i to predict earnings of firm j. The comparability between firm i and j is defined by the equation $\left(-\frac{1}{16}\right) * \sum_{t-15}^{t} |E(earnings_i) - E(earnings_j)|$. For each firm i they rank all J firms and compute the average comparability of top four J firms for firm i, which is comparability4, and the average comparability of top ten J firms for firm i, which is comparability10 for firm i.

Figure 1.1 The distribution of investors' beliefs (truncated)



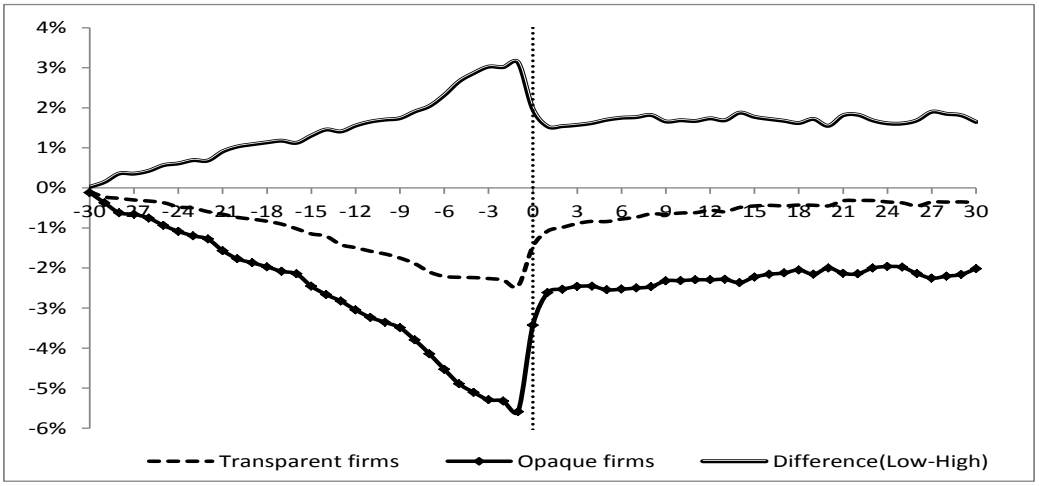
Note: Truncated distribution assuming managers know future cash flows with certainty ($\sigma_m = 0$). The black solid curve represents the distribution of investors' beliefs before repurchase announcement for a firm with high information asymmetry. The red solid curve represents the distribution of investors' beliefs before repurchase announcement for a firm with low information asymmetry. The black (red) dotted curve represents the conditional distribution after repurchase announcement for firms with high (low) information asymmetry.

Figure 1.2 The distribution of investors' beliefs (simulated)



Note: The distribution of investors' beliefs generated by simulation and assuming managers' distribution of discounted future cash flows $\sim N(\mu_m, \sigma_m)$,where $\sigma_m > 0$. The black solid curve represents the distribution of investors' beliefs before repurchase announcement for a firm with high information asymmetry $\sim N(0,1)$. The red solid curve represents the distribution of investors' beliefs before repurchase announcement for a firm with low information asymmetry $\sim N(0,0.5)$. The black (red) dotted curve represents the conditional distribution after repurchase announcement for firms with high (low) information asymmetry.

Figure 1.3 Market adjusted returns around the announcement of open market share repurchases



Note: Market adjusted return around the announcement of open market share repurchases program for opaque firms (high information asymmetry) and transparent firms (low information asymmetry), where day 0 is the announcement day.

CHAPTER 2
THE EFFECT OF ASYMMETRIC INFORMATION ON PRODUCT MARKET OUTCOMES

2.1 Introduction

There is a large and growing literature linking firm finance with product market decisions and outcomes. Theoretical work posits that financial frictions inhibit firms' abilities to compete, for example by discouraging constrained firms from engaging in a price war for market share.[18] Empirical work has focused on measuring these frictions and relating them to firms' market share outcomes. Studies have shown that leverage, cash holdings, financial constraints, governance, and litigation outcomes can influence product market outcomes (market share).[19]

At some level, much of the extant empirical work in this literature views frictions from an "outcomes" perspective. Leverage and cash are outcomes of decisions made by the firm, and these decisions likely result from the firm's own characteristics.[20] However, there is little work studying the underpinnings of these financial outcomes, particularly that of leverage which the literature has consistently found to influence product market outcomes. Such underpinnings of financial market outcomes may be particularly fruitful

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[18] E.g. Chevalier and Scharfstein (1996).

[19] See Chevalier and Scharfstein (1995), Kovenock and Phillips (1995), Phiillips (1995), Chevalier (1995a), Chevalier (1995b), Chevalier and Scharfstein (1996), Kovenock and Phillips (1997), Zingales (1998), Khanna and Tice (2000), Campello (2003), Giroud and Mueller (2010), Fresard (2010).

[20] Litigation might also be construed as an outcome of prior decisions. Financial constraints and governance, less so.

areas of examination for our understanding of *product* market outcomes. In particular, they may offer the firm a powerful lever for changing its financial status (albeit in the long run) in ways that are potentially valuable to their product market competitive stature.

We extend the literature linking finance with product market outcomes by focusing on one such potential underpinning: asymmetric information about the firm's financial condition. As Myers and Majluf (1984) and many others note, asymmetric information between insiders and outsiders can significantly influence both the cost and availability of capital. In a competitive environment, access to and the cost of capital are critical to a firm's product market share. Given the importance of capital to a firm's ability to compete for market share, as well as the influence of asymmetric information on capital raising activities and costs, we ask whether asymmetric information affects firms' market shares. We buttress our analysis by studying the influence of asymmetric information on firms' capital raising activities.

Although no empirical work has specifically studied how asymmetric information about financial condition might influence product market outcomes, there is precedent for our analysis. We expect firms with high asymmetric information to have greater difficulty, or to experience higher costs of, raising finance (as in Lee and Masulis, 2009, and Yu, 2005, and consistent with Duffie and Lando, 2001). We also know from the extant literature that access to financial resources, such as cash, enhance product market outcomes (Fresard, 2010), while constraints on capital raising detract from product market performance (Chevalier, 1995; Phillips, 1995). Therefore, asymmetric information may influence product market outcomes through its influence on capital raising activities.

However, ascertaining causality is difficult because of the endogenous relationship between asymmetric information and market share. For example, high asymmetric information firms may have smaller market shares because they are unable to raise finance at favorable rates or in sufficient quantity. On the other hand, smaller market share firms may be harder to understand (they may be smaller or less well-followed by analysts), implying greater asymmetric information. Moreover, firms insulated from competition may not find high asymmetric information to be costly or asymmetric information may result from protecting advantages.

To mitigate this interpretation problem, we study how the relation between asymmetric information and market share *changes* around shocks to the competitive environment. Following work by Zingales (1998), Khanna and Tice (2000), and Fresard (2010), shocks that increase competition are likely to influence firms differently depending on their capacity to respond to new entry. Asymmetric information hinders a firm's ability to raise capital (at favorable rates), reducing their capacity to fight new entrants. Such compromised firms should lose more market share ex-post.

We study five industries that underwent deregulation between 1960 and 2007. Deregulation increases competition and provides the exogenous shock that helps us break the endogenous link between asymmetric information and product market outcomes. For this sample, we show that greater asymmetric information about a firm's financial condition, associates with larger declines in market share after the deregulatory shock. Given greater competition engendered by deregulation, the importance of access to capital is heightened. More opaque firms typically find it more difficult/expensive to access capital, and this compromises their ability to compete in the new environment.

Our evidence suggests another avenue of association between financial market conditions and product market outcomes, beyond those that have already been documented in the literature. Asymmetric information in financial markets is an important determinant of product market share.

Our inferences clearly rely on the hypothesized negative effect of asymmetric information on firms' capital raising activities. We confirm this relationship, again controlling for endogeneity by studying the post-deregulation period. Not only do higher asymmetric information firms raise less external capital, the relationship is particularly acute in equity capital raising activities. This, too, is consistent with Myers and Majluf (1984).

Our conclusions also rely on properly measuring asymmetric information. Recent work by Lee and Masulis (2009) posits that accruals quality is a more direct measure than prior constructs (such as stock return volatility, analysts' earnings forecast dispersions, bid-ask spread or a component, and others). They provide evidence consistent with this conjecture by documenting a positive relationship between accruals quality (where a larger number actually implies higher information asymmetry) and gross spreads on SEOs. They also show that SEO announcement returns are declining in their measure of accruals quality. Thus financial market participants who care about (and price) asymmetric information, pay attention to accruals quality. This is precisely what we seek when linking financial market information asymmetry with product market outcomes. We therefore follow Lee and Masulis (2009) in using accruals quality as our metric for information asymmetry.

Our results contribute to the product market – finance literature. "In the narrow", after controlling for extant financial market determinants of product market outcomes, we uncover a new financial determinant of market share. More generally (as noted above), one might view asymmetric information about financial condition as an underlying determinant or "primitive" for constraints on capital raising activity. Other studies of this genre focus on outcomes of such primitives (such as leverage levels or quantity of cash carried). We highlight a potential determinant of leverage, similar to Yu (2005)[21]. Moreover, asymmetric information has a particular effect on access to equity capital (and the price of it), and there is no empirical work focusing on the cost of equity and its influence on product market outcomes.

Overall, one might summarize our relation to extant work in the finance – product market literature as follows. A firm is not completely financially constrained if it is truly transparent. There exists a price at which the firm *can* raise capital.[22] Thus, studies of the influence of financial outcomes on product market outcomes capture some of the relation between financial and product markets. However, our evidence potentially measures a broader influence of finance (future access to capital) on product market share.

The remainder of this paper is organized as follows. We begin with a more detailed discussion of the relationship between finance and product markets, placing our work in the context of extant evidence. Section II presents a brief discussion of the

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[21] Though he studies the influence of asymmetric information on spreads, and we link it to capital raising (both debt and equity). Nevertheless, if asymmetric information raises the cost of debt as in Yu (2005), firms likely will carry less leverage.

[22] Even during the height of the financial crisis, credit risk spreads were estimable for various quality debt issues. We hypothesize that firms could have raised capital, but were simply unwilling to do so at available prices.

literature seeking to measure asymmetric information between managers and investors, along with a description of our main proxy's calculation. We describe our data in section III. Results on the relation between opacity (asymmetric information) and market share (product market outcomes) are presented in section IV. Section V details the influence of opacity on external financing by firms. We conclude in section VI.

2.2 Finance and Product Markets

The literature linking finance with product market outcomes largely focuses on the constraints imposed by financial difficulties on a firm's competitive stature. For example, Chevalier and Scharfstein (1995) find that industries comprised of more small firms (which they argue are financially constrained) raise prices more in downturns. Chevalier (1995a, 1995b) follows up with evidence that higher leverage (which she views as financially constraining ex-post) associates with greater entry by competitors and higher prices respectively. In the former, the implication is that potential entrants perceive an opportunity when an incumbent is financially constrained and may not engage in a costly price war. In the latter, price increases are by the existing firms in the industry, and are viewed as disinvestment in market share.

Similar inferences are reached by Phillips (1995), Kovenock and Phillips (1997), Zingales (1998), Khanna and Tice (2000), and Campello (2003). Phillips (1995) finds that (in most cases) output is negatively associated with industry debt ratio (i.e. leverage constrains investment, similar in spirit to Chevalier (1995b)). Kovenock and Phillips (1997) find that leveraged recaps associate with more plant closings. Zingales (1998) studies product market outcomes in the trucking industry following deregulation. Highly

levered carriers are less likely to survive. Khanna and Tice (2000) study competitive responses to entry by Wal-Mart into a community. Highly levered incumbents respond less aggressively. Campello (2003) finds that leverage has a negative impact on firm sales growth in industries where rivals are relatively less levered during recessions. Overall, leverage is viewed as constraining to product market behavior.[23]

However, other financial characteristics may have a positive influence on product market share. Chief among these is a firm's cash levels. Fresard (2010) finds that large cash reserves associate with larger market share gains after tariffs decline; cash insulates firms from exogenous shocks to the competitive environment.

Overall, the literature linking finance with product market outcomes suggests that financial constraints (be they size-driven, leverage-driven, or reduced by a surfeit of cash) inhibit a firm's competitive stature. However, little work in this literature studies financial constraints from an equity (cost) perspective. Moreover, not much is known about potentially underlying determinants of financial position, and these could influence competitive postures. Our investigation of asymmetric information's influence on product market outcomes and capital raising activities offers a new window into the relation between finance and real economic outcomes.

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[23] One might view a few papers from the capital structure literature as contradicting this notion. In particular, the notion that low debt indicates higher debt capacity may be premature. Faulkender and Petersen (2006) show that firms with public debt actually carry higher leverage, implying that access to public debt markets enhances debt capacity, rather than existing debt on a balance sheet curtailing debt capacity. Lemmon and Roberts (2010) and Sufi (2009) also conclude that a low leverage ratio may not necessarily imply financial strength. However, none of these papers take a product market perspective.

2.3 Measuring Asymmetric Information

The finance literature is replete with proxies for asymmetric information between issuers and investors. The most common ones include: bid-ask spreads or a component (Bagehot, 1971, George, Kaul and Nimalendran, 1991 and many others); stock return volatility (Harris and Raviv, 1993, Boehme, Danielson, and Sorescu, 2005 and others); and analysts' forecast dispersion (Ajinkya, Atiase, and Gift, 1991, and Diether, Malloy, and Scherbina, 2002, among others). However, each of these is subject to a degree of criticism that they potentially measure more than the disconnect between insiders' and outsiders' information about a firm's financial condition. Spreads may be a function of market structure (Huang and Stoll, 1996); stock return volatility can be influenced by firm-specific and macro news; analysts' forecasts may be biased by investment bank affiliation (Michaely and Womack, 1999).

Lee and Masulis (2009) posit that accruals quality may be viewed as a viable alternative proxy. They begin their argument by noting that financial statements are a primary source of information for investors seeking to learn about firm performance, while the *quality* of financial statements affects outside investors' ability to *infer* a firm's financial health from said statements. By contrast, insiders rely less on the reported financials than investors, as they have access to the determinants of the report. This implies that a decrease in the quality of financial statements is likely to widen the asymmetry (in information about firm financial position) between insiders and outsiders. Lower accounting quality should associate with wider information asymmetries between outside investors and managers.

Accrual quality is a common measure of financial statement quality in the accounting literature. Since Dechow and Dichev (2002), the accepted view is that both managerial discretion and uncertainty over firm operating fundamentals (size, operating cycle length, revenue and cash flow volatility, effects due to mergers and acquisitions or divestitures, among other factors) influence accrual quality. On the former, managers have some discretion over when to recognize cash flows as earnings. But if an uncertain future cash flow is recognized as current earnings, and subsequently the cash flow is different from the (prior) recorded amount in earnings, an adjustment must be made upon this realization. These estimation errors in accruals (and the subsequent correction) reduce the quality of accruals—i.e. they reduce the information that outside investors can glean from financial statements. On the latter, an acquisition (for example) typically increases net current assets and therefore likely influences the error term from equation (1) below.

Critically, accrual quality has already been related to both underwriting costs and announcement returns of SEOs (Lee and Masulis (2009)). This encourages our use of it to capture the finance perspective of asymmetric information about a firm's financial condition, and in particular the cost and difficulty of raising external capital. It is also consistent with the accounting literature view that accruals quality is a more direct approach to assessing the information available to outside investors.

To estimate accruals errors, Dechow and Dichev (2002) set up the following empirical model:

$$CA_{j,t} = c + \phi_1 CFO_{j,t-1} + \phi_2 CFO_{j,t-1} + \phi_3 CFO_{j,t+1} + v_{j,t} \qquad (2.1)$$

where CA = total current accruals = Δcurrent assets – Δcurrent liabilities – Δcash + Δdebt in current liabilities, and Δ = changes between year t-1 and t; CFO = cash flow from operations = net income before extraordinary items – total accruals; and total accruals = current accruals – depreciation and amortization expense. All variables are scaled by the average of total assets between years t-1 and t.

They estimate the model annually, across firms with available data. Then they calculate the (time-series) standard deviations (per firm) of regression residuals from t-4 through t (5 years). Larger standard deviations are hypothesized to indicate poorer accruals quality (at year t). McNichols' (2002) modifies the Dechow and Dichev (2002) model by acknowledging the importance of changes in sales revenue and plant, property and equipment (PPE) to expectations about current accruals. In particular, higher revenues typically require more inventory, accounts receivable and accounts payable. Since the net of these is typically positive, larger revenues are typically associated with more accruals. Similar thinking applies to PPE through its effect on depreciation. McNichols' (2002) empirical model is:

$$CA_{j,t} = c + ø_1 CFO_{j,t-1} + ø_2 CFO_{j,t-1} + ø_3 CFO_{j,t+1} + ø_4 \Delta Sales_{j,t} + ø_5 PPE_{j,t} + v_{j,t} \quad (2.2)$$

where Sales = total revenue, and PPE = property, plant, and equipment, both scaled by average total assets between years t-1 and t. This is also the model used by Francis et al. (2005).

Our primary results are built on the measure of accruals quality from equation (2) above, as implemented by Francis et al. (2005). However, as we note below, we run several robustness checks to validate our inferences. Details are provided in section IV.B.

2.4 Data and variables

Following Ovtchinnikov (2010), our sample is built from the following non-financial industries that underwent deregulation between 1960 and 2007 (with the deregulation completion year in parentheses): Entertainment (1984), petroleum and natural gas (1992), utilities (1999), telecommunications (1996), and transportation (1995).[24] Given these industries, we select all firms with the following data available on, or calculable from Compustat: sales growth, cash, leverage, assets, and accruals quality (which was defined in section II above). We require control variables (defined below) to be ex-ante to the market share year. Specifically, size, leverage, and market share variables must be available in year t-1, while leverage, market share, opacity, and cash variables must be available in year t-2 (see Fresard (2010)).[25] The total number of firm-years that meet these general criteria is 22,709, comprised from 1,911 firms.

We also analyze the post-deregulation and pre-deregulation periods separately (see below). The pre-deregulation period begins in 1960 and ends in the year preceding completion of deregulation. The post-deregulation period begins in the year following the completion of deregulation and ends five years later. For example, the entertainment industry completed its deregulation in 1984. The pre-deregulation period runs from 1960 through 1983. The post-deregulation periods runs from 1985 through 1989. The exclusion of the deregulation completion year, coupled with the need for ex-ante

[24] Ovtchinnikov (2010) sources Viscusi, Harrington, and Vernon (2005). See his Table 1.

[25] The requirement that opacity be at t-2 is also because opacity stems from a regression of current accruals on *next period's* cash flow (and other factors). Given market share (sales growth) is closely related to cash flow, we do not wish to contaminate the opacity – market share relationship with opacity that is linked to cash flow that is contemporaneous with market share.

regressors leads to sample sizes of 13,922 firm-years (1,251 firms) in the pre-deregulation sample, and 3,305 firm-years (853 firms) in the post-deregulation sample.

Our specific variables used in the analysis of market share are constructed as follows (where years refer to fiscal years):

> **Opacity** (our name for accruals quality) is the standard deviation of a firm's residuals from a modified (by McNichols (2002)) Dechow and Dichev (2002) model. See section II for details of the estimation. Opacity is at the end of year t-2, where market share changes between the end of year t-1 and the end of year t.
>
> **ΔMarketShares** equals the percentage change in sales from t-1 through t, minus the industry average (excluding the sample firm) of the same. This follows Campello's (2003, 2006) and Fresard's (2010) calculation of market share changes. We also include control variables for market share changes over years t-1 and t-2, following Fresard (2010).
>
> **Firm size** is the logarithm of total book value of assets, at the end of year t-1 (see again Fresard (2010)).
>
> **Tobin's Q** equals total assets minus book equity plus market equity (shares outstanding times fiscal year-end stock price), all divided by total assets. Tobin's Q at both t-1 and t-2 year-ends are included as controls (Fresard (2010)).
>
> **Leverage** equals long-term debt plus short-term debt, all scaled by total assets. Leverage is at both t-1 and t-2 year-ends as controls (Fresard (2010)).
>
> **Cash** equals cash plus short-term investments, all divided by total assets. Cash is at the end of year t-2 (Fresard (2010)).

We adjust many of the above variables for industry performance. In our tables, all variables with the prefix "Adj_" are calculated by subtracting the industry average value, excluding the sample firm from the industry average.[26] To do so, we define industry (first) based on 4-digit SIC. If that classification leads to fewer than five rival firms in the same industry, we relax the matching to 3-digit SIC, then to 2-digit SIC (if

[26] In our robustness checks, we adjust by industry median.

there are fewer than five rivals with the same 3-digit SIC), and then to 1-digit SIC if necessary.

We also study firms' external financing behavior around deregulation. We follow Richardson and Sloan (2003) in our calculations.

Total external financing is net equity financing from the cash flow statement, plus net debt financing from the same.

Net equity financing is the cash proceeds from the sale of common stock and preferred stock, minus cash payments for the purchase of the same, minus dividend cash payments.

Net debt financing is the cash proceeds from issuance of long-term debt, minus cash payment for long-term debt reductions, plus net changes in current debt. If net changes in current debt are missing, we set it to zero.

All external financing measures are scaled by average total assets (averaged over years t-1 and t). We require a few additional variables for our analysis of external financing behavior. All are measured at the end of year t-1, where t is the external financing measurement year.

R&D scaled by total assets. If R&D is missing, we set it to zero.

Capex equals capital expenditures scaled by total assets.

Profitability equals operating income before depreciation, scaled by total assets.

Fixed assets equals property, plant, and equipment, scalled by total assets.

Cash Dividend is an indicator equal to one when the cash dividend is positive, zero otherwise.

Table I presents descriptive statistics for our variables. We report the mean, median and number of firm-years for the full sample, the post-deregulation subsample, and the pre-deregulation subsample. A few points are noteworthy.

Opacity and adjusted opacity are positively skewed. In the post-deregulation subsample the mean opacity is over 50% larger than the median, with an even larger percentage difference in adjusted opacity. In our robustness checks, our market share inferences are robust to taking logs of opacity (and then industry adjusting where tests use adjusted opacity).

Market share declines most in the post-deregulation subsample. This is consistent with the presumption that deregulation increases competitive pressures on incumbents. Leverage drops minimally between the pre-deregulation and post-deregulation periods. This is a bit surprising in light of the extant evidence that leverage may inhibit competitive responses by incumbents. On the other hand, it may also help explain the typical decline in market share. The firms in our sample are small (average assets of $532 million) and growth oriented (average Q of 1.477), consistent with a sample relying on Compustat data.

2.5 The effect of opacity on market share changes

2.5.1 Main regressions

We examine the relation between opacity and market share changes around deregulation in two ways. First, we follow the extant literature and analyze the full panel of data (all firm-years, from 1960 through 2007), estimating the influence of opacity on market share, using an interactive variable to pick up the effects of deregulation. The baseline model is (see Figure I for pictorial representation):

$$\Delta\text{Market Share}_t = \alpha_i + \eta_t + \gamma_1*\text{Opacity}_{t-2} + \gamma_2*\text{Opacity}_{t-2}*\text{Complete} + \boldsymbol{\beta}'\mathbf{X}_i + \varepsilon_{I,t} \quad (2.3)$$

where α picks up firm fixed effects and η measures the influence of time fixed effects. Complete is a dummy variable that takes the value of one for the first five years following the deregulation completion year. Thus, γ_2 is our parameter of interest. If opacity hinders firms' capital raising ability and therefore capacity to compete, a more competitive post-deregulatory environment should associate with larger market share declines for more opaque firms. In other words, we expect γ_2 to be significantly negative. We also replace Opacity with Adjusted Opacity (subtracting industry mean opacity, where the mean does not include the sample firm) in some specifications—see below.

Our second approach to ascertaining the influence of opacity on market share outcomes while controlling for endogeneity, is to sample strictly on the five-year post-deregulation window. The model then becomes:

$$\Delta\text{Market Share}_t = \alpha_i + \eta_t + \gamma_1 * \text{Opacity}_{t-2} + \boldsymbol{\beta}'\mathbf{X}_i + \varepsilon_{I,t} \qquad (2.4)$$

We expect γ_1 to be significantly negative in this case. An advantage of this latter approach is the allowance for error terms to vary between the pre- and post-deregulation windows. A second benefit of studying only the five years following deregulation is that a shorter time-series for each firm implies less concern with clustering of standard errors (Petersen, 2009). Thus, we may view our results with White-corrected standard errors with more confidence.

Our main results are presented in Table II. Panel A contains estimates from equation (3) and Panel B contains estimates from equation (4). Each panel has four specifications in it. The first two include a subset of control variables, eschewing regressors for prior market share. The latter two columns of estimates include prior market share changes (i.e. industry-adjusted sales growth). For completeness, Panel C

presents results from estimating our regressions over the pre-deregulation window. T-statistics are reported in brackets below each coefficient. The first t-statistic uses White-corrected standard errors, while the second uses standard errors controlling for clustering (hereafter clustered standard errors).

Panel A presents evidence consistent with opacity compromising a firm's ability to compete when there is an exogenous shock to the competitive environment. The coefficient on Opacity*Complete from equation 3 (γ_2) is significantly negative (see columns 1 and 3), with both White-corrected and clustered error t-statistics indicating significance at better than the 5% level. In the five years following completion of an industry's deregulation, more opaque firms experience larger declines in market share.

The coefficients on the Opacity variable without the Complete interactive are also telling. They are positive and sometimes significant. This highlights the endogeneity problem typically faced in corporate finance studies. In our context, prior to deregulation, more opaque firms associate with higher market shares, perhaps because with a higher market share the firm can afford to be more opaque—it requires capital less often. The exogenous shock of deregulation allows us to better isolate (albeit not completely) the influence of opacity on competitive behavior through its influence on capital acquisition.

Similar to Fresard (2010), more cash than rivals associates with more market share growth, particularly post-deregulation. Prior market share has no influence. Two year lagged leverage is insignificant, while the same specifications show a weakly positive influence of one year lagged leverage. This result is inconsistent with Fresard (2010) and other work which concludes that leverage compromises competitive position. However, leverage's compromising influence (on market share) turns upon the notion

that more debt makes it harder/more expensive to raise further funds. Our Opacity variable is designed to pick up the same *outcome*, even if it's not via the same exact mechanism. Once Opacity measures the influence of access to future capital, leverage's influence may proxy for any number of potentially positive influences on market share (tax shields, lack of agency conflicts between managers and shareholders because debt constrains managers, etc.). Finally, size carries a significantly negative coefficient. Larger firms exhibit slower growth in market share than smaller firms, which is typical.

We report results from replacing Opacity with Adjusted Opacity in columns 2 and 4. Here too, the coefficient (γ_2) is significantly negative, but at the 10% level, and not in column 2 with clustered t-statistics. In other words, the results are weaker and this too is noteworthy. The literature studying finance – product market interactions typically finds that a firm's leverage (or other factor) matters more *when it is different* from their rivals'. For example, Campello (2003) finds that a firm's leverage has a negative effect on market share in industries where rivals are less levered, but not in high-debt industries. By contrast, our evidence is stronger when we focus on Opacity by itself, rather than relative to its industry peers. In other words, Opacity is costly *prima facie*, regardless of whether peers are also opaque. This makes sense if the increased competition is due to new entry.[27] Opaque firms *generally* find it more difficult/expensive to raise capital. This compromises their competitive stature and they lose market share when competition exogenously increases.

[27] As long as new entrants are not similarly opaque or similarly constrained in their capital raising ability. We think this is likely—they would not enter without the capital necessary to compete straight away.

In Panel B of Table II, we study only the post-deregulation window of five years of market share determinants. There are several advantages to doing so. Primarily, it allows the error structure to differ in the post-deregulation period. Our Panel A results do not allow this. Also, the coefficients on each regressor are allowed to differ from those in the full sample. In our Panel A regressions, we only allowed this for Opacity (to work around the endogeneity problem) and for cash, which under Fresard's (2010) intuition is more important post-deregulation. Finally, a shorter time-series or cluster of years per firm may give us more confidence in White-corrected t-statistics than those associated with a longer panel (in the time series component—see Petersen, 2009).

We begin with our opacity results. The coefficient on Opacity is significantly negative at the 5% level using White-corrected t-stats, across all four specifications (both raw and adjusted opacity, and including or excluding ex-ante market share controls and two-year lagged leverage). Greater opacity continues to associate with greater losses in market share post-deregulation. The t-statistics are somewhat muted with clustered standard errors (though still largely significant), but as noted above, we have greater confidence in White-corrected t-stats in the post-deregulation subsample.

The coefficients on control variables are similar to those in Panel A, with the exception of those on prior market shares. These carry significantly negative coefficients, and this is perhaps driven simply by the deregulation event. Firms that had the highest market share prior to deregulation have more ground to lose in the event of exogenously increased competition. They may also have adopted policies that were inefficient (while

they were protected) and that are hard to immediately change, and this is picked up by the market share lags.[28]

Finally, in Panel C we study the pre-deregulation period. Market share is unrelated to Opacity (adjusted or not). This suggests equilibrium during the pre-deregulation period, which is then disrupted by the exogenous shock. Cash has a positive influence on market share, consistent with Fresard (2010). Size has a negative influence, again consistent with slower sales growth among larger firms. Leverage carries a significantly positive coefficient, again suggesting either tax benefits or reduced agency (between managers and shareholders) costs.

2.5.2 Different measures of market share, industry, and opacity

Table III presents estimates from regressions explaining market share changes calculated by subtracting industry *median* rather than industry mean sales growth. We focus on the post-deregulation subsample because of the benefits noted above. We again report four columns of estimates, differentiated by the definition of Opacity (adjusted or not) and by the inclusion or exclusion of prior market share controls and two-year lagged leverage.

The main inferences from above persist. More opacity associates with greater loss of market share post-deregulation. The coefficients on both Opacity and adjusted opacity are significant at the 5% level with White-corrected t-stats and 10% level with clustered t-stats. Cash and leverage carry significantly positive coefficients (see above). Prior market share measures carry significantly negative coefficients.

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[28] Of course, this assumes that the other variables fail to measure such inefficient policies.

In Table IV we re-define the industry (used to calculate adjusted variables and market share changes) using the Fama/French groupings of 48 industries. In all four (of the usual specifications) more Opacity associates with larger declines in market share post-deregulation. The coefficients are significant at the 5% level with White-corrected t-stats and at the 10% level (except in one case) with clustered t-stats. Cash continues to positively influence market share, as does prior leverage. Lagged market share carries significantly negative coefficients. Our conclusions are robust to industry definition.

Table V offers two alternative measures of Opacity and its influence on market share. In the first two columns of results, we use zOpacity as a regressor. We construct zOpacity using the same approach that Fresard (2010) uses to construct zCash. It is industry-mean-adjusted Opacity, divided by the standard deviation of Opacity across industry firms in that same year. As usual, it is lagged two years from change in market share. The coefficient on zOpacity is significantly negative at the 5% level with both White-corrected and clustered t-stats (except in column 2, with clustered t-stats). In columns 3 and 4 of the results, we use the logarithm of Opacity as a regressor.[29]

Finally, we make two separate adjustments to our regressors and continue to show that greater opacity associates with larger market share losses post-deregulation. First, we winsorize all of our regressors at the 1% and 99% level to control for outliers.[30] Our results are similar. Second, we include controls for abnormal accruals (earnings manipulation). Again, our results are quite similar and our inferences unaffected. This

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[29] However, in the actual table, the coefficients and t-statistics are reported in the rows associated with zOpacity. This is solely to conserve space.

[30] We also winsorize the dependent variable and re-run our tests, and this does not affect our inferences.

latter control helps address the concern that accruals quality is influenced by executives' attempts to manage earnings, which Teoh, Welch and Wong (1998a, 1998b) have shown influences capital raising activity (and thus may influence market share).

2.5.3 Time, adjustment of opacity, and market share

Our choice of post-deregulation analysis window (five years) is based on prior work in the area examining corporate finance effects of deregulation.[31] It is not obvious that this is the most appropriate window. Competitive equilibria may be reached faster in some cases or industries. We therefore investigate the robustness of our results to shortening the post-event market share analysis window to three years. Table VI presents our results, and they are quite similar. Opacity carries negative coefficients throughout the usual four specifications, significant at the 5% level with White-corrected t-statistics and at the 10% level with clustered t-stats (again except with adjusted opacity and controls for prior market share outcomes).

However, the possibility of equilibrium being reached quicker opens a wider door to questions about how quickly firms may change their opacity. At some level, our use of the deregulation shock and analysis of opacity on market share presumes a certain stickiness to opacity. If firms could move from complete opacity to complete transparency immediately and costlessly, *and if investors correspondingly freed up access to capital immediately*, we would likely document no relation between opacity and market share after deregulation. We therefore examine the validity of this presumption of stickiness.

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31 Ovtchinnikov (2010).

Table VII describes changes in opacity and the time it takes for firms to change their opacity's position relative to the industry average. In Panel A we present descriptive statistics for firm changes to Opacity from the end of year t-2 through each of the first five years following deregulation. The results indicate ostensible shrinkage in average firm opacity over the first three years following deregulation. Average Opacity shrinks by .0017, .0018, and .0004 respectively. However, pre-deregulation mean Opacity is .024, and each of the changes in Opacity is statistically indistinguishable from zero. So though it appears firms attempt actions designed to mitigate asymmetric information, it's either a noisy process, or firms find it difficult to change accrual quality significantly.

We take an alternative view of changes in Opacity in Panel B. We examine the number of firms that change their position relative to industry average (or median) Opacity, and how long it takes them to do so. Column (1) shows that 277 firms change their opacity position from above (below) the industry average to below (above) it, between the year prior to deregulation and five years following it. On average these changes take place within three years (2.76) and the median time to effect such a change is two years. Column (2) presents similar information but where the benchmark Opacity is the industry median.

The above numbers indicate a few things. First, some firms do change their opacity relative to the industry average (and median), even if Panel A indicates that the average firm's raw change in opacity is not statistically significant. Second, these changes may reflect either rises or falls relative to industry average (median). Thus, columns (3) and (4) focus on the subsample of firms that reduces opacity from above the

industry mean (median) to below it. Of the 277 firms that change their Opacity's relative-to-industry-average position (in column (1)), 137 of them lowered it (implying 140 raised it). Of the 368 firms that change their Opacity's relative-to-industry-median position (in column (2)), 191 of them lowered it (implying 177 raised it). In all cases of changed relative position, the mean and median time to do so hovers between 2.5 and 3 years.

Given the results in Table VII, we inquire whether unchanged opacity influences market share outcomes post-deregulation in a manner similar to Opacity that may vary through time. In Table VIII, we "lock" Opacity at the end of year t-2, where t-1 is the deregulation completion year. We then investigate the effects of "locked" Opacity on market share changes in t through t+4. This no longer allows Opacity to "roll" forward with the market share change being analyzed. Table VIII presents three panels of results. Panel A (B, C) studies market share changes for two (3, 4) years after deregulation. Since Opacity is locked for each year of analysis per firm, we no longer include fixed effects.

Panel A indicates a negative relationship between Opacity prior to the deregulation completion year and market share changes over the two years following deregulation. The coefficient is significant with White-corrected t-stats, but not with clustered.[32] Given the very short time series (two years) for each firm, it is perhaps asking a bit much to control for clustering.

Panel B however contradicts the result in Panel A, finding no significant effect of "locked" Opacity on market share changes over the three years following deregulation.

[32] Moreover, all of the significant results in Table IX are based on raw Opacity. Nothing is significant under adjusted Opacity.

While it's tempting to conclude that using potentially stale Opacity to explain market share outcomes is (again) asking a bit much of the data, the results in Panel C again reverse the prior Panel's conclusions. Four years of post-deregulation market share outcomes are significantly negatively influenced by Opacity that existed prior to deregulation. Overall, the sensitivity of our results to the market share time window analyzed when we "lock" Opacity at its pre-deregulation value, calls for future research to better understand the dynamics of Opacity through time. In particular, investors' willingness to change their attitude about a firm's information advantage and a concomitant change in capital provision, is not well understood yet.

2.6 The effect of opacity on capital acquisition

To this point, our conclusions about the influence of asymmetric information on product market outcomes were built on the assumption that asymmetric information compromises a firm's capital raising ability and this is what hurts sales growth after deregulation. This section empirically tests the assumed link between asymmetric information and capital raising. The analysis takes the same basic form as prior regressions, with Opacity as the proxy for asymmetric information (at t-2), and external financing over the year t-1 to t. Analysis is conducted over five years following the completion of an industry's deregulation. The variables included in the analysis were discussed in section III.

Table IX presents the results. External financing is declining in Opacity. Regardless of the Opacity measure (raw or industry-adjusted) and whether we control for clustering or not, total external financing is decreasing in our proxy for asymmetric

information. The coefficients are always negative and significant at the 5% level or better. The linchpin of our argument linking asymmetric information with product market outcomes is empirically supported.

The results also indicate that the effect is stronger among equity financing than debt financing, consistent with Myers and Majluf (1984) and others. The coefficients in the external equity financing regressions are always significant at the 5% level or better, but this is not the case in the external debt financing regressions.

Third, the effects of raw Opacity appear to be stronger than the effects of industry-adjusted Opacity. In particular, the influence of Opacity on debt is significant only in the "raw" case. This provides support for our earlier statement that access to capital *prima facie* appears to be at least as important (if not moreso) than relative access to capital.

Our other results (the influence of control variables) are as expected. Smaller firms raise less external capital. More levered firms raise less debt and more equity. No other variables appear to have a consistent influence on external financing activity post-deregulation.

Overall, the negative influence of Opacity on external fundraising post-deregulation supports our earlier inferences. When deregulation leads to potentially increased competition, firms with greater asymmetric information are more compromised in their ability to compete because of their relative difficulty in raising external financing.

2.7 Conclusions

The literature on finance and product market interactions is long and varied. However, much (though not all) of the work focuses on leverage as a financial constraint with little treatment of equity costs/constraints, and we know of no work examining asymmetric information as an underpinning of financial constraints that may influence product market outcomes.

We study the influence of asymmetric information on both capital raising and market share growth. We address the inherent endogeneity problem of such a study by focusing on post-deregulation outcomes for firms in five deregulated industries between 1960 and 2007. Given a shock to the competitive structure of an industry induced by deregulation, firms that have difficulty raising external finance should suffer greater losses in market share. Firms with greater asymmetric information (between insiders and outsiders) should be just such firms.

We find that firms with greater asymmetric information problems (proxied by the accounting literature's accruals quality metric) do lose more market share post-deregulation and they are also the firms that raise less external finance. Finance's influence on product market outcomes is partly driven by the effects of asymmetric information on capital acquisition.

Much work remains to be done. We know little about the dynamics of opacity and investors' willingness to provide financial capital over time. How long does it take a firm to change its opacity to mirror that of firms more successful at raising capital? How long does it take investors to trust a firm that has changed its opacity? How might these lags influence product market behavior? Perhaps work linking accounting measures of

opacity with financial measures of investor confidence can begin to address such questions.

Table 2.1 Descriptive statistics

	Deregulation Industry 1960-2007			Pre-Deregulation sample			Post-Deregulation sample		
	N	Mean	Median	N	Mean	Median	N	Mean	Median
Opacity	22709	0.033	0.019	13922	0.024	0.014	3305	0.036	0.023
Sales Growth	22709	0.132	0.071	13922	0.105	0.067	3305	0.168	0.075
Leverage	22709	0.337	0.333	13922	0.337	0.342	3305	0.328	0.323
Size	22709	6.277	6.582	13922	6.166	6.433	3305	6.465	6.983
Cash	22709	0.067	0.026	13922	0.056	0.023	3305	0.069	0.022
Adj_Opacity	22709	-0.002	-0.004	13922	-0.001	-0.003	3305	-0.001	-0.007
ΔMarketShares	22709	-0.102	-0.072	13922	-0.059	-0.050	3305	-0.180	-0.168
Adj_Leverage	22709	-0.014	-0.022	13922	-0.011	-0.017	3305	-0.019	-0.031
Adj_Size	22709	0.382	0.476	13922	0.466	0.531	3305	0.164	0.237
Adj_Cash	22709	-0.004	-0.016	13922	-0.005	-0.013	3305	-0.009	-0.021
Tobin's Q	17408	1.477	1.185	10106	1.273	1.116	2465	1.619	1.290
Capital Expenditures	22537	0.101	0.082	13840	0.099	0.084	3265	0.104	0.078
R&D Expenditures	22709	0.002	0.000	13922	0.002	0.000	3305	0.002	0.000
Fixed Assets	22709	0.645	0.698	13922	0.676	0.725	3305	0.615	0.659
Cash Dividend Indicator	22709	0.641	1	13922	0.709	1	3305	0.601	1
KZ	22676	-0.857	0.232	13910	-0.311	0.066	3304	-0.828	0.584
Z Score	17913	2.298	1.735	10717	2.350	1.699	2427	2.566	1.763
Investment Grade Indicator	8775	0.770	1	4319	0.882	1	1796	0.766	1
Rating Indicator	14804	0.593	1	6827	0.633	1	2881	0.623	1

Note: Table presents the number of observations, mean and median statistics for the whole deregulation industry which includes Entertainment (#7), Petroleum and natural gas (#30), Utility (#31), Telecommunications (#32), and Transportation (#40) over the years of 1960-2007. The industry numbers in the brackets are based on Fama-French 48-industry category. It also provides the statistics for the pre-deregulation sample and post-deregulation sample. The pre-deregulation sample includes Entertainment (#7) 1960-1983, Petroleum (#30) 1960-1991, Utility (#31) 1960-1998, Telecommunication (#32) 1960-1995 and Transportation (#40) 1960-1994. The post-deregulation sample includes Entertainment (#7) 1985-1989, Petroleum (#30) 1993-1997, Utility (#31) 2000-2004, Telecommunication (#32) 1997-2001 and Transportation (#40) 1996-2000. Opacity is measured by accruals quality, which is calculated by the standard deviation of firm's residual from modified Dechow and Dichev model across five years from t-4 to t. Sales growth is calculated by sales (SALE) at year t minus sales at year t-1, all scaled by sales at year t-1. Leverage is the sum of long-term debt (DLTT) and short-term debt (DLC), all scaled by total assets (AT). Size is measured by the logarithm of total book value of assets (AT). Cash is the cash and short-term investment (CHE) divided by total assets (AT). The variables opacity, leverage, size, cash with prefix Adj are variables adjusted by subtracting the industry average values excluding the firm itself. ΔMarketShares is calculated as firm's sales growth minus the industry average sales growth excluding the firm itself. We first define the same industry based on 4-digit SIC. If the industry based on 4-digit SIC has less than 5 rival firms, then we relax the 4-digit SIC restriction to 3-digit SIC, to 2-digit SIC and to 1-digit SIC (as necessary) until the industry has at least 5 rival firms.

Tobin's Q is total assets (AT), minus total book value of common equity (CEQ), plus market value of common equity(PRCC_F*CSHO), all divided by total book value of assets(AT). Capital expenditure is computed as capital expenditures (CAPX) divided by total assets (AT). R&D expenditure is defined as research and development expense (XRD) divided by total assets (AT). If the research and development expense is missing, we set it to zero. Fixed assets is calculated as property plant and equipment (PPENT) scaled by total assets (AT). If the cash dividend (DV) is greater than zero, then we set cash dividend indicator as one, otherwise we set it to zero.

KZ index is calculated in the following way. KZ index = -1.001909*(Net income(IB)+Depreciation(DP))t /Fixed assets(PPENT)t-1 +0.2826389*(Assets +Market value of Equity (PRCC_C*CSHO)-book value of common equity(CEQ)-deferred taxes(TXDB)) t /Assets(AT)t + 3.139193*((Long term debt(DLTT) + Short term debt(DLC))t /(Long term debt(DLTT)t+ Short term debt(DLC) + Shareholders equity(SEQ))t – 39.3678*(common dividend(DVC) + preferred dividend (DVP))t /Fixed assets(PPENT)t-1 – 1.314759*(Cash (CHE)/ Fixed assets(PPENT)t-1).

Altman's Z score is calculated as Z score = 3.3*Operating income before depreciation (OIADP) t/Assets (AT)t-1 +0.999*Sales(SALE) t/Assets(AT) t-1 +1.4*Retained earnings(RE) t /Assets(AT) t-1+1.2*Working capital(ACT-LCT) t/ Assets(AT) t-1+0.6*(Market value of equity(PRCC_C*CSHO) t/Liabilities (LT) t).

The credit rating is based on the S&P domestic long-term issuer credit rating (SPLTICRM). Compustat provides the monthly credit rating data. We use the last month with available rating data for each year to proxy the yearly credit rating. If the rating is BBB- or above, then we set investment grade indicator as one, otherwise we set it as zero. If the company has the SPLTICRM rating data, rating indicator is one, otherwise it is zero.

Table 2.2 The impact of opacity on market share changes

Panel A: The Impact of Opacity on Market Share Changes for Deregulation Industry over the Years of 1960-2007

	ΔMarketShares	ΔMarketShares	ΔMarketShares	ΔMarketShares
	(1)	(2)	(3)	(4)
Intercept	-0.048	-0.043	-0.043	-0.038
	[-1.61]	[-1.47]	[-1.45]	[-1.30]
	[-1.69]	[-1.57]	[-1.48]	[-1.35]
Opacity $_{t-2}$	0.909*		0.961**	
	[1.90]		[2.00]	
	[1.59]		[1.66]	
Opacity $_{t-2}$ * Complete	-1.421**		-1.456**	
	[-2.43]		[-2.49]	
	[-2.01]		[-2.04]	
Adj_Opacity $_{t-2}$		0.712		0.764*
		[1.63]		[1.74]
		[1.37]		[1.45]
Adj_Opacity $_{t-2}$ * Complete		-1.086*		-1.115*
		[-1.90]		[-1.96]
		[-1.62]		[-1.65]
Complete	0.008	-0.044***	0.008	-0.046***
	[0.41]	[-2.63]	[0.37]	[-2.75]
	[0.35]	[-2.27]	[0.31]	[-2.31]
Adj_Cash $_{t-2}$	0.408***	0.414***	0.401***	0.406***
	[3.65]	[3.68]	[3.54]	[3.57]
	[3.37]	[3.37]	[3.19]	[3.20]
Adj_Cash $_{t-2}$ * Complete	0.461*	0.445*	0.466**	0.450*
	[1.94]	[1.87]	[1.97]	[1.89]
	[2.25]	[2.17]	[2.25]	[2.17]
Adj_Size $_{t-1}$	-0.033***	-0.033***	-0.032***	-0.031***
	[-2.89]	[-2.77]	[-2.83]	[-2.71]
	[-3.02]	[-2.89]	[-2.75]	[-2.63]
Adj_Leverage $_{t-1}$	0.045	0.047	0.101*	0.103*
	[1.10]	[1.14]	[1.66]	[1.67]
	[0.96]	[0.99]	[1.61]	[1.62]
Adj_Leverage $_{t-2}$			-0.091	-0.091
			[-1.47]	[-1.47]
			[-1.45]	[-1.44]
ΔMarketShares $_{t-1}$			-0.024	-0.023
			[-1.01]	[-0.97]
			[-1.00]	[-0.95]
ΔMarketShares $_{t-2}$			-0.007	-0.007
			[-0.23]	[-0.22]
			[-0.24]	[-0.23]
N	22,709	22,709	22,709	22,709
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adj R-Squared	0.135	0.134	0.136	0.135
F test	11.51	11.49	10.99	10.97

Table 2.2 Continued

Panel B: The Impact of Opacity on Market Share Changes for Deregulation Industry during the Post-Deregulation

	ΔMarketShares	ΔMarketShares	ΔMarketShares	ΔMarketShares $_{t}$
	(1)	(2)	(3)	(4)
Intercept	0.014	-0.125***	-0.145*	-0.278***
	[0.18]	[-3.65]	[-1.81]	[-5.86]
	[0.15]	[-3.36]	[-1.46]	[-5.53]
Opacity $_{t-2}$	-3.588**		-3.448**	
	[-2.15]		[-2.31]	
	[-1.78]		[-1.66]	
Adj_Opacity $_{t-2}$		-3.396**		-3.083**
		[-2.16]		[-2.19]
		[-1.81]		[-1.59]
Adj_Cash $_{t-2}$	1.116**	1.129**	1.170**	1.177**
	[2.46]	[2.48]	[2.54]	[2.55]
	[2.57]	[2.58]	[2.22]	[2.22]
Adj_Size $_{t-1}$	-0.114	-0.123	0.031	0.022
	[-1.48]	[-1.57]	[0.45]	[0.33]
	[-1.51]	[-1.62]	[0.41]	[0.30]
Adj_Leverage $_{t-1}$	0.352*	0.362*	0.416**	0.425**
	[1.85]	[1.90]	[2.12]	[2.17]
	[1.64]	[1.68]	[1.98]	[2.03]
Adj_Leverage $_{t-2}$			0.005	0.004
			[0.03]	[0.02]
			[0.03]	[0.02]
ΔMarketShares $_{t-1}$			-0.305***	-0.304***
			[-4.47]	[-4.45]
			[-4.75]	[-4.77]
ΔMarketShares $_{t-2}$			-0.240***	-0.239***
			[-3.25]	[-3.23]
			[-3.99]	[-3.94]
N	3,305	3,305	3,305	3,305
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adj R-Squared	0.223	0.223	0.302	0.301
F test	5.472	5.472	5.711	5.676

Table 2.2 Continued

Panel C: The Impact of Opacity on Market Share Changes for Deregulation Industry during the Pre-Deregulation Period

	$\Delta MarketShares_t$ (1)	$\Delta MarketShares_t$ (2)	$\Delta MarketShares_t$ (3)	$\Delta MarketShares_t$ (4)
Intercept	-0.073**	-0.072**	-0.064**	-0.062**
	[-2.52]	[-2.46]	[-2.15]	[-2.09]
	[-2.63]	[-2.58]	[-2.19]	[-2.15]
$Opacity_{t-2}$	0.104		0.188	
	[0.18]		[0.34]	
	[0.17]		[0.30]	
$Adj\_Opacity_{t-2}$		-0.190		-0.115
		[-0.36]		[-0.23]
		[-0.33]		[-0.20]
Adj_Cash_{t-2}	0.438***	0.441***	0.417***	0.420***
	[3.88]	[3.89]	[3.58]	[3.58]
	[3.41]	[3.40]	[3.12]	[3.11]
Adj_Size_{t-1}	-0.054***	-0.055***	-0.052***	-0.053***
	[-5.04]	[-5.09]	[-4.93]	[-4.99]
	[-4.94]	[-4.96]	[-4.57]	[-4.60]
$Adj\_Leverage_{t-1}$	0.086*	0.088*	0.181**	0.183**
	[1.86]	[1.91]	[2.44]	[2.48]
	[1.63]	[1.68]	[2.16]	[2.20]
$Adj\_Leverage_{t-2}$			-0.148*	-0.149*
			[-1.77]	[-1.78]
			[-1.70]	[-1.71]
$\Delta MarketShares_{t-1}$			-0.040	-0.039
			[-1.11]	[-1.09]
			[-1.01]	[-0.99]
$\Delta MarketShares_{t-2}$			-0.040	-0.039
			[-1.33]	[-1.31]
			[-1.25]	[-1.23]
N	13,922	13,922	13,922	13,922
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adj R-Squared	0.145	0.145	0.148	0.148
F test	8.867	8.857	8.485	8.463

Note: Table presents the regression results for sample of deregulated industries during the period of 1960-2007. In Panel A, sample period is 1960-2007. In Panel B, we study post-deregulation sample and in Panel C, we study pre-deregulation sample. The whole deregulation industry sample includes Entertainment (#7), Petroleum (#30), Utility ((#31), Telecommunication (#32) and Transportation (#40) from 1960-2007. We set complete dummy as one, for entertainment 1985-1989, petroleum 1993-1997, utility 2000-2004, telecommunication 1997-2001 and transportation 1996-2000. Otherwise, we set complete dummy as zero. The post-deregulation sample includes Entertainment (#7) 1985-1989, Petroleum (#30) 1993-1997, Utility (#31) 2000-2004, Telecommunication (#32) 1997-2001 and Transportation (#40) 1996-2000. The pre-deregulation sample includes Entertainment (#7) 1960-1983, Petroleum (#30) 1960-1991, Utility (#31) 1960-1998, Telecommunication (#32) 1960-1995 and Transportation (#40) 1960-1994.

The dependent variable ΔMarketShares is calculated as firm's sales growth minus the industry average sales growth excluding the firm itself. Sales growth is calculated as sales (SALE) at year t minus sales at year t-1, divided by sales at year t-1. Opacity is measured by accruals quality, which is calculated as the standard deviation of a firm's residual from a modified Dechow and Dichev model across five years from t-6 to t-2. Cash is the cash and short-term investment

(CHE), all scaled by total assets (AT). Size is measured by the logarithm of total book value of assets (AT). Leverage is the sum of long-term debt (DLTT) and short-term debt (DLC) scaled by total assets (AT). The variables opacity, cash, size, leverage with prefix Adj are variables adjusted by subtracting the industry average values excluding the firm itself. We first define the same industry based on 4-digit SIC code. If the industry based on 4-digit SIC code has less than 5 rival firms, then we relax the 4-digit SIC restriction to 3-digit SIC, to 2-digit SIC and to 1-digit SIC until the industry has at least 5 rival firms. White t-statistics are reported in brackets, and clustered t-statistics are reported in brackets underneath the white t-statistics. *, **, and *** denote two-sided statistical significance at the 10%, 5%, and 1% levels, respectively, with respect to the white t-statistics.

Table 2.3 The impact of opacity on market share changes which is defined as industry median adjusted sales growth

	$\Delta MarketShares_t$	$\Delta MarketShares_t$	$\Delta MarketShares_t$	$\Delta MarketShares_t$
	(1)	(2)	(3)	(4)
Intercept	0.070	-0.029	0.027	-0.066*
	[1.04]	[-0.86]	[0.41]	[-1.73]
	[0.89]	[-0.75]	[0.34]	[-1.43]
$Opacity_{t-2}$	-3.423**		-3.203**	
	[-2.25]		[-2.38]	
	[-1.94]		[-1.83]	
$Adj\_Opacity_{t-2}$		-3.232**		-2.978**
		[-2.23]		[-2.34]
		[-1.93]		[-1.81]
Adj_Cash_{t-2}	1.300**	1.299**	1.271**	1.270**
	[2.52]	[2.52]	[2.47]	[2.46]
	[2.45]	[2.44]	[2.04]	[2.03]
Adj_Size_{t-1}	-0.098	-0.102	0.040	0.036
	[-1.42]	[-1.47]	[0.65]	[0.59]
	[-1.33]	[-1.38]	[0.63]	[0.57]
$Adj\_Leverage_{t-1}$	0.261	0.265	0.382*	0.386*
	[1.31]	[1.33]	[1.87]	[1.90]
	[1.14]	[1.16]	[1.67]	[1.70]
$Adj\_Leverage_{t-2}$			-0.080	-0.081
			[-0.46]	[-0.47]
			[-0.43]	[-0.43]
$\Delta MarketShares_{t-1}$			-0.331***	-0.331***
			[-4.20]	[-4.20]
			[-6.49]	[-6.50]
$\Delta MarketShares_{t-2}$			-0.277***	-0.277***
			[-3.34]	[-3.34]
			[-5.05]	[-5.05]
N	3,305	3,305	3,305	3,305
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adj R-Squared	0.116	0.115	0.228	0.228
F test	2.931	2.927	3.971	3.955

Note: Table presents the regression results for sample of post-deregulation. The post-deregulation sample includes Entertainment (#7) 1985-1989, Petroleum (#30) 1993-1997, Utility (#31) 2000-2004, Telecommunication (#32) 1997-2001 and Transportation (#40) 1996-2000. The dependent variable ΔMarketShares is calculated as firm's sales growth minus the industry median sales growth excluding the firm itself. Sales growth is calculated as sales (SALE) at year t minus sales at year t-1, divided by sales at year t-1. Opacity is measured by accruals quality, which is calculated as the standard deviation of a firm's residual from a modified Dechow and Dichev model across five years from t-6 to t-2. Cash is the cash and short-term investment (CHE) scaled by total assets (AT). Size is measured by the logarithm of total book value of assets (AT). Leverage is the sum of long-term debt (DLTT) and short-term debt (DLC), all scaled by total assets (AT). The variables opacity, cash, size, leverage with prefix Adj are variables adjusted by subtracting the industry median values excluding the firm itself. We first define the same industry based on 4-digit SIC code. If the industry based on 4-digit SIC code has less than 5 rival firms, then we relax the 4-

digit SIC restriction to 3-digit SIC, to 2-digit SIC and to 1-digit SIC until the industry has at least 5 rival firms. White t-statistics are reported in brackets, and clustered t-statistics are reported in brackets underneath the white t-statistics. *, **, and *** denote two-sided statistical significance at the 10%, 5%, and 1% levels, respectively, with respect to the white t-statistics.

Table 2.4 The impact of opacity on market share changes which is defined as Fama-French 48 industry average adjusted sales growth

	$\Delta MarketShares_t$ (1)	$\Delta MarketShares_t$ (2)	$\Delta MarketShares_t$ (3)	$\Delta MarketShares_t$ (4)
Intercept	-0.039	-0.260***	-0.188***	-0.395***
	[-0.48]	[-3.20]	[-5.41]	[-8.23]
	[-0.42]	[-2.72]	[-5.16]	[-8.17]
$Opacity_{t-2}$	-3.725**	-3.386**		
	[-2.24]	[-2.30]		
	[-1.87]	[-1.64]		
$Adj\_Opacity_{t-2}$			-3.803**	-3.400**
			[-2.30]	[-2.33]
			[-1.93]	[-1.67]
Adj_Cash_{t-2}	1.148**	1.145**	1.148**	1.145**
	[2.37]	[2.33]	[2.37]	[2.33]
	[2.50]	[2.07]	[2.50]	[2.07]
Adj_Size_{t-1}	-0.108	0.094	-0.110	0.091
	[-1.17]	[1.19]	[-1.19]	[1.16]
	[-1.21]	[1.09]	[-1.24]	[1.07]
$Adj\_Leverage_{t-1}$	0.330*	0.448**	0.329*	0.447**
	[1.79]	[2.34]	[1.79]	[2.34]
	[1.59]	[2.20]	[1.59]	[2.19]
$Adj\_Leverage_{t-2}$		-0.137		-0.135
		[-0.85]		[-0.84]
		[-0.74]		[-0.72]
$\Delta MarketShares_{t-1}$		-0.340***		-0.339***
		[-4.77]		[-4.76]
		[-5.02]		[-5.03]
$\Delta MarketShares_{t-2}$		-0.272***		-0.272***
		[-3.50]		[-3.49]
		[-4.25]		[-4.25]
N	3,305	3,305	3,305	3,305
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adj R-Squared	0.209	0.307	0.210	0.307
F test	7.612	8.118	7.629	8.128

Note: Table presents the regression results for sample of post-deregulation by using Fama-French 48 industry average adjusted sales growth as dependent variable. The post-deregulation sample includes Entertainment (#7) 1985-1989, Petroleum (#30) 1993-1997, Utility (#31) 2000-2004, Telecommunication (#32) 1997-2001 and Transportation (#40) 1996-2000. The dependent variable ΔMarketShares is calculated as firm's sales growth minus the industry median sales growth excluding the firm itself. Sales growth is calculated as sales (SALE) at year t minus sales at year t-1, divided by sales at year t-1. Opacity is measured by accruals quality, which is calculated as the standard deviation of a firm's residual from a modified Dechow and Dichev model across five years from t-6 to t-2. Cash is the cash and short-term investment (CHE) scaled by total assets (AT). Size is measured by the logarithm of total book value of assets (AT). Leverage is the sum of long-term debt (DLTT) and short-term debt (DLC), all scaled by total assets (AT). The variables opacity, cash, size, leverage with prefix Adj are variables adjusted by subtracting the industry average values excluding the firm itself.

The industry is based on Fama-French 48 industry definition. We require for each industry there are at least 5 rival firms which have the available data of sales growth, cash, assets and leverage, as well as data used to calculate the degree of opacity. White t-statistics are reported in brackets, and clustered t-statistics are reported in brackets underneath the white t-statistics. *, **, and *** denote two-sided statistical significance at the 10%, 5%, and 1% levels, respectively, with respect to the white t-statistics

Table 2.5 The impact of opacity on market share changes based on different transforms of opacity measure

	ΔMarketShares t (1)	ΔMarketShares t (2)	ΔMarketShares t (3)	ΔMarketShares t (4)
Intercept	-0.131***	-0.284***	-0.157	-0.454
	[-3.86]	[-6.03]	[-0.39]	[-1.12]
	[-3.57]	[-5.69]	[-0.57]	[-1.58]
zOpacity $_{t-2}$	-0.071**	-0.068**	-0.094***	-0.093***
	[-2.20]	[-2.33]	[-3.06]	[-3.19]
	[-1.98]	[-1.83]	[-2.28]	[-2.11]
Adj_Cash $_{t-2}$	1.079**	1.133**	1.077***	1.131***
	[2.38]	[2.46]	[2.78]	[2.87]
	[2.49]	[2.17]	[2.53]	[2.21]
Adj_Size $_{t-1}$	-0.112	0.033	-0.109	0.037
	[-1.44]	[0.48]	[-1.63]	[0.62]
	[-1.46]	[0.43]	[-1.44]	[0.48]
Adj_Leverage $_{t-1}$	0.365*	0.429**	0.357**	0.425**
	[1.90]	[2.18]	[2.16]	[2.50]
	[1.69]	[2.05]	[1.67]	[2.06]
Adj_Leverage $_{t-2}$		0.002		-0.011
		[0.01]		[-0.08]
		[0.01]		[-0.06]
ΔMarketShares $_{t-1}$		-0.305***		-0.306***
		[-4.47]		[-5.23]
		[-4.76]		[-4.85]
ΔMarketShares $_{t-2}$		-0.241***		-0.241***
		[-3.22]		[-3.75]
		[-4.01]		[-4.06]
N	3,305	3,305	3,305	3,305
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adj R-Squared	0.218	0.298	0.218	0.297
F test	5.514	5.692	2.050	2.600

Note: Table presents the regression results for sample of post-deregulation by using different transforms of opacity measure. In column (1) and (2), zOpacity is defined as the difference of opacity and its industry average (excluding the firm itself), scaled by standard deviation of opacity within the industry. In column (3) and (4), zOpacity is defined as logarithm of opacity.

In the regression, the post-deregulation sample includes Entertainment (#7) 1985-1989, Petroleum (#30) 1993-1997, Utility (#31) 2000-2004, Telecommunication (#32) 1997-2001 and Transportation (#40) 1996-2000. The dependent variable ΔMarketShares is calculated as firm's sales growth subtracted by the industry average sales growth excluding the firm itself. Sales growth is calculated as sales (SALE) at year t minus sales at year t-1, divided by sales at year t-1. Opacity is measured by accruals quality, which is calculated as the standard deviation of a firm's residual from a modified Dechow and Dichev model across five years from t-6 to t-2. Cash is the cash and short-term investment (CHE) scaled by total assets (AT). Size is measured by the logarithm of total book value of assets (AT). Leverage is the sum of long-term debt (DLTT) and short-term debt (DLC), all scaled by total assets (AT). The variables opacity, cash, size, leverage with prefix Adj are variables adjusted by subtracting the industry average values excluding the firm itself.

We first define the same industry based on 4-digit SIC code. If the industry based on 4-digit SIC code has less than 5 rival firms, then we relax the 4-digit SIC restriction to 3-digit SIC, to 2-digit SIC and to 1-digit SIC until the industry has at least 5 rival firms. White t-statistics are reported in brackets, and clustered t-statistics are reported in brackets underneath the white t-statistics. *, **, and *** denote two-sided statistical significance at the 10%, 5%, and 1% levels, respectively, with respect to the white t-statistics.

Table 2.6 The impact of opacity on market share changes for post-deregulation sample which is defined as three years immediately following the last deregulatory initiative adoption

	ΔMarketShares $_t$	ΔMarketShares $_t$	ΔMarketShares $_t$	ΔMarketShares $_t$
	(1)	(2)	(3)	(4)
Intercept	0.255	-0.124***	-0.024	-0.304***
	[1.58]	[-4.52]	[-0.19]	[-8.26]
	[1.15]	[-4.20]	[-0.14]	[-7.92]
Opacity $_{t-2}$	-11.068**		-8.149**	
	[-2.55]		[-2.41]	
	[-1.82]		[-1.74]	
Adj_Opacity $_{t-2}$		-9.829**		-7.123**
		[-2.40]		[-2.24]
		[-1.72]		[-1.62]
Adj_Cash $_{t-2}$	0.912	0.903	0.746	0.737
	[1.05]	[1.04]	[0.84]	[0.83]
	[0.81]	[0.81]	[0.61]	[0.60]
Adj_Size $_{t-1}$	-0.261**	-0.277**	-0.041	-0.051
	[-2.34]	[-2.44]	[-0.36]	[-0.45]
	[-1.88]	[-1.95]	[-0.29]	[-0.37]
Adj_Leverage $_{t-1}$	0.469	0.476	0.414	0.419
	[1.54]	[1.55]	[1.31]	[1.33]
	[1.21]	[1.22]	[1.01]	[1.02]
Adj_Leverage $_{t-2}$			0.123	0.122
			[0.55]	[0.54]
			[0.44]	[0.44]
ΔMarketShares $_{t-1}$			-0.502***	-0.506***
			[-5.23]	[-5.25]
			[-6.94]	[-6.94]
ΔMarketShares $_{t-2}$			-0.458***	-0.458***
			[-5.49]	[-5.48]
			[-4.48]	[-4.47]
N	1,995	1,995	1,995	1,995
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adj R-Squared	0.152	0.146	0.341	0.337
F test	4.276	4.113	5.722	5.582

Note: Table presents the regression results for sample of post-deregulation which is defined as three years immediately following the last deregulatory initiative adoption. The sample includes Entertainment (#7) 1985-1987, Petroleum (#30) 1993-1995, Utility (#31) 2000-2002, Telecommunication (#32) 1997-1999 and Transportation (#40) 1996-1998. The dependent variable ΔMarketShares is calculated as firm's sales growth minus the industry average sales growth excluding the firm itself. Sales growth is calculated as sales (SALE) at year t minus sales at year t-1, and divided by sales at year t-1. Opacity is measured by accruals quality, which is calculated as the standard deviation of a firm's residual from a modified Dechow and Dichev model across five years from t-6 to t-2. Cash is the cash and short-term investment (CHE) scaled by total assets (AT). Size is measured by the logarithm of total book value of assets (AT). Leverage is the sum of long-term debt (DLTT) and short-term debt (DLC), all scaled by total assets (AT). The variables opacity, cash, size, leverage with prefix Adj are variables adjusted by subtracting the industry average values excluding the firm itself. We first define the same industry based on 4-digit SIC code. If the industry based on 4-digit SIC code has less than 5 rival firms, then we relax the 4-digit SIC restriction to 3-digit SIC, to 2-digit SIC and to 1-digit SIC until the industry has at least 5 rival firms. White t-statistics are reported in brackets, and clustered t-statistics are reported in brackets underneath the white t-statistics. *, **, and *** denote two-sided statistical significance at the 10%, 5%, and 1% levels, respectively, with respect to the white t-statistics.

Table 2.7 Changes in opacity and the time of change in opacity

Panel A: Changes in Opacity

	N	Mean	Median	Standard Deviation
$Opacity_{t} - Opacity_{t-2}$	674	-0.0017	0.0002	0.0273
$Opacity_{t+1} - Opacity_{t-2}$	622	-0.0018	0.0009	0.0356
$Opacity_{t+2} - Opacity_{t-2}$	584	-0.0004	0.0011	0.0369
$Opacity_{t+3} - Opacity_{t-2}$	542	0.0016	0.0023	0.0388
$Opacity_{t+4} - Opacity_{t-2}$	500	0.0016	0.0018	0.0404

Panel B: Time of Change in Opacity

(1)			(2)			(3)			(4)		
N	Mean	Median	N	Mean	Median	N	Mean	Median	N	Mean	Median
277	2.76	2	368	2.74	2	137	2.59	2	191	2.81	3

Note: Table reports the changes in opacity from pre-deregulation to post-deregulation in panel A and the time of change in opacity in panel B. In panel A, we report the changes of opacity in each of five years immediately following the last deregulatory initiative adoption (year t to year t+4) to the opacity in the year prior to the last deregulatory initiative adoption (year t-2). Year t-1 is the year that the last deregulatory initiative is adopted. In panel B, we report the time of change in opacity. Column (1) reports the number of firms, mean and median of the number of years for firms which change their position relative to industry average opacity from the year prior to the last deregulatory initiative adoption (year t-2) to the six following years (year t-1 to year t+4). If the firm's opacity degree is higher (lower) than industry average in the year of t-2, but is lower (higher) than industry average in the year of t-1, then the time of change is equal to one. If the firm's opacity degree is higher (lower) than industry average in the year of t-2, and stays higher(lower) than industry average in the year of t-1, but changes to lower(higher) than industry average in the year of t, then the time of change is equal to two. If the firm does not change its position relative to the industry average opacity during the years of t-2 to t+4, then the firm is not included in 277 sample firms in column (1). Column (2) reports the number of firms, mean and median of the number of years for firms which change their position relative to industry median opacity from the year prior to the last deregulatory initiative adoption (year t-2) to the six following years (year t-1 to year t+4). Column(3) (Column(4)) reports the number of firms, mean and median of the time of change in opacity for firms which have opacity higher than industry average (median) opacity in the year prior to the last deregulatory legislation adoption, and change their positions in the years of t-1 to t+4.

Table 2.8 The impact of opacity on market share changes by locking opacity at the year prior to the adoption of last deregulatory initiative

Panel A: Two Years after Deregulation

	$\Delta MarketShares_t$ (1)	$\Delta MarketShares_t$ (2)	$\Delta MarketShares_t$ (3)	$\Delta MarketShares_t$ (4)
Intercept	-0.139***	-0.180***	-0.104***	-0.144***
	[-7.42]	[-9.84]	[-4.63]	[-6.88]
	[-6.89]	[-9.68]	[-5.30]	[-9.20]
$Opacity_{t-2}$	-1.069***		-1.063***	
	[-2.73]		[-2.62]	
	[-2.57]		[-2.66]	
$Adj\_Opacity_{t-2}$		-0.194		-0.295
		[-0.47]		[-0.69]
		[-0.42]		[-0.69]
Adj_Cash_{t-2}	0.550*	0.524*	0.467	0.442
	[1.89]	[1.81]	[1.54]	[1.46]
	[2.30]	[2.27]	[1.96]	[1.91]
Adj_Size_{t-1}	-0.011	-0.005	-0.007	-0.002
	[-0.99]	[-0.41]	[-0.69]	[-0.18]
	[-0.98]	[-0.40]	[-0.76]	[-0.20]
$Adj\_Leverage_{t-1}$	0.180**	0.169**	0.439**	0.436**
	[2.19]	[2.01]	[2.15]	[2.12]
	[2.33]	[2.11]	[2.13]	[2.08]
$Adj\_Leverage_{t-2}$			-0.388*	-0.395**
			[-1.94]	[-1.98]
			[-1.85]	[-1.88]
$\Delta MarketShares_{t-1}$			0.202***	0.202***
			[2.77]	[2.75]
			[3.17]	[3.16]
$\Delta MarketShares_{t-2}$			0.014	0.013
			[0.28]	[0.25]
			[0.25]	[0.22]
N	1,323	1,323	1,323	1,323
Adj R-Squared	0.013	0.006	0.049	0.043
F test	5.210	3.080	10.720	9.470

Table 2.8 Continued

Panel B: Three Years after Deregulation

	$\Delta MarketShares_t$ (1)	$\Delta MarketShares_t$ (2)	$\Delta MarketShares_t$ (3)	$\Delta MarketShares_t$ (4)
Intercept	-0.159***	-0.184***	-0.140***	-0.162***
	[-8.15]	[-11.94]	[-6.00]	[-10.84]
	[-8.14]	[-11.64]	[-6.86]	[-14.39]
$Opacity_{t-2}$	-0.656		-0.592	
	[-1.21]		[-1.07]	
	[-1.36]		[-1.32]	
$Adj\_Opacity_{t-2}$		0.397		0.363
		[0.65]		[0.58]
		[0.73]		[0.69]
Adj_Cash_{t-2}	0.731***	0.712***	0.644**	0.626**
	[2.78]	[2.72]	[2.35]	[2.29]
	[2.89]	[2.88]	[2.63]	[2.60]
Adj_Size_{t-1}	-0.009	-0.002	-0.007	-0.001
	[-1.00]	[-0.18]	[-0.86]	[-0.11]
	[-0.97]	[-0.18]	[-0.91]	[-0.12]
$Adj\_Leverage_{t-1}$	0.161*	0.147*	0.407**	0.407**
	[1.88]	[1.66]	[2.12]	[2.11]
	[1.93]	[1.71]	[2.09]	[2.06]
$Adj\_Leverage_{t-2}$			-0.348*	-0.363*
			[-1.85]	[-1.93]
			[-1.81]	[-1.88]
$\Delta MarketShares_{t-1}$			0.114**	0.115**
			[2.33]	[2.31]
			[2.62]	[2.58]
$\Delta MarketShares_{t-2}$			0.039	0.038
			[0.94]	[0.89]
			[0.93]	[0.88]
N	1,939	1,939	1,939	1,939
Adj R-Squared	0.014	0.013	0.029	0.028
F test	8.040	7.270	9.190	8.820

Table 2.8 Continued

Panel C: Four Years after Deregulation

	ΔMarketShares $_t$ (1)	ΔMarketShares $_t$ (2)	ΔMarketShares $_t$ (3)	ΔMarketShares $_t$ (4)
Intercept	-0.152***	-0.185***	-0.129***	-0.161***
	[-9.26]	[-13.45]	[-6.79]	[-11.74]
	[-8.74]	[-12.30]	[-7.22]	[-14.08]
Opacity $_{t-2}$	-0.890*		-0.857*	
	[-1.96]		[-1.86]	
	[-2.22]		[-2.51]	
Adj_Opacity $_{t-2}$		0.209		0.116
		[0.41]		[0.22]
		[0.47]		[0.28]
Adj_Cash $_{t-2}$	0.727***	0.710***	0.622***	0.606***
	[3.37]	[3.32]	[2.78]	[2.72]
	[3.33]	[3.36]	[3.04]	[3.05]
Adj_Size $_{t-1}$	-0.006	0.002	-0.005	0.001
	[-0.71]	[0.20]	[-0.69]	[0.12]
	[-0.62]	[0.17]	[-0.67]	[0.12]
Adj_Leverage $_{t-1}$	0.235***	0.223**	0.399**	0.393**
	[2.66]	[2.48]	[2.09]	[2.04]
	[2.53]	[2.35]	[2.16]	[2.11]
Adj_Leverage $_{t-2}$			-0.253	-0.256
			[-1.41]	[-1.42]
			[-1.40]	[-1.42]
ΔMarketShares $_{t-1}$			0.115**	0.115**
			[2.55]	[2.48]
			[2.37]	[2.28]
ΔMarketShares $_{t-2}$			0.044	0.045
			[1.33]	[1.30]
			[1.42]	[1.40]
N	2,515	2,515	2,515	2,515
Adj R-Squared	0.0174	0.014	0.032	0.028
F test	12.100	9.700	12.800	11.450

Note: Table presents the regression results of ΔMarketShares effect by locking opacity at the year prior to the adoption of last deregulatory initiative. The dependent variable ΔMarketShares and other controls are from sample of post-deregulation which is defined as two years immediately following the last deregulatory initiative adoption in panel A, three years immediately following the last deregulatory initiative adoption in panel B and four years immediately following the last deregulatory initiative adoption in panel C. Specifically, in panel A, panel B and panel C, opacity variable is from the data of Entertainment (#7) in 1983, Petroleum (#30) in 1991, Utility (#31) in 1998, Telecommunication (#32) in 1995 and Transportation (#40) in 1994. Further, in panel A, the dependent variable ΔMarketShares and other controls are from the data of Entertainment (#7) 1985-1986, Petroleum (#30) 1993-1994, Utility (#31) 2000-2001, Telecommunication (#32) 1997-1998 and Transportation (#40) 1996-1997. In panel B, the dependent variable ΔMarketShares and other controls are from the data of Entertainment (#7) 1985-1987, Petroleum (#30) 1993-1995, Utility (#31) 2000-2002, Telecommunication (#32) 1997-1999 and Transportation (#40) 1996-1998. In panel C, the dependent variable ΔMarketShares and other controls are from the data of Entertainment (#7) 1985-1988, Petroleum (#30) 1993-1996, Utility (#31) 2000-2003, Telecommunication (#32) 1997-2000 and Transportation (#40) 1996-1999.

The dependent variable ΔMarketShares is calculated as firm's sales growth minus the industry average sales growth excluding the firm itself. Sales growth is calculated as sales (SALE) at year t minus sales at year t-1, divided by sales at

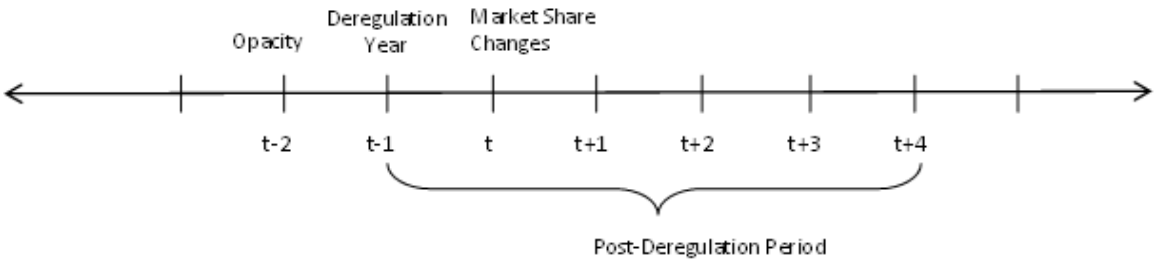
year t-1. Opacity is measured by accruals quality, which is calculated as the standard deviation of a firm's residual from a modified Dechow and Dichev model across five years from t-6 to t-2. Cash is the cash and short-term investment (CHE) scaled by total assets (AT). Size is measured by the logarithm of total book value of assets (AT). Leverage is the sum of long-term debt (DLTT) and short-term debt (DLC), all scaled by total assets (AT). The variables opacity, cash, size, leverage with prefix Adj are variables adjusted by subtracting the industry average values excluding the firm itself. We first define the same industry based on 4-digit SIC code. If the industry based on 4-digit SIC code has less than 5 rival firms, then we relax the 4-digit SIC restriction to 3-digit SIC, to 2-digit SIC and to 1-digit SIC until the industry has at least 5 rival firms. White t-statistics are reported in brackets, and clustered t-statistics are reported in brackets underneath the white t-statistics. *, **, and *** denote two-sided statistical significance at the 10%, 5%, and 1% levels, respectively, with respect to the white t-statistics.

Table 2.9 The impact of opacity on external financing

	Total External	External Financing_Equity	External Financing_Debt	Total External	External Financing_Equity	External Financing_Debt
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.904***	0.248***	0.500***	1.016***	0.177	0.728***
	[4.52]	[2.58]	[3.75]	[4.46]	[1.44]	[4.46]
	[4.22]	[2.37]	[3.57]	[3.69]	[1.19]	[3.74]
Opacity $_{t-2}$	-1.137***	-0.675**	-0.489**			
	[-3.14]	[-2.26]	[-2.16]			
	[-2.96]	[-1.99]	[-1.63]			
Adj_Opacity $_{t-2}$				-0.894***	-0.609**	-0.257
				[-3.23]	[-2.54]	[-1.49]
				[-2.52]	[-1.96]	[-0.98]
Size $_{t-1}$	-0.110***	-0.042***	-0.054***	-0.109***	-0.044***	-0.056***
	[-4.25]	[-2.83]	[-3.22]	[-5.04]	[-3.44]	[-3.70]
	[-3.90]	[-2.55]	[-3.09]	[-3.95]	[-2.61]	[-2.88]
Tobinq's Q $_{t-1}$	0.004	0.002	0.010*	0.004	0.002	0.004
	[0.30]	[0.18]	[1.79]	[0.31]	[0.16]	[0.90]
	[0.26]	[0.16]	[1.44]	[0.23]	[0.13]	[0.59]
Leverage $_{t-1}$	-0.227***	0.138***	-0.383***	-0.227***	0.148***	-0.355***
	[-3.04]	[2.81]	[-6.77]	[-3.64]	[3.46]	[-7.99]
	[-2.55]	[2.20]	[-5.53]	[-2.61]	[2.30]	[-5.60]
Leverage $_{t-2}$	-0.063	0.022	-0.041	-0.066	0.006	-0.070*
	[-0.91]	[0.55]	[-0.77]	[-1.15]	[0.17]	[-1.82]
	[-0.86]	[0.52]	[-0.63]	[-0.93]	[0.14]	[-1.44]
Sales growth $_{t-1}$	0.013	0.005	0.011	0.013	0.005	0.006
	[1.13]	[0.52]	[1.43]	[1.34]	[0.62]	[1.00]
	[1.12]	[0.45]	[1.20]	[1.13]	[0.45]	[0.88]
Sales growth $_{t-2}$	0.006	-0.006	0.011	0.006	-0.007	0.011*
	[0.50]	[-0.72]	[1.63]	[0.58]	[-0.90]	[1.87]
	[0.45]	[-0.66]	[1.32]	[0.45]	[-0.70]	[1.35]
Cash $_{t-1}$	-0.136	-0.148*	-0.052	-0.130	-0.154**	0.006
	[-1.09]	[-1.82]	[-0.70]	[-1.25]	[-2.18]	[0.09]
	[-1.02]	[-1.94]	[-0.61]	[-1.00]	[-2.00]	[0.06]
Cash $_{t-2}$	-0.007	-0.009	0.016	-0.010	-0.001	0.020
	[-0.09]	[-0.15]	[0.27]	[-0.14]	[-0.02]	[0.45]
	[-0.09]	[-0.16]	[0.22]	[-0.12]	[-0.02]	[0.37]
R&D expenditure $_{t-1}$	-1.165	-0.080	-0.581	-1.123	-0.314	-0.635*
	[-1.36]	[-0.11]	[-1.19]	[-1.57]	[-0.48]	[-1.68]
	[-1.22]	[-0.11]	[-0.98]	[-1.22]	[-0.43]	[-1.29]
Capital expenditure $_{t-1}$	0.106	-0.094	0.136	0.107	-0.095*	0.173**
	[0.91]	[-1.60]	[1.40]	[1.10]	[-1.86]	[2.20]
	[0.87]	[-1.37]	[1.32]	[0.89]	[-1.36]	[1.67]
Profitability $_{t-1}$	-0.007	0.152	-0.024	-0.007	0.157	-0.104*
	[-0.04]	[1.42]	[-0.35]	[-0.05]	[1.64]	[-1.71]
	[-0.03]	[1.19]	[-0.30]	[-0.03]	[1.17]	[-1.07]
Fixed assets $_{t-1}$	-0.030	0.007	-0.016	-0.026	-0.004	-0.023
	[-0.34]	[0.11]	[-0.29]	[-0.35]	[-0.08]	[-0.48]
	[-0.29]	[0.10]	[-0.25]	[-0.26]	[-0.06]	[-0.34]
N	2,147	2,254	2,315	2,035	2,035	2,035
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj R-squared	0.418	0.466	0.311	0.364	0.341	0.322
F test	4.789	1.950	7.764	3.160	2.950	2.790

Note: The table presents the regression results of the impact of opacity on external financing for sample of post-deregulation, which includes Entertainment (#7) 1985-1989, Petroleum (#30) 1993-1997, Utility (#31) 2000-2004, Telecommunication (#32) 1997-2001 and Transportation (#40) 1996-2000.
External financing measures follow Richardson and Sloan (2003). Total external financing is net equity financing from cash flow statement, plus net debt financing from cash flow statement. Net equity financing is the cash proceeds from the sale of common and preferred stock (SSTK), minus the cash payments for the purchase of common and preferred stock (PRSTKC), minus the dividend cash payments(DV). Net debt financing is the cash proceeds from the issuance of long term debt (DLTIS), minus the cash payments for long term debt reductions (DLTR), plus the net changes in debt (DLCCH). If the data of net changes in debt (DLCCH) is missing, we set it as zero. All of the total external financing, net equity financing and net debt financing are scaled by the average of total assets. The average of total assets is calculated as the sum of assets (AT) at year t and assets at year t-1 divided by 2. The data for the sale of common and preferred stock (SSTK), the purchase of common and preferred stock (PRSTKC), dividend cash payments (DV), cash proceeds from the issuance of long term debt (DLTIS), the cash payments for long term debt reductions (DLTR) are available starting from 1971.
Opacity is measured by accruals quality, which is calculated as the standard deviation of a firm's residual from a modified Dechow and Dichev model across five years from t-6 to t-4. The variable opacity with prefix Adj is adjusted by subtracting the industry average values excluding the firm itself. We first define the same industry based on 4-digit SIC code. If the industry based on 4-digit SIC code has less than 5 rival firms, then we relax the 4-digit SIC restriction to 3-digit SIC, to 2-digit SIC and to 1-digit SIC until the industry has at least 5 rival firms. Sales growth is calculated as sales (SALE) at year t minus sales at year t-1, and scaled by sales at year t-1. Size is measured by the logarithm of total book value of assets (AT). Tobin's Q is total assets (AT), minus total book value of common equity (CEQ), plus market value of common equity(PRCC_F*CSHO), divided by total book value of assets(AT). Leverage is the sum of long-term debt (DLTT) and short-term debt (DLC), all scaled by total assets (AT). Cash is the cash and short-term investment (CHE) divided by total assets (AT). R&D expenditure is defined as research and development expense (XRD) divided by total current assets (AT). If the research and development expense is missing, we set it as zero. Capital expenditure is computed by capital expenditures (CAPX) divided by total assets (AT). Profitability is defined as operating income before depreciation (OIBDP) scaled by total assets (AT). Fixed assets are calculated as property plant and equipment (PPENT) scaled by total assets (AT). If the cash dividend (DV) is greater than zero, then we set cash dividend indicator as one, otherwise we set it as zero. White t-statistics are reported in brackets, and clustered t-statistics are reported in brackets underneath the white t-statistics. *, **, and *** denote two-sided statistical significance at the 10%, 5%, and 1% levels, respectively, with respect to the white t-statistics.

Figure 2.1 Opacity timing relative to market share changes



Note: The time line showing opacity timing relative to Market Share Changes (All "tick-marks" on the time line denote the end of year). This figure shows the time line of our research design. In equation 3, we have a full panel data from 1960 through 2007. Complete is a dummy variable that takes the value of one for the first five years following the deregulation completion year, from the beginning of t through the end of t+4 in the figure. Opacity always lags market share changes by two years. If market share changes is in year t, then opacity is in year t-2 (as illustrated in the figure). If market share changes is in year t+1, then opacity is in year t-1, etc. In equation 4, we restrict our sample to the five-year post-deregulation window. Therefore, we have market share changes data in years t through t+4, and opacity data in years t-2 through t+2.

CHAPTER 3
CRASH RISK AND FIRMS' CASH POLICIES

3.1 Introduction

Bates, Kahle and Stulz (2009) document the phenomena that the average cash-to-assets ratio for U.S. industrial firms increases from 10.5% in1980 to 23.2% in 2006. There is a strand of literature investigating the determinants of this phenomenon. However, how crash risk affects firms' liquidity management has not been attracted a lot of attention. Significant price drops may cause investors to reevaluate the company and increase required risk premium, and also cause the operating and financial leverage rise automatically. These circumstances could result in higher cost of external financing for the company. Therefore, we suspect the company may adjust their cash accumulation to accommodate the happening of this extreme tail event. During the economic downturn, negative skewness in returns is more likely to occur. A recent article in CFO.com states that because of the lessons learned from the crisis in the late 2008, many companies have become cash hoarders.[33] The survey of 1050 Chief Financial Officers during the financial crisis conducted by Campello, Graham and Harvey (2010) shows that more than half of U.S companies rely on the internally generated cash flows and about four in ten use cash

33 *"Like children of the Great Depression who stuffed cash under their mattresses as adults, many companies have taken the lessons learned during the liquidity scares of late 2008 to heart. They have become cash hoarders after watching traditional short-term borrowing methods dry up or become cost-prohibitive."*(CFO.com, 2010 April 29). Another example cited in Graham and Narasimhan (2004) is about Sewell Avery, who is known for his insist on keeping firm "*debt-free and cash-rich"* because of the fear of another coming depression. A recent article in *CFO* says that during the downturn, firms implement every possible ways and even sacrifice the sustainable strategies to extract cash, when the sales are flat. The methods include lying off staff, cutting capital expenditures and R&D expenditures, lowering SG&A costs, reducing discretionary expenses, and managing working capital such as downsizing inventory, getting customers pay on time, delaying the accounts payable (Good to Last Drop, CFO.com, March 12, 2010).

reserves to fund attractive investment when they cannot borrow. This recent scenario tells us that crash risk to some extent plays a role in firms' cash police decisions. Thus, it is worth further exploring that how fat left tail of the return distribution affects firms' cash strategies. In this study, we examine the effect of crash risk on firms' cash reserves and the marginal value of cash for firms with different degrees of crash risk.

We find that firms with high crash risk accumulate more cash relative to assets compared to low crash risk firms. In addition, the significant positive impact of crash risk on cash holdings appears among financial constraint firms, but not financial unconstraint firms. This is consistent with our expectations that firms with difficulty to raise fund from external capital market are more likely to store cash within the firm, while higher crash risk worsen the firm's position in financing market. We further examine the effects by sub-sample tests for different time periods. The results show that high crash risk firms holding more cash stand up after the 1990s. Before the 1990s, crash risk has non-significant impact on firms' cash policies. In addition to cash holdings, we also examine the effect of crash risk on marginal value of cash and find that when the firm collects cash, the marginal value of cash is lower for high crash risk firms compared to low crash risk firms.

Bates, Kahle and Stulz(2009) show that firms which experience less increase in idiosyncratic risk increase cash less dramatically over time. Their idiosyncratic risk is measured by the mean of cash flow standard deviation in past several years for each industry. Acharya, Almeida and Campello (2009) claim that the degree of aggregate risk determines firms' choice between credit lines from banks and cash reserves, because banks only provide liquidity to the firms when they have sufficient funds and they might

shrink their loans in bad economy when they could not collect funds from healthy firms. The line of credit does not insure the cash supply to the firms, thus firms which have higher aggregate risk prefer to hold more cash in order to meet future liquidity needs especially in economic downturn[34]. Ivashina and Scharfstein (2010)' findings about bank lending during the financial crisis of 2008 provide the supportive evidence to Acharya, Almeida and Campello's arguments. They show that the lending fell in 2008 partially due to the drop in the supply of credit. They further claim that it is hard for corporate to switch bank, once its initial bank is liquidity-constrained. This fix lender-borrower relationship in the banking lending system in some degree magnifies the problem of supply shock in the banking sector. The prior studies imply that risks push firms to reserve cash.

Our study focuses on the cross-sectional variation of crash risk and tests if it has impact on firms' cash holding strategies. Chen, Hong and Stein (2001) examine the determinants of negative skewness in stock returns and argue that firms with large investor opinion divergence are more likely to experience negative asymmetries in stock returns. Hutton, Marcus and Tehranian (2009) and Kim, Li and Zhang (2011) explore that bad news hiding activities are associated with firm specific stock price crash risk. However, to the best of our knowledge, there are limited papers examining the effect of crash risk on firms' financing decisions or investment decisions. Our paper contributes to the literature at least in two ways. First, in contrast to prior literature which is interested in the causes of crash risk, we are interested in the impact of crash risk on the firm's financing decisions. Second, our study complements the prior work which shows the

[34] In their study, asset beta (unlevered equity beta) is used to measure aggregate risk.

effect of cash flow risk on the firm's cash levels (Bates, Kahle and Stulz, 2009) or the aggregate risk on the firm's financing choices (Acharya, Almeida and Campello, 2009), we employ the crash risk and examine how the negative extreme events or the likelihood of crash risk affect the firm's cash decisions.

The rest of the paper is organized as follows. In Section 2, we review the determinants of cash holdings shown in previous literature, which we adopt as controls in our regression model. In Section 3, we introduce the data and model we use to test the influence of crash risk on firms' cash policies. In Section 4, we discuss our empirical findings. We conclude in Section 5.

3.2 Related literature

There are many empirical papers investigating factors that influence the firms' cash reserves. Opler et al. (1999) argue that cash holdings and debt are two faces of the same coin and the determinants of cash are closely related to debt. They show that firms with strong growth opportunities, riskier cash flows measured by the standard deviation of industry cash flow and smaller size hold more cash than others. Depending on the negative effect of size and credit rating on cash reserve, Opler et al. conclude that firms having greatest access to the capital market tend to hold less cash. According to Opler et al.'s findings, growth opportunities, cash flows risk and size are adopted as controls in our regression model.

Free cash flow theory (Jensen, 1986) explains that due to the conflicts of interest between shareholders and managers, managers are reluctant to distribute the cash to shareholders when firms have substantial free cash flows. Agency conflict attracts a lot of

attention in cash holding studies. However, Opler et al. find little evidence of the impact of agency conflicts on cash holdings. Dittmar, Mahrt-Smith, and Servaes (2003) employ the international data from 45 countries to study the effect of agency cost. They argue that generally shareholders in the U.S. have good protection. The use of international data allows the sample to include firms with substantial variation in agency cost. The shareholder rights level measured by anti-director rights index is constructed as the proxy of agency problem. Dittmar, Mahrt-Smith, and Servaes show that firms with poor shareholder rights protection hold more cash than firms do in which shareholder rights are well protected. Furthermore, they also explore that investment opportunities (measured by market to book ratio) and asymmetric information (measured by R&D expenditures) has less impact on cash balances in firms with poor shareholder rights protection. Following Dittmar, Mahrt-Smith, and Servaes, we also include R&D expenditures as a control variable.

The paper by Harford, Mansi and Maxwell (2008) use U.S. firm data and employ the GIM index and BCF index to examine corporate governance in determining the cash balances. In addition, they use the inside ownership, institutional ownership, compensation to top management as well as board structure to represent the agency cost. They conclude that firms with weaker corporate governance tend to hold less cash. Harford, Mansi, and Maxwell (2008) explain that higher cash balances in firms with fewer shareholder rights easily cause shareholder agitation. Thus, less controlled managers tend to spend cash quickly on acquisitions and capital expenditures, even they are value destroyable.

Haushalter, Klasa, and Maxwell (2007) examine the impact of product market on corporate cash holdings. They point out that the cash holdings are affected by the predation risk as well, which is defined as the underinvestment risk leading to a loss of investment opportunities and market shares to rivals. The results from models show that the cash holdings are positively associated with industry concentration and correlation of stock returns with industry stock returns, but negatively correlated with the deviation from industry capital-to-labor. This means the higher interdependence with product market rivals, the greater cash holdings for the firm. Haushalter, Klasa, and Maxwell also include potential determinants shown in Opler et al. (1999)'s regression model as control variables such as the diversity factor (number of business segments). They get the significant negative correlation between number of business segments and cash-to-assets ratio. This implies that diversified firms are more likely to hold less cash, because in some degree diversified firms have non-core segments which could be sold when they face the cash shortage (Opler et al., 1999). According to the findings in prior studies, we also include industry concentration (HHI) to control for the effect of predation risk and number of business segments to control for the effect of diversification.

Klasa, Maxwell, and Ortiz-Molina (2008) study the cash holdings from a new perspective. They examine the relationship between cash holdings and industry unionization rate. The assumption is that lower cash balances improve firms' bargaining power over union. The empirical findings provide supportive evidence that cash holdings and unionization rate are negatively correlated. Due to the restriction of unionization data, we have not included the unionization rate as a control variable in our regression model.

In addition to cash levels, Pinkowitz and Williamson (2004) investigate the value of a marginal dollar of cash placed by shareholders. Pinkowitz and Williamson set the dependent variable as the market value of firm's equity deflated by the book value of total assets and use current cash level and changes in cash holdings as explanatory variables in the regression. The authors interpret the coefficient of cash level as the market value of cash. Pinkowitz and Williamson find that the coefficient of current cash level is about 0.94. Therefore, they conclude that the market values a marginal dollar of cash at the face value. Additionally, they examine the impact of growth opportunity, investment uncertainty, financial distress and capital market access on the value of cash. The empirical results suggest that cash held by firms with higher growth opportunity and higher investment uncertainty is valued at a premium. In addition, cash in firms that face financial distress and have greater access to capital market are less valuable than cash in counterparts. It is obvious that the aspects included in the regressions are quite similar to the determinants of cash holdings.

Pinkowitz and Williamson (2004)'s methodology is employed by Pinkowitz, Stulz, and Williamson (2006) to apply the agency theory in the value of cash holdings. As indicated above, Dittmar, Mahrt-Smith, and Servaes (2003) using the international data find that firms with poor shareholder rights protection hold more cash. Pinkowitz, Stulz, and Williamson (2006) demonstrate that cash is worth less in countries with poor investor protection.

Faulkender and Wang (2006) question the setting of dependent variable in Pinkowitz and Williamson (2004)'s value model. They argue that time-varying market value of the firm should also reflect the different sensitivities to risk factors over time, not

just the firm-specific characteristics. In addition, due to the different accounting method, the book value of total asset as the proxy of replacement cost would bias the estimate results. Therefore, they suggest use realized individual stock return adjusted by benchmark return as dependent variable, because the benchmark return could capture the time-series variation in risk factors and cross-sectional variation in exposures to risk factors. Faulkender and Wang (2006) argue that because of the higher corporate tax rate and the presence of agency cost, the marginal value of cash is declining in the level of cash reserves. An extra dollar of cash holdings is worth less in firms with higher leverage, but worth more in financially constrained firms.

The corporate governance aspect is tested by Dittmar and Mahrt-Smith (2007). They argue that previous governance literature concerns the level of cash holdings instead of the marginal value of cash. Dittmar and Mahrt-Smith estimate two regression models developed by Pinkowitz and Williamson (2004) and Faulkender and Wang (2006) separately to relate the value of cash to corporate governance. They find that for well governed firm, one additional dollar is valued at a premium. In contrast, for poorly governed firm, one additional dollar is valued at a discount. In our study, we adopt Faulkender and Wang (2006)'s cash value model to compare the cash value for firms having higher crash risk with firms having lower crash risk. We expect that the value of an additional dollar for firms with higher crash risk would be lower than the value for firms with lower crash risk after controlling for the other determinants.

3.3 Data and methodology

Our sample covers firms in COMPUSTAT from 1979 to 2010 having available data of variables in regression. We delete financial firms with SIC codes of 6000-65000 and utility firms with SIC codes of 4900-4999. All the accounting variables used in our regression models are winsorized at one percent level. The stock return data come from the Center for Research in Securities (CRSP). Table 1 shows that in 2008 there are about 31 percent of companies suffer the big negative returns and generally in the 2000s there are higher percentage of firms in the market experience big stock price drops compared to early periods. These companies have significantly higher market leverage and higher bankruptcy risk and are more likely to be financially constrained according the KZ index.

3.3.1 Crash risk

We follow Kim, Li and Zhang (2011) (also see Chen, Hong and Stein, 2001 and Hutton, Marcus and Tehranian, 2009) to measure firm-specific crash risk. Specifically, we employ two ways to define crash risk. One is crash risk dummy which is based on actual crash identified across the fiscal year. The second one is negative conditional return skewness (NCSKEW) which measures the likelihood of suffering large negative returns. To calculate the firm-specific crash risk, we define W as firm-specific weekly returns, which is equal to ln (1+ $\varepsilon_{i,t}$) from following model:

$$r_{j,t} = \alpha_j + \beta_{1,j} r_{m,t-2} + \beta_{2,j} r_{m,t-1} + \beta_{3,j} r_{m,t} + \beta_{4,j} r_{m,t-1} + \beta_{5,j} r_{m,t-2} + \varepsilon_{j,t} \qquad (3.1)$$

where $r_{j,t}$ represents the stock return for firm j in week t and $r_{m,t}$ represents the CRSP value-weighted market index in week t. After calculating the firm-specific weekly returns W, we define crash week as W below the mean firm-specific weekly returns by 3

standard deviations over the fiscal year. This process allows us to locate the negative return weeks which have 0.1 percent possibility to show up based on normal distribution. If over the fiscal year, there is at least one crash week, then the crash risk dummy is equal to one (high crash risk firm) for that firm-year, otherwise it is equal to zero (low crash risk firm). The second measure is the skewness of the stock return distribution for a given fiscal year. A higher value means the firm is more likely to experience stock crash. Specifically, we calculate the negative conditional return skewness (NCSKEW) by the negative of third moment of firm-specific weekly returns divided by the standard deviation of firm-specific weekly returns raised to the third power for a given fiscal year. The estimation equation is shown as follows (Chen, Hong and Stein, 2001 and Kim, Li and Zhang, 2011):

$$CSKEW_{jt} = -\frac{\left[n(n-1)^{\frac{3}{2}}\sum w_{jt}^{3}\right]}{\left[(n-1)(n-2)\left(\sum w_{jt}^{2}\right)^{\frac{3}{2}}\right]} \tag{3.2}$$

3.3.2 Cash holdings

In order to examine the influence of firms' exposure to systematic risk on their cash policies, we employ the regression models using log value of cash ratio and the change of cash holdings as dependent variable to show whether the higher exposure to systematic risk lead to higher cash reserves. Cash ratio is defined as the cash and cash equivalent divided by total assets. The change of cash holdings is calculated by the cash

and cash equivalent at year t substrate the cash and cash equivalent at year t-1 and the difference scaled by the total assets. The regression equation is

$$Log\frac{Cash_{j,t}}{Assets_{j,t}} = \alpha_0 + \alpha_1 Crashrisk_{j,t} + \alpha_2 Q_{j,t} + \alpha_3 Size_{j,t} + \alpha_4 Cashflow_{j,t} + \alpha_5 NWC_{j,t} + \alpha_6 CAPX_{j,t} + \alpha_7 L_{j,t} + \alpha_8 Cashflowrisk_{j,t} + \alpha_9 R\&D_{j,t} + \alpha_{10} DIV_{j,t} + \alpha_{11} Z_{j,t} + \alpha_{12} KZ_{j,t} + \alpha_{13} HHI_{j,t} + \alpha_{14} Diversification_{j,t} + \varepsilon_{j,t} \quad (3.3)$$

The estimation of Crash risk is based on the discussion in section A. We control for factors mostly examined in Opler, Pinkowitz and et al. (1999) which determine firms' cash holdings. *Cashflow* is the summation of income before extraordinary item (IB) and depreciation and amortization (DP) divided by total assets (AT). *NWC* is net working capital measured as current liability (LCT) subtracted by debt in current liability (DLC), less current assets (ACT) without cash and cash equivalent (CHE). *CAPX* is capital expenditure (CAPX) scaled by total assets. *L* represents the market leverage defined by the summation of long term debt (DLTT) and short term debt (DLC) divided by the market value of assets (PRCC_F*CSHO+DLTT+DLC). Opler, Pinkowitz and et al. (1999) explore that firms with riskier cash flows tend to hold more cash than others. *Cashflowrisk* is calculated as industry mean of standard deviation of last 20 years operating cash flow (OIBDP) scaled by total assets. Industry is defined by Fama-French 49 industry classification.

R&D is research and development expenses scaled by sales. *DIV* is the dividend payment dummy. It is set as one, if the firms paid common stock dividend in the year. Otherwise, it is set as zero. *Z* score is used as the proxy for the likelihood of financial

distress[35]. Campello, Graham and Harvey (2010) based on the survey of whether the company is financial constrained explore that financially constrained firms have been forced to burn a large portion of cash savings during the crisis. In constrast, the cash holdings of unconstrained firms stay constant. The easy cash shortage for constrained firms during the crisis forces them to cancel more valuable projects relative to unconstrained firms. Thus, we expect that financial constraint condition does matter in firms' cash saving policies. The paper by Almeida, Campello and Weisbach (2004) shows that financial constraint firms have completely different cash flow sensitivity of cash from financial unconstraint firms. Financially constrained firms have the propensity to save cash out of cash flows, while financial unconstrained firms do not. We employ *KZ* index based on Lamont, Polk and Saa-Requejo (2001) as the proxy for the likelihood that a firm faces financial constraint[36].

Haushalter, Klasa, and Maxwell (2007) examine the impact of product market on corporate cash holdings. They interpret that the cash holdings are affected by the predation risk as well. Since the predation risk largely depends on the extent of interdependence of firms' investment opportunities with rival firms, three proxies for interdependence are used. They are industry concentration (Herfindahl-Hirschman Index and four-firm concentration ratio), similarity of operations (absolute deviation from median industry capital-to-labor ratio), and covariance of firm growth opportunities with

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35 Z score = 3.3*Operating income before depreciation $_t$/Assets$_{t-1}$ +1.0*Sales $_t$/Assets $_{t-1}$ +1.4*Retained earnings $_t$ /Assets $_{t-1}$+1.2*Working capital $_t$/ Assets $_{t-1}$

36 KZ index = -1.001909*(Net income(IB)+Depreciation(DP))$_t$ /Fixed assets(PPENT)$_{t-1}$ +0.2826389*(Long term debt (DLTT) +Short term debt(DLC)) $_t$ /Assets(AT)$_t$ + 3.139193*((Long term debt(DLTT) + Short term debt(DLC))$_t$ /(Long term debt(DLTT)$_t$+ Short term debt(DLC) + Shareholders equity(SEQ))$_t$ – 39.3678*(common dividend(DVC) + preferred dividend (DVP))$_t$ / Fixed assets(PPENT)$_{t-1}$ – 1.314759/ Fixed assets(PPENT)$_{t-1}$

those of industry rivals (firm-industry stock return correlation). The results imply that firms closely connected to the product market rivals have greater cash holdings. Herfindahl-Hirschman Index (*HHI*) is adopted in our model to control for the predation risk.

Haushalter, Klasa, and Maxwell (2007) and Opler, Pinkowitz and et al. (1999) find that number of business segments and cash-to-assets ratio are significantly negatively correlated. This implies that diversified firms are less likely to reserve cash. Opler, Pinkowitz and et al. (1999) argue that diversified firms have non-core segments which could be sold when they face the cash shortage. Duchin(2010) investigate how the investment opportunity risk affect cash holdings. Duchin explain that multi-segment firms could diversify their investment opportunity risks, so multi-segment firms hold less cash than single-segment firms. We use diversification dummy to capture the investment opportunity risk. *Diversification* is set as one if firms have more than one segment, and is set as zero otherwise. The number of the segments data is from COMPUSTAT segment tapes.

3.3.3 Cash saving behavior

In order to examine the cash saving behaviors for firms with high crash risk versus firms with low crash risk, we employ the method in Almeida, Campello and Weisbach (2004) and add one more cash source stock issuance into the model. Almeida, Campello and Weisbach regress the change of cash holdings on the sources and uses of cash reserves. Their argument is that each new dollar that is not spent must be added to the ‘saving account’. In addition to capital expenditures, acquisitions are also included in

the model as the uses of cash, because Harford (1999) find that cash-rich firms are more likely to take value destroying acquisitions. By controlling for the net working capital and short-term debt which could be treated as cash alternatives, we use the model to estimate firms' propensity to saving cash out of the cash flow. In our study, we adopt the model to examine the cash saving behavior for firms with different Beta exposures. Except for the operating cash flow used in Almeida, Campello and Weisbach's model, seasoned equity offering (SEO) is another important cash sources. DeAngelo, DeAngelo and Stulz (2010) state that it is norm for firms conducting SEOs are cash shortage. They document that more than sixty percent SEO firms would have run out of cash without the proceeds from stock issuance. In addition, McLean (2010) also shows that firms save cash out of stock issuance due to the increasing precautionary motives. Thus, we include stock issuance into Almeida, Campello and Weisbach's model. The regression specification is as follows:

$$\frac{Cash_{j,t}-Cash_{j,t-1}}{Assets_{j,t-1}} = \alpha_0 + \alpha_1 CR_{j,t} + \alpha_2 CR_{j,t} Cashflow_{j,t} + \alpha_3 CR_{j,t} Stockissue_{j,t} +$$

$$\alpha_4 CR_{j,t} Debtissue_{j,t} + \alpha_5 CR_{j,t} \Delta\mathrm{NWC}_{j,t} + \alpha_6 CR_{j,t} \Delta\mathrm{CAPX}_{j,t} + \alpha_7 CR_{j,t} \Delta\mathrm{R\&D}_{j,t} +$$

$$\alpha_8 CR_{j,t} AQC_{j,t} + \alpha_9 CR_{j,t} Size_{j,t} + \alpha_{10} CR_{j,t} Q_{j,t} + \alpha_{11} CR_{j,t} L_{j,t} + \alpha_{12} CR_{j,t} DIV_{j,t} +$$

$$\alpha_{13} CR_{j,t} Z_{j,t} + \alpha_{14} CR_{j,t} KZ_{j,t} + \alpha_{15} CR_{j,t} HHI_{j,t} + \alpha_{16} CR_{j,t} Diversification_{j,t} +$$

$$MainEffects + \varepsilon_{j,t} \quad (3.4)$$

CR represents crash risk. We use two different measures of *Stockissue* in our model Following Fama and French (2005), one measure is the sum of net issues and gross stock repurchases (PRSTKC) scaled by total assets. Net stock issue is defined as the split-adjusted change in shares outstanding (CSHO) by the average split-adjusted

stock prices (PRCC_F) of the beginning and ending of the fiscal year[37]. The second measure is the net stock issuance from cash flow statement (SSTK-PRSTKC). According to McLean (2010) cash saving regression model, we also include debt issuance (DLTIS). *ΔNWC* is the change of net working capital. *Acquisition* is measured by the cash outflow of the funds for the acquisition of the company (AQC) scaled by the assets. Other control variables are the same as the corresponding variables in the model in section B.

3.3.4 The value of cash

Firms with different levels of Beta implement different financial policies. Firms severely affected by the bad market tend to hold more cash. We expect they store certain amount cash by different cash saving behaviors. The cash flow sensitivity of cash for high Beta firms is higher than the sensitivity for low Beta firms. If this the case, we further check whether the value of cash is totally different for firms with different Beta. We expect the value of cash is higher for firms with higher Beta, compare to the value of cash for firms with lower Beta. The cash value model is following Faulkender and Wang (2006).

$$r_{i,t} - R_{i,t}^{B} = \gamma_0 + \gamma_1 CrashRisk + \gamma_2 CrashRisk * \frac{\Delta C_{i,t}}{M_{i,t-1}} + \gamma_3 \frac{\Delta C_{i,t}}{M_{i,t-1}} + \gamma_4 \frac{\Delta E_{i,t}}{M_{i,t-1}} + \gamma_5 \frac{\Delta NA_{i,t}}{M_{i,t-1}} + \gamma_6 \frac{\Delta RD_{i,t}}{M_{i,t-1}} + \gamma_7 \frac{\Delta I_{i,t}}{M_{i,t-1}} + \gamma_8 \frac{\Delta D_{i,t}}{M_{i,t-1}} + \gamma_9 \frac{C_{i,t-1}}{M_{i,t-1}} + \gamma_{10} L_{i,t} + \gamma_{11} \frac{NF_{i,t}}{M_{i,t-1}} + \gamma_{12} \frac{C_{i,t-1}}{M_{i,t-1}} * \frac{\Delta C_{i,t}}{M_{i,t-1}} + + \gamma_{13} L_{i,t} * \frac{\Delta C_{i,t}}{M_{i,t-1}} + \epsilon_{i,t} \quad (3.5)$$

[37] Fama and French (2005) Stock issue= (Shares $_t$ Adjust $_t$ - Shares $_{t-1}$ Adjust $_{t-1}$)* (Price $_{t-1}$ / Adjust $_{t-1}$ + Price $_t$ / Adjust $_t$)/2, where Shares Adjust is AJEX*CSHO and Price/ Adjust is PRCC_F/AJEX.

The dependent variable is the excess return defined as the individual firm return $r_{i,t}$ in fiscal year t, minus $R^{B}_{i,t}$ the bench market return based on Fama-French 25 portfolios according to size and book-to-market breakpoints. M_{it-1} is the market value of equity (CSHPRI*PRCC_F) in year t-1. ΔX is the change of value from year t-1 to year t. *C* is cash and cash equivalents (CHE). *E* is earnings before extraordinary item (IB). *RD* is research and development expenditures (XRD). Other financial controls include *I*, interest expense (XINT), *D*, Dividend payment (DVC), *L*, Market leverage ((DLTT+DLC) / (CSHPRI*PRCC_F+DLTT+DLC) and *NF*, net financing. Net financing is defined as sale of common and preferred stock (SSTK) subtracted the purchase of common and preferred stock (PRSTKC), plus the issuance of long-term debt (DLTIS) subtracted the reduction of long-term debt (DLTR).

3.4 Empirical results

3.4.1 The impact of crash risk on cash holdings

Table 2 reports the Fama-MacBeth regression results on the impact of crash risk on the firm's cash holdings. Industry dummy is included in all of regressions in this study. Industry is organized based on Fama-French 49 industry definition. Following Opler and et al, we use logarithm of cash ratio as our dependent variable in the cross-sectional cash level investigation. All the controls shown in the model are discussed in the above section. In the first columns, we test the effect of crash risk dummy which is an indicator variable. Crash risk dummy is equal to one if there is more than one weeks over fiscal year t that firm-specific weekly returns are lower than (mean – 3*standard deviation). Otherwise it is zero. The results show that the crash risk dummy is significantly positively correlated

with the level of cash holdings after controlling for the influence of other characteristics. It indicates that if the firm suffers extreme negative returns, it appears to be high cash holding firms.[38] The coefficient is about 0.046 which is significant at the one percent level. We further define crash risk dummy across three years. Crash risk dummy_ over three years is equal to one if there is more than one weeks over fiscal years t, t-1, t-2 that firm-specific weekly returns are lower than (mean – 3*standard deviation). The results are consistent with our expectations. Crash risk plays an important role in firms' financing decisions.

In addition to indicator variable, we also employ NCSKEW as proxy for crash risk. NCSKEW measures the likelihood of stock price crash based on the distribution of stock returns. We find consistent results that cross sectional firms with higher negative stock return skewness accumulate more cash within the firm. In general, we find that cash holdings decrease significantly with growth opportunities, size, capital expenditure, market leverage, dividend payment dummy. Cash holdings increase significantly with net working capital, cash flow risk, R&D expenditures, financial constraints and financial distress index. The relations between firms' cash holdings and specific characteristics presented in Table 2 are consistent with the findings in prior literature. The coefficients of cash flow are also significantly positive, which implies that firms generating more operating cash flow in daily operation keep more cash within the firm controlling for the impact of others. When firms hold plenty of net working capital, they hold more cash

[38] We also test the effect of jump on firms' cash levels and find jump does not have significant impact on firms' cash to assets ratio. It implies that the effect of extreme events on firms' cash holdings is asymmetry. Jump is one if there is more than one weeks over fiscal year t that firm-specific weekly returns are higher than (mean+3*standard deviation). Otherwise it is zero.

than others. In contrast, when firms need to spend cash for capital investments or distribute cash to shareholders, they have to slow down their cash savings. As shown in Table 2, market leverage is negatively associated with the level of cash and R&D expenditures are positively related to the cash levels.

The panel B of the table exhibits the effect of crash risk on cash holdings for financial constraint firms and financial unconstraint firms. We rank KZ index into two groups. Firms belonging to top KZ index group are defined as financial constraint firms. Firms belonging to bottom KZ index group are defined as financial unconstraint firms. According to the sub-sample tests results, we find that the effect of crash risk on firms' cash holdings is concentrated on financial constraint firms. If firms are financially constrained, the large negative returns make the situation even worse. The firms tend to hold more cash than counterparts which do not experience large negative returns over the fiscal year. In table 3, we test the impact of crash risk on cash decisions for different time periods. It is shown that the significant effect appears on the periods after the 1990s.

3.4.2 Cash saving behavior

We show that crash risk plays an important role in firms' cash holding decisions. Firms with high crash risk tend to hold more cash. We further investigate where the cash comes from and whether different crash risk companies implement different cash saving strategies. Table 4 presents the results of cash saving examinations. According to the model in Almeida, Campello and Weisbach (2004), one of the cash sources *Cashflow* is defined as income before extraordinary item, plus depreciation and amortization, and then scaled by total assets. Another cash source *Stockissue* is the net stock issuance

scaled by total assets. *Debt issuance* is issuance of debt from cash flow statement divided by total assets. The test results show that high crash risk firms save significantly smaller proportion of cash from operating cash flow relative to low crash risk firms. There is no significant difference of cash saving behaviors in stock issuance and debt issuance for high crash risk firms and low crash risk firms.

3.4.3 The value of Cash

We further examine the cash value for firms with different crash risk. The results in table 5 show that a dollar worth more in low crash risk firms than high crash risk firms and the difference is statistically significant. The coefficient is about -0.41, which means a dollar actually worth more than the face value in low crash risk firms, but worth close to the face value in high crash risk firms. The corresponding coefficient for the interaction term of crash risk and change of cash ratio is about -0.16 by using NCSKEW.

We also check the cash value for sub-periods of 1979-1990, 1991-2000 and 2001-2010 separately. For the three sub-periods, we can see that the effect of crash risk on marginal value of cash increases over time. Especially, the marginal value of cash increase from 1.2 in the 1980s to 1.6 in the 1990s and decrease to 1.1 in the 2000s for high crash risk firms and increase from 1.5 in the 1980s to 2.2 in the 1990s and decrease to 1.4 in the 2000s for low crash risk firms. Table 5 panel B shows that the marginal value of cash is significantly lower for high crash risk firms compared to crash risk companies in the 1990s and 2000s. However, in the 1980s, the marginally values of cash are not significantly different for firms with different crash risk.

3.5 Conclusion

In this study, we investigate the different cash policies for firms with different degrees of crash risk. First, we analyze the impact of crash risk on firms' cash holdings and find firms experiencing large negative returns or show big negative skewness in return distribution over a fiscal year tend to hold more cash than counterparts. Second, we check whether firms with different degrees of crash risk would have different cash saving behaviors and find firms with higher cash risk save less cash from operating activities. Last, we examine the marginal value of cash for firms with different degrees of crash risk. Our results explore that firms with high crash risk have lower marginal value of cash than firms with low crash risk. Based on our findings, we argue that firms do consider crash risk when they make cash decisions. In addition, we find the effect of crash risk on firms' cash holdings is more pronounced among financial constraint firms and small firms. We further infer that when firms are financially constrained, they are more likely to take crash risk into account when they decide how much cash to reserve. Moreover, we think it is also interesting for future research to explore the effect of crash risk on other financial decisions and investment decisions.

Table 3.1 Summary statistics

Panel A

Year	Number of high crash risk firms	Number of low crash risk firms	Percentage of high crash risk firms within the sample
1979	174	1871	8.51
1980	364	2671	11.99
1981	328	2673	10.93
1982	496	2571	16.17
1983	319	2798	10.23
1984	598	2652	18.40
1985	612	2710	18.42
1986	514	2690	16.04
1987	468	2853	14.09
1988	472	2827	14.31
1989	493	2653	15.67
1990	650	2400	21.31
1991	525	2486	17.44
1992	543	2711	16.69
1993	619	2973	17.23
1994	697	3256	17.63
1995	723	3448	17.33
1996	818	3586	18.57
1997	907	3781	19.35
1998	927	3658	20.22
1999	750	3546	17.46
2000	812	3343	19.54
2001	806	3042	20.95
2002	851	2619	24.52
2003	680	2593	20.78
2004	779	2481	23.90
2005	905	2283	28.39
2006	812	2306	26.04
2007	829	2211	27.27
2008	948	2145	30.65
2009	631	2200	22.29
2010	56	277	16.82
Total	20,106	86,314	

Table 3.1 Continued

Panel B

	High Crash Risk Firms	Low Crash Risk Firms	Difference	t value
Cash ratio	0.164	0.166	-0.002	-0.69
Cash flow	0.016	0.018	-0.001	-0.44
Log size	5.008	4.893	0.115	2.39
Market to book	1.720	1.943	-0.223	-11.11
Net working capital	-0.178	-0.169	-0.009	-3.57
Capital expenditure	0.068	0.069	-0.001	-1.05
Market Leverage	0.251	0.233	0.018	4.63
Cash flow risk	0.103	0.103	0.001	1.58
R&D scaled by sales	0.191	0.204	-0.013	-1.3
Dividend dummy	0.360	0.355	0.005	0.94
Z score	2.080	1.890	0.190	3.97
KZ index	341.415	399.359	-57.944	-9.41
Industry competition(HHI)	0.089	0.089	0.000	0.35
Diversification Dummy	0.382	0.393	-0.011	-1.98

Note: The table reports the summary statistics. Panel A of the table reports the number of high crash risk firms and the number of low crash risk firms over years 1979-2010. Firms are defined as high crash risk firms if firm-specific weekly returns over the fiscal year are lower than the mean subtracted by 3 standard deviations. Panel B reports the characteristics for these two kinds of firms. The differences and the corresponding t values are shown in the last two columns. Financial firms with SIC codes of 6000-65000 and Utility firms with SIC codes of 4900-4999 are excluded. All the accounting data are winsorized at 1 percent and 99 percent level.

Cash ratio is defined as the cash and cash equivalent divided by total assets. *Cash flow* is the summation of income before extraordinary item (IB) and depreciation and amortization (DP) divided by total assets (AT). *Size* is the log value of total assets (AT). Market to Book is defined as total value of assets (AT), minus book value of equity (SEQ), plus market value of equity (PRCC_F*CSHO), divided by total assets (AT). *Net Working Capital* is net working capital measured as current liability (LCT) subtracted by debt in current liability (DLC), less current assets (ACT) without cash and cash equivalent (CHE). *Capital expenditure* is capital expenditure (CAPX) scaled by total assets. *Market leverage* is defined by the summation of long term debt (DLTT) and short term debt (DLC) divided by the market value of assets (PRCC_F*CSHO+DLTT+DLC). *Cash flow risk* is calculated as industry mean of standard deviation of last 20 years operating cash flow (OIBDP) scaled by total assets. Industry is defined by 2-digit SIC code. *R&D* is research and development expenses scaled by sales. *Dividend dummy* is the dividend payment dummy. It is set as one, if the firms paid common stock dividend in the year. Otherwise, it is set as zero. *Z score* is used as the proxy for the likelihood of financial distress. *KZ index* is used as the proxy for the likelihood that a firm faces financial constraint. *Diversification dummy* is set as one if firms have more than one segment, and is set as zero otherwise. The number of the segments data is from COMPUSTAT segment tapes.

Table 3.2 The effects of crash risk on firms' cash holdings

Panel A: the effect of crash risk on cash holdings for the whole sample

	Log of cash to assets ratio		
	(1)	(2)	(3)
Crash Risk Dummy	0.046***		
	3.53		
Crash Risk Dummy_ over three years		0.025***	
		2.82	
NCSKEW			0.023***
			2.93
Market to Book	-0.075***	-0.076***	-0.075***
	-5.63	-5.69	-5.52
Log size	-0.088***	-0.088***	-0.089***
	-14.60	-14.27	-14.99
Cash flow /Assets	0.120**	0.119**	0.125**
	2.07	2.06	2.17
Net working capital	2.854****	2.854***	2.852***
	42.81	43.00	42.37
Capital expenditure	-2.934***	-2.923***	-2.941***
	-18.47	-18.61	-18.41
Market Leverage	-2.193***	-2.194***	-2.191***
	-30.71	-30.63	-30.96
Cash flow risk	-16.829	-18.046	-17.384
	-0.69	-0.73	-0.71
R&D scaled by sales	0.399***	0.403***	0.403***
	4.70	4.66	4.65
Dividend Dummy	-0.206***	-0.205***	-0.204***
	-10.56	-10.51	-10.38
Z score	0.060***	0.060***	0.059***
	8.17	8.22	8.06
KZ score	0.000***	0.000***	0.000***
	10.58	10.56	10.51
Industry competition(HHI)	1.295	1.288	1.273
	1.51	1.52	1.53
Diversification Dummy	-0.045***	-0.045***	-0.044***
	-4.32	-4.27	-4.26
Intercept	-0.227	-0.149	-0.164
	-0.15	-0.10	-0.11
Industry Dummy	Yes	Yes	Yes
Adjusted R square	0.392	0.392	0.392

Table 3.2 Continued

Panel B: the effect of crash risk on cash holdings for financial constraint and financial unconstraint firms

	Log of cash to assets ratio					
	Financial Constraint			Financial Unconstraint		
	(1)	(2)	(3)	(4)	(5)	(6)
Crash Risk Dummy	0.063***			0.013		
	4.27			0.73		
Crash Risk Dummy_ over three years		0.032**			0.003	
		2.46			0.24	
NCSKEW			0.034***			0.003
			4.54			0.26
Market to Book	-0.064	-0.065***	-0.063***	-0.159***	-0.160***	-0.160***
	-4.78	-4.87	-4.68	-5.36	-5.47	-5.41
Log size	-0.080	-0.080***	-0.081***	-0.081***	-0.081***	-0.081***
	-14.43	-14.47	-14.60	-11.58	-11.01	-12.46
Cash flow /Assets	0.139	0.136***	0.148***	-0.138	-0.135	-0.142
	3.10	3.02	3.15	-1.47	-1.43	-1.51
Net working capital	2.836	2.836***	2.834***	2.688***	2.689***	2.686***
	44.01	44.19	44.07	27.19	27.19	27.08
Capital expenditure	-3.057	-3.051***	-3.067***	-2.330***	-2.321***	-2.325***
	-16.82	-16.79	-16.71	-11.76	-11.95	-11.63
Market Leverage	-4.325	-4.325***	-4.324***	-2.079***	-2.083***	-2.078***
	-21.78	-21.72	-21.92	-24.80	-24.45	-25.09
Cash flow risk	-14.701	-14.709	-15.750	-19.944*	-20.205*	-19.672*
	-1.05	-1.06	-1.11	-1.73	-1.74	-1.73
R&D scaled by sales	0.427	0.430***	0.430***	0.672***	0.673***	0.674***
	3.23	3.25	3.18	2.59	2.56	2.59
Dividend Dummy	-0.212	-0.211***	-0.210***	-0.165***	-0.166***	-0.164***
	-8.25	-8.15	-8.04	-6.71	-6.75	-6.66
Z score	0.056	0.057***	0.056***	0.042***	0.042***	0.042***
	6.79	6.89	6.65	5.96	5.93	5.97
KZ score	0.000	0.000***	0.000***	-0.001***	-0.001***	-0.001***
	6.01	6.05	5.93	-5.35	-5.35	-5.36
Industry competition(HHI)	-0.358	-0.340	-0.336	6.127**	6.102**	6.014**
	-0.23	-0.22	-0.22	1.95	1.94	1.99
Diversification Dummy	-0.129	-0.129***	-0.127***	0.069***	0.070***	0.069***
	-9.67	-9.60	-9.47	5.39	5.42	5.40

Table 3.2 Continued

Intercept	-0.053	-0.054	0.058	-0.078	-0.059	-0.085
	-0.06	-0.06	0.06	-0.11	-0.08	-0.12
Industry Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R square	0.415	0.414	0.415	0.278	0.278	0.279

Panel C: the effect of crash risk on cash holdings for large firms and small firms

	Log of cash to assets ratio					
	Large Firms			Small Firms		
	(1)	(2)	(3)	(4)	(5)	(6)
Crash Risk Dummy	0.025			0.066***		
	1.14			5.47		
Crash Risk Dummy_ over three years		0.013			0.036***	
		1.07			2.83	
NCSKEW			0.012			0.036***
			1.00			4.61
Market to Book	-0.042*	-0.044**	-0.043*	-0.076***	-0.076***	-0.075***
	-1.92	-1.99	-1.94	-5.93	-5.97	-5.80
Log size	-0.155***	-0.155***	-0.156***	-0.018*	-0.018*	-0.020**
	-21.03	-20.75	-21.21	-1.85	-1.86	-2.10
Cash flow /Assets	-0.569***	-0.566***	-0.564***	0.124**	0.124**	0.134**
	-4.29	-4.27	-4.25	2.32	2.32	2.48
Net working capital	3.084***	3.088***	3.081***	2.643***	2.642***	2.643***
	37.81	38.53	37.05	43.37	43.29	43.21
Capital expenditure	-3.730***	-3.726***	-3.748***	-2.481***	-2.463***	-2.486***
	-15.24	-15.36	-14.96	-18.86	-18.81	-18.84
Market Leverage	-1.662***	-1.660***	-1.659***	-2.837***	-2.837***	-2.835***
	-27.47	-27.56	-27.37	-28.03	-27.80	-28.22

Table 3.2 Continued

Cash flow risk	-54.584	-54.912	-55.015	19.387	17.265	19.270
	-0.87	-0.87	-0.87	1.02	0.98	1.03
R&D scaled by sales	0.919***	0.929***	0.927***	0.259***	0.260***	0.260***
	4.09	4.09	4.02	4.44	4.38	4.52
Dividend Dummy	-0.246***	-0.244***	-0.243***	-0.008	-0.007	-0.006
	-12.02	-11.90	-11.68	-0.43	-0.42	-0.35
Z score	0.080***	0.081***	0.080***	0.040***	0.040***	0.039***
	10.21	10.06	10.26	5.13	5.18	5.05
KZ score	0.001***	0.001***	0.001***	0.000***	0.000***	0.000***
	6.77	6.78	6.79	10.15	10.14	10.09
Industry competition(HHI)	-1.584	-1.651	-1.596	0.767	0.764	0.788
	-0.42	-0.43	-0.42	0.48	0.48	0.50
Diversification Dummy	0.008	0.009	0.009	-0.062***	-0.062***	-0.061***
	0.65	0.76	0.80	-3.62	-3.65	-3.52
Intercept	2.543	2.564	2.583	-2.758**	-2.609**	-2.724**
	0.68	0.68	0.69	-2.44	-2.48	-2.44
Industry Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R square	0.365	0.364	0.365	0.411	0.411	0.412

Note: Panel A reports the regression results of the effects of crash risk on firms' cash holdings. The Fama-Macbeth method is used in this regression. The dependent variable is the log value of cash to asset ratio. Crash risk dummy is equal to one if there is more than one weeks over fiscal year t that firm-specific weekly returns are lower than (mean – 3*standard deviation); otherwise it is zero. Crash risk dummy_ over three years is equal to one if there is more than one weeks over fiscal years t, t-1, t-2 that firm-specific weekly returns are lower than (mean – 3*standard deviation). Mean and standard deviation are estimated over the same three fiscal years. Otherwise it is equal to zero. NCSKEW represents negative conditional skewness of the return distribution. The estimation process is discussed in section 3. The sample period covers from 1979 to 2010. Financial firms with SIC codes of 6000-65000 and Utility firms with SIC codes of 4900-4999 are excluded. In the regression sample we have 103,442 observations. All the accounting data are winsorized at one percent level.

Panel B reports the effects of crash risk on firms' cash holdings for financial constraint firms and financial unconstraint firms separately. We rank KZ index into two groups. Firms belonging to top KZ index group are defined as financial constraint firms. Firms belonging to bottom KZ index group are defined as financial unconstraint firms. Panel C reports the effects of crash risk on firms' cash holdings for large firms and small firms separately. Large firms are defined as firms which have assets greater than the median for a given year and small firms are defined as firms which have asset lower than the median.

Cash ratio is defined as the cash and cash equivalent divided by total assets. *Cash flow* is the summation of income before extraordinary item (IB) and depreciation and amortization (DP) divided by total assets (AT). *Size* is the log value of total assets (AT). *Market to Book* is defined as total value of assets (AT), minus book value of equity (SEQ), plus market value of equity (PRCC_F*CSHO), divided by total assets (AT). *Net Working Capital* is net working capital measured as current liability (LCT) subtracted by debt in current liability (DLC), less current assets (ACT) without cash and cash equivalent (CHE). *Capital expenditure* is capital expenditure (CAPX) scaled by total assets. *Market leverage* is defined by the summation of long term debt (DLTT) and short term debt (DLC) divided by the market value of assets (PRCC_F*CSHO+DLTT+DLC). *Cash flow risk* is calculated as industry mean of standard deviation of last 20 years operating cash flow (OIBDP) scaled by total assets. Industry is defined by 2-digit SIC code. *R&D* is research and development expenses scaled by sales. *Dividend dummy* is the dividend payment dummy. It is set as one, if the firms paid common stock dividend in the year. Otherwise, it is set as zero. *Z score* is used as the proxy for the likelihood of financial distress. *KZ index* is used as the proxy for the likelihood that a firm faces financial constraint. *HHI* are Herfindahl-Hirschman Index describing the industry concentration. *Diversification dummy* is set as one if firms have more than one segment, and is set as zero otherwise. The number of the segments data is from COMPUSTAT segment tapes. . ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. t values are reported in the parentheses.

Table 3.3 The effects of crash risk on firms' cash holdings for different time periods

	Log of cash to assets ratio								
	1979-1990			1991-2000			2001-2010		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Risk Dummy	0.013			0.063***			0.068**		
	0.66			3.66			2.41		
Crash Risk Dummy		-0.003			0.039***			0.046***	
		-0.15			3.54			3.72	
NCSKEW			0.005			0.019			0.050**
			1.35			1.51			2.51
Market to Book	-0.132***	-0.133**	-0.133***	-0.045***	-0.045***	-0.046***	-0.037*	-0.038*	-0.035
	-5.88	-5.89	-5.84	-4.61	-4.68	-4.55	-1.77	-1.85	-1.63
Log size	-0.080***	-0.080***	-0.081***	-0.124***	-0.124***	-0.125***	-0.061***	-0.060***	-0.063***
	-15.93	-15.87	-15.47	-20.49	-21.24	-19.69	-6.38	-5.86	-6.94
Cash flow /Assets	0.394***	0.394***	0.398***	-0.021	-0.023	-0.023	-0.069	-0.068	-0.055
	4.59	4.56	4.59	-0.38	-0.41	-0.42	-0.84	-0.83	-0.69
Net working capital	2.872***	2.871***	2.873***	2.896***	2.897***	2.894***	2.789***	2.791***	2.784***
	58.61	57.94	58.54	49.19	49.12	48.94	13.73	13.82	13.56
Capital expenditure	-2.912***	-2.914***	-2.914***	-2.330***	-2.318***	-2.329***	-3.563***	-3.539***	-3.584***
	-24.23	-24.43	-24.09	-12.02	-12.02	-12.03	-9.71	-9.77	-9.77
Market Leverage	-1.781***	-1.780***	-1.781***	-2.410***	-2.412***	-2.409***	-2.471***	-2.473***	-2.466***
	-20.06	-20.14	-20.06	-58.41	-58.42	-59.34	-30.79	-30.34	-32.14
Cash flow risk	-46.061	-48.810	-46.751	-0.711	-0.767	-0.792	2.133	1.592	1.264
	-0.70	-0.74	-0.71	-0.32	-0.35	-0.36	0.45	0.33	0.26
R&D scaled by sales	0.793***	0.789***	0.805***	0.146***	0.146***	0.146***	0.180	0.197	0.176
	6.15	6.22	5.95	4.28	4.28	4.23	1.25	1.22	1.25
Dividend Dummy	-0.153***	-0.153***	-0.153***	-0.237***	-0.237***	-0.236***	-0.238***	-0.236***	-0.235***
	-4.37	-4.39	-4.34	-13.88	-14.00	-14.21	-6.13	-5.98	-5.85

Table 3.3 Continued

Z score	0.093***	0.093***	0.092***	0.065***	0.065***	0.065***	0.015***	0.015***	0.014**
	10.79	10.84	10.81	7.55	7.62	7.53	2.59	2.64	2.39
KZ score	0.001***	0.001***	0.001***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	6.30	6.28	6.26	7.85	7.88	7.75	7.84	7.83	7.76
Industry competition(HHI)	0.765	0.782	0.777	-0.016	-0.014	-0.023	3.242	3.196	3.165
	1.45	1.50	1.49	-0.03	-0.03	-0.05	1.24	1.23	1.25
Diversification Dummy	-0.001	-0.001	-0.001	-0.040**	-0.040**	-0.040**	-0.102***	-0.102***	-0.101***
	-0.16	-0.13	-0.13	-2.38	-2.33	-2.35	-7.67	-7.56	-7.28
Intercept	1.422	1.589	1.466	-1.047***	-1.045***	-1.020***	-1.385*	-1.340*	-1.262*
	0.36	0.40	0.37	-5.83	-5.80	-5.75	-1.95	-1.86	-1.76
Industry Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R square	0.313	0.313	0.313	0.412	0.412	0.412	0.466	0.466	0.468

Note: The table reports the regression results of the effects of crash risk on firms' cash holdings for different time periods 1979-1990, 1991-2000 and 2001-2010 separately. The Fama-Macbeth method is used in this regression. The dependent variable is the log value of cash to asset ratio. Crash risk dummy is equal to one if there is more than one weeks over fiscal year t that firm-specific weekly returns are lower than (mean – 3*standard deviation); otherwise it is zero. Crash risk dummy_ over three years is equal to one if there is more than one weeks over fiscal years t, t-1, t-2 that firm-specific weekly returns are lower than (mean – 3*standard deviation). Mean and standard deviation are estimated over the same three fiscal years. Otherwise it is equal to zero. NCSKEW represents negative conditional skewness. The estimation process is discussed in section 3. The sample period covers from 1979 to 2010. Financial firms with SIC codes of 6000-65000 and Utility firms with SIC codes of 4900-4999 are excluded. All the accounting data are winsorized at one percent level.

Cash ratio is defined as the cash and cash equivalent divided by total assets. *Cash flow* is the summation of income before extraordinary item (IB) and depreciation and amortization (DP) divided by total assets (AT). *Size* is the log value of total assets (AT). *Market to Book* is defined as total value of assets (AT), minus book value of equity (SEQ), plus market value of equity (PRCC_F*CSHO), divided by total assets (AT). *Net Working Capital* is net working capital measured as current liability (LCT) subtracted by debt in current liability (DLC), less current assets (ACT) without cash and cash equivalent (CHE). *Capital expenditure* is capital expenditure (CAPX) scaled by total assets. *Market leverage* is defined by the summation of long term debt (DLTT) and short term debt (DLC) divided by the market value of assets (PRCC_F*CSHO+DLTT+DLC). *Cash flow risk* is calculated as industry mean of standard deviation of last 20 years operating cash flow (OIBDP) scaled by total assets. Industry is defined by 2-digit SIC code. *R&D* is research and development expenses scaled by sales. *Dividend dummy* is the dividend payment dummy. It is set as one, if the firms paid common stock dividend in the year. Otherwise, it is set as zero. *Z score* is used as the proxy for the likelihood of financial distress. *KZ index* is used as the proxy for the likelihood that a firm faces financial constraint. *HHI* are Herfindahl-Hirschman Index describing the industry concentration. *Diversification dummy* is set as one if firms have more than one segment, and is set as zero otherwise. The number of the segments data is from COMPUSTAT segment tapes. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. t values are reported in the parentheses.

Table 3.4 Cash saving behavior tests

	The change of cash holdings	
	Crash Risk Dummy	NCSKEW
Crash risk	-0.012	-0.397
	-1.20	-1.04
Crash*Cash flow$_t$ / Assetst-1	-0.067***	-0.035***
	-4.49	-4.82
Crash*Stock Issuance$_t$ /Assets$_{t-1}$	-0.087	0.003
	-1.19	0.21
Crash*Debt Issuance$_t$ / Assets$_{t-1}$	-0.021*	0.001
	-1.68	0.14
Crash*Δ Net Working Capital	0.024	0.017
	1.33	1.46
Crash*Δ Capital Expenditure$_t$	-0.150***	-0.065***
	-5.84	-3.82
Crash*Δ R&D	0.081	0.046
	1.48	1.61
Crash* Acquisition$_t$ / Assetst-1	0.040	-0.022
	0.97	-1.20
Crash* Logsize	0.001	0.000
	0.76	-0.91
Crash*Market to Book	0.000	-0.001
	-0.14	-0.91
Crash*Market Leverage	0.013*	0.014***
	1.69	2.82
Crash*Cash Flow Risk	-0.050	3.623
	-0.77	1.00
Crash*Dividend Dummy	0.001	-0.001
	0.59	-0.38
Crash*Z score	0.006***	0.004***
	3.66	4.74
Crash*KZ score	0.000	0.000
	-0.34	0.76
Crash*Industry Competition	-0.027*	0.127
	-1.73	0.98
Crash*Diversification	0.003	0.001
	1.39	0.96
Intercept	-0.098	-0.094
	-0.37	-0.29
Main Effects	Yes	Yes
Industry Dummy	Yes	Yes

Note: This table reports the regression results for the cash flow sensitivity of cash, stock issuance sensitivity of cash and et al. The model mainly follows Almeida, Campello and Weisbach (2004) and McLean (2010). In the model, The Fama-Macbeth method is used and the dependent variable is the change of cash holdings ($Cash_{i,t}$ - $Cash_{i,t-1}$) / $Assets_{i,t-1}$. We report how crash risk interacted with cash sources affect the change of cash. The crash risk is based on two proxies: crash risk dummy and NCSKEW. Crash risk dummy is equal to one if there is more than one weeks over fiscal year t that firm-specific weekly returns are lower than (mean – 3*standard deviation); otherwise it is zero. Mean and standard deviation are estimated over the same fiscal year. NCSKEW represents negative conditional skewness. The estimation process is discussed in section 3. The sample period covers from 1979 to 2010. Financial firms with SIC codes of 6000-65000 and Utility firms with SIC codes of 4900-4999 are excluded. All the accounting data are winsorized at one percent level.

We only report the results of crash risk and the interactions of crash risk and controls. Other controls in the model are explained as follows. *Cash flow* is the operating income before depreciation (OIBDP) divided by lagged total assets (AT). *ΔNWC* is the change of net working capital, and *Debt issuance* is issuance of debt from cash flow statement (DLTIS). *Acquisition* is measured by the cash outflow of the funds for the acquisition of the company (AQC) scaled by lagged assets. *Stock issuance* is the issuance of stock from cash flow statement (SSTK). Δ *Capital Expenditure*$_t$ is the difference between capital expenditure (CAPX) and capital expenditure at last year scaled by total assets at the beginning of the year. Δ *R&D*$_t$ is the difference between R&D expenditure (XRD) and R&D at last year scaled by last year's sales. *Size* is the log value of total assets (AT). *Market to Book* is defined as total value of assets (AT), minus book value of equity (SEQ), plus market value of equity (PRCC_F*CSHO), divided by total assets (AT). *Z score* is used as the proxy for the likelihood of financial distress. *KZ index* is used as the proxy for the likelihood that a firm faces financial constraint. *HHI* are Herfindahl-Hirschman Index describing the industry concentration. *Diversification dummy* is set as one if firms have more than one segment, and is set as zero otherwise. The number of the segments data is from COMPUSTAT segment tapes. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. t values are reported in the parentheses.

Table 3.5 The effect of crash risk on the value of cash

Panel A: whole sample

	Crash Risk Dummy	NCSKEW
	(1)	(2)
Crash Risk	-0.178***	-0.126***
	-16.44	-17.15
Crash*Δ cash ratio	-0.409***	-0.157***
	-3.76	-2.94
Δ cash ratio	1.740***	1.612***
	11.00	11.55
Δ earnings before extraordinary item	0.702***	0.687***
	9.61	9.44
Net assets	0.165***	0.163***
	6.89	7.13
R&D expenditure	1.146***	1.181***
	2.82	2.83
Interest expense	-2.257***	-2.204***
	-6.48	-6.35
Dividend	2.612***	2.508***
	6.40	5.96
Lag of cash	0.131***	0.110**
	3.01	2.51
Market leverage	-0.478***	-0.480***
	-14.75	-14.70
Net Financing	0.072	0.074
	1.50	1.49
Lag of cash*Δ cash ratio	-0.959***	-0.960***
	-4.23	-4.18
Leverage*Δ cash ratio	-1.989***	-1.936***
	-7.27	-7.85
Intercept	0.137***	0.093***
	4.44	3.08
Industry Dummy	Yes	Yes
Adjusted R square	0.262	0.279

Table 3.5 Continued

Panel B: Sub-Sample tests

	1979-1990		1991-2000		2001-2010	
	(1)	(2)	(3)	(4)	(5)	(6)
Crash Risk Dummy	-0.137***		-0.221***		-0.186***	
	-9.76		-12.35		-12.73	
Crash Risk Dummy*Δ cash ratio	-0.260*		-0.571**		-0.428***	
	-1.89		-2.00		-4.55	
NCSKEW		-0.094***		-0.154***		-0.138***
		-14.28		-12.14		-12.41
NCSKEW*Δ cash ratio		-0.059		-0.273*		-0.160***
		-1.17		-1.92		-2.69
Δ cash ratio	1.511***	1.437***	2.162***	1.982***	1.577***	1.433***
	7.00	6.71	5.68	6.37	11.23	10.68
Δ earnings before extraordinary item	0.934***	0.919***	0.572***	0.561***	0.536***	0.517***
	7.69	7.54	5.32	5.22	4.77	4.73
Net assets	0.184***	0.185***	0.176***	0.170***	0.128***	0.128***
	5.13	4.96	3.34	3.69	3.50	3.48
R&D expenditure	2.981***	3.055***	-0.006	0.062	-0.020	-0.073
	4.82	4.74	-0.01	0.13	-0.04	-0.15
Interest expense	-1.951***	-1.922***	-2.832***	-2.644***	-2.025***	-2.090***
	-4.09	-3.99	-3.82	-3.64	-3.22	-3.19
Dividend	3.875***	3.781***	1.095	1.082	2.613***	2.398***
	7.91	7.87	1.31	1.17	5.17	4.85
Lag of cash	0.243***	0.216***	0.011	-0.011	0.115	0.104
	4.70	4.20	0.18	-0.18	1.10	0.99
Market leverage	-0.473***	-0.478***	-0.624***	-0.629***	-0.322***	-0.319***
	-13.60	-13.66	-10.69	-11.09	-9.90	-9.25
Net Financing	0.087**	0.088**	0.201	0.200	-0.091**	-0.084**
	2.46	2.36	1.57	1.49	-2.27	-2.12
Lag of cash*Δ cash ratio	-0.514*	-0.504*	-1.939***	-1.971***	-0.465**	-0.446**
	-1.76	-1.77	-4.12	-4.11	-2.47	-2.31
Leverage*Δ cash ratio	-1.973***	-1.957***	-2.542***	-2.437***	-1.398***	-1.349***
	-6.50	-6.69	-3.59	-4.03	-4.84	-4.44
Intercept	0.182***	0.139***	0.178***	0.138***	0.030	-0.017
	4.91	4.08	3.55	2.94	0.44	-0.24
Industry Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R square	0.280	0.298	0.245	0.259	0.257	0.275

Note: The table reports the results about the cash value for high beta firms and low beta firms. The cash value model is borrowed from Faulkender and Wang (2006) and Fama-Macbeth method is used. Panel A shows the whole sample tests results. Panel B reports the sub-sample tests results for sub-periods of 1979-1990, 1991-2000, and 2001-2010. The crash risk is based on two proxies: crash risk dummy and NCSKEW. Crash risk dummy is equal to one if there is more than one weeks over fiscal year t that firm-specific weekly returns are lower than (mean – 3*standard deviation); otherwise it is zero. Mean and standard deviation are estimated over the same fiscal year. NCSKEW represents negative conditional skewness of the return distribution. The estimation process is discussed in section 3. The dependent variable is the excess return defined as the individual firm return $r_{i,t}$ in fiscal year t, minus $R_{i,t}^{B}$ the bench market return based on Fama-French 25 portfolios according to size and book-to-market breakpoints. M_{it-1} is the market value of equity (CSHPRI*PRCC_F) in year t-1. ΔX is the change of value from year t-1 to year t. *C* is cash and cash equivalents (CHE). *E* is earnings before extraordinary item (IB). *RD* is research and development expenditures (XRD). Other financial controls include *I*, interest expense (XINT), *D*, Dividend payment (DVC), *L*, Market leverage ((DLTT+DLC) / (CSHPRI*PRCC_F+DLTT+DLC) and *NF*, net financing. Net financing is defined as sale of common and preferred stock (SSTK) subtracted the purchase of common and preferred stock (PRSTKC), plus the issuance of long-term debt (DLTIS) subtracted the reduction of long-term debt (DLTR). . ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. t values are reported in the parentheses.

APPENDIX

BOOK-TO-MARKET ANALYSIS

Table A.1 Abnormal announcement returns for B/M quintile rank, 1981-2007

		Market adjusted return		Size and Book-to-Market adjusted return	
	N	3 days (-1, +1)	5 days (-2, +2)	3 days (-1, +1)	5 days (-2, +2)
Book-to-Market quintile					
1 (glamour stocks)	807	1.28***	1.21***	1.30***	1.24***
2	807	0.97***	0.90***	1.05***	1.01***
3	807	1.52***	1.68***	1.60***	1.78***
4	807	2.14***	2.06***	2.12***	2.09***
5 (value stocks)	807	3.62***	3.74***	3.66***	3.78***

Table A.2 Abnormal announcement returns for high B/M firms and low B/M firms, 1981-2007

		Market adjusted return		Size and Book to market adjusted return	
	N	3 days (-1, +1)	5 days (-2, +2)	3 days (-1, +1)	5 days (-2, +2)
High book-to-market	1345	3.06***	3.08***	3.05***	3.10***
Low book-to-market	1345	1.13***	1.09***	1.16***	1.14***
Difference (High-Low)		1.93***	1.99***	1.89***	1.96***

Note: We sort firms into three groups and define the first tercile as low Book-to-Market (B/M) firms and the last tercile as high Book-to-Market firms.

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