

Three Essays on Corporate Finance:
Raising Capital, Financial Constraint and Value of cash

by

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Abstract

The thesis consists of three essays. In the first essay, we examine whether alleviating financial constraints is one of the motives for non-U.S. firms to cross-list in stock markets in the United States. Using payout ratio, payout level, and WW index (Whited and Wu, 2006) as measures of financial constraints, we find that firms with higher financial constraints are more likely to cross-list in the U.S. This pattern is driven by small firms, which tend to be financially constrained. After firms cross-list, they significantly increase their payout ratio and payout level. Small firms have more increases in payouts than large firms. WW index decreases for small firms after cross-listing. Tests about cash flow sensitivities of cash also suggest that the decline in financial constraints is more significant for small firms. Overall the results suggest that relief from financial constraints may be an important motive for cross-listing, especially for small firms.

In the second essay, we investigate the level of cash holdings of IPO firms in the year of IPO issuance assuming the IPO proceeds are not received. The results show that more than 70% of IPO firms will run out of cash if they do not receive IPO proceeds, indicating that near-term cash shortage is probably a common phenomenon for IPO firms prior to IPO issuance. We next examine whether the near-term cash shortage is correlated with post-IPO long-run underperformance and find that the near-term cash shortage will negatively and significantly affect the post-IPO long-run performance. The IPO firms with higher level of cash shortage underperform more than IPO firms with lower level of cash shortage or without cash shortage, consistent with the market underreaction hypothesis. Further tests also suggest that near-term cash shortage is negatively and significantly correlated with post-IPO operating performance.

Faulkender and Wang (2006)'s study about the value of cash holdings may be subject to endogeneity problem and under-reaction problem. In the third essay, I investigate the marginal value of cash holdings using a sample of cash windfalls for oil-and-gas firms during 2000-2007. This sample avoids the endogeneity problem to a large extent. The results indicate that on average one extra dollar of cash is worth much more than what Faulkender and Wang (2006) suggest. Tests about future stock performance suggest that while the under-reaction problem may cause Faulkender and Wang (2006) to underestimate the marginal value of cash, our method does not suffer from the same issue.

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Chapter 1 General Introduction

This thesis consists of three essays on corporate finance. In the first essay, we explore if alleviating financial constraints is one motivation for non-U.S. firms to cross-list in U.S. stock markets. Cross-listing in foreign stock markets, especially in U.S. stock markets, becomes a more and more common phenomenon for firms that were already listed in their home countries. This is because there are numerous advantages to be obtained through cross-listing. For example, firms can get access to a larger pool of potential investors, which is also beneficial for investors because they will have more kinds of stocks to choose from. In addition, cross-listing can improve firms' share liquidity. Shares are traded in more than one market so that it is much easier for investors to quickly buy and sell stock shares at a fair price. What's more, cross-listing can provide a larger and deeper capital market for firms to raise funds, rather than being confined to the domestic stock market. Those benefits will be enhanced for firms with binding financial constraints, which means firms with high level of financial constraints probably have more incentives to cross-list in foreign firms. For non-U.S. firms, a popular channel to cross-list in U.S. markets is American Depositary Receipts (ADRs). In chapter 2, we investigate the relation between the financial constraints and the probability of cross-listing through ADRs for non-U.S. public firms.

In the second essay, we measure the level of cash holdings for IPO firms assuming no IPO proceeds are received and examine how this new cash measure affects the post-IPO long-run performance. Long-run underperformance is one of the most important anomalies for IPOs. Several theories are proposed to explain IPO long-run underperformance, such as divergence of opinion hypothesis, market timing hypothesis, market over-optimism hypothesis, etc. Empirically, many factors are found to be correlated with IPO long-run underperformance. Previous literature document that firms with higher discretionary accruals, non-venture-backed feature, less prestigious underwriters or higher new cash raised from IPOs will have worse post-IPO long-run performance. In chapter 3, we construct a new cash variable – pro forma cash (PFCASH) to measure the level of cash holding without IPO proceeds in the year of IPO issuance, according to DeAngelo, DeAngelo and Stulz (2010). A negative PFCASH indicates that IPO firms will run out of cash if IPO proceeds are not received. We then test the market underreaction hypothesis by

examining the relation between the near-term cash shortage prior to IPOs and post-IPO long-run stock performance.

The marginal value of cash holdings is investigated in the third essay, with endogeneity issue maximumly eliminated. A firm's cash holding is a very important indicator for analysts, investment bankers and practitioners to evaluate firm values. It can implicitly disclose some information related to growth opportunities, financial constraints, managerial agency problem, corporate diversification and so on. However, there is not too much literature discussing the marginal value of cash holdings. Faulkender and Wang (2006) provide relatively comprehensive evidence that on average one extra dollar of cash is less than fully valued to shareholders, developing a distinctive methodology. Some other scholars adopt the same approach and find similar results using samples across different countries. The problem is the level of cash holdings can be determined by some firm-specific characteristics, causing the change in cash holding endogenous and thus the findings in Faulkender and Wang (2006) as well as other literature unreliable. In Chapter 4, we select oil-and-gas firms during oil price shock period as our sample because the sudden oil price run-up makes the change in cash holdings unpredictable and thus exogenous, eliminating the endogeneity issue previous literature may encounter. Our evidence show that the marginal value of cash is more than \$1 to shareholders and it will be negatively affected by the current level of cash holdings and leverage. Further market underreaction tests show that Faulkender and Wang (2006) do underestimate the marginal value of cash while our study does not, especially for financially constrained firms.

Chapter 2 Financial Constraints and Cross-Listing

2.1 Introduction

Thousands of firms worldwide are cross listed in stock exchanges in another country in addition to being listed in their home country. Surveys of corporate managers suggest that one of the important motives for cross-listing is to get better access to a larger, deeper market for capital (Bancel and Mittoo, 2001; Mittoo, 1992). This motive implies that firms with more financial constraints will have stronger incentives to cross-list in developed stock markets like those in the United States. The leading theories about cross-listing also have the same implication. In the market segmentation hypothesis proposed by Brennan et al. (1977), Errunza and Losq (1985), Eun and Janakiramanan (1986), and Alexander et al., (1987), firms can cross-list their shares across different segmented markets to have broader global investor base, higher valuation and lower cost of equity capital. These benefits of cross-listing are the greatest for financially constrained firms, so these firms are more likely to seek cross-listing. As pointed out in Karolyi (2012), the model of bonding hypothesis in Doidge et al. (2004) also shows that firms with more binding financial constraints will benefit more from cross-listing and will be more inclined to list in a foreign market. We call this argument the constraint alleviation hypothesis and test this hypothesis in this paper.

From the population of all firm years in Compustat Global, we construct a sample of non-U.S. public firm years that meet the minimum requirements for listing in the NASDAQ market. In this sample, we identify the firms that cross-list in one of the major U.S. markets (NYSE, Amex, and NASDAQ) at some point during the sample period through American Deposit Receipts (ADR), the main tool for non-U.S. firms to cross-list in the U.S. markets. To measure financial constraints, we estimate payout ratio and payout level. Firms that are financially constrained are less likely to make payouts through dividends or share repurchase (Almeida et al., 2004; Fazzari et al., 1988) and have lower payout ratio/level. Another measure of financial constraints we use is the WW index proposed in Whited and Wu (2006). They show that higher WW index is associated with higher level of financial constraints. Almeida et al. (2004) and Almeida et al. (2014) propose that the cash flow sensitivity of cash is a reliable measure for financial constraint, so we estimate the

cash flow sensitivity for groups of firms in our sample with different payout ratios/levels and different WW index levels and confirm that the three variables are valid measures of financial constraints for our cross-country sample.

We run a logistic regression model to examine whether non-U.S. firms with higher financial constraints are more likely to cross-list in the United States. Consistent with the constraints alleviation hypothesis, the logistic regression results show that non-U.S. firms with higher payout ratio or higher payout level are less likely to cross-list in the U.S. markets. Because large firms usually face fewer financial constraints and are less likely to seek cross-listing for the purpose of reducing financial constraint, the constraints alleviation hypothesis predicts that the negative relation between payout and the probability of cross-listing should be stronger for small firms. After we divide the sample into two sub-samples based on firm size and run the regression on the sub-samples, we find that the negative relation between payout and cross-listing is indeed driven by small firms. Then we redo the tests using WW index as alternative measure for financial constraints. The regression results suggest a positive relation between WW index and the probability of cross-listing. In tests on sub-samples based on firm size, the positive relation is also driven by small firms. All these results suggest that non-U.S. firms with higher level of financial constraints are more likely to cross-list in the U.S. markets, providing support to the constraints alleviation hypothesis.

If reducing financial constraints is one of the motives for non-U.S. firms, especially small ones, to cross-list in the U.S. markets, then we should observe decline of financial constraints for those firms that do cross-list successfully. To test this prediction of the constraints alleviation hypothesis, we examine the change in payouts and WW index around cross-listing for the ADR firms in our sample. Consistent with the hypothesis, we find that ADR firms increase both the payout ratio and payout level significantly after cross-listing. Because small firms are more likely to seek cross-listing for the purpose of reducing financial constraints, we also divide the ADR sample into small firm and large firm sub-samples and repeat the tests. We find that small ADR firms have more increase in payouts, suggesting that small firms benefit more from cross-listing in terms of lower financial constraints. When we repeat the tests on the change in WW index, we find that the WW index of ADR firms decrease significantly and the decrease is driven by small firms. We also adapt the regression model in Almeida et al. (2004) to estimate the change in cash

flow sensitivity of cash around cross-listing. The regression results show that the cash flow sensitivity of cash declines after non-U.S. firms cross-list in the U.S. markets through ADR. This decrease is more significant for small firms. These results are all consistent with the constraints alleviation hypothesis.

This study contributes to the finance literature in at least three ways. First, we are the first empirical study about the relation between financial constraints and the probability of cross-listing. Several papers about cross-listing use logistic or hazard models to analyze the factors affecting cross-listing decisions (Doidge et al., 2009a, 2009b; Fernandes and Giannetti, 2014; Li et al., 2019; Reese and Weisbach, 2002). None of these studies document any significant relation between financial constraints and cross-listing. Our study fills this void and shows that the alleviation of financial constraints may be an important motive for cross-listing, especially for small firms. Second, although we are not the first study to examine the effect of cross-listing on financial constraints, our evidence is more reliable. Lins et al. (2005) and Charest et al. (2014) examine whether cross-listing in U.S. exchanges reduces financial constraints. They use the cash flow sensitivity of investment as the measure of financial constraints (Fazzari et al., 1988). However, Kaplan and Zingales (1997), Cleary (1999), Erickson and Whited (2000), Alti (2003), and Almeida and Campello (2007) all challenge the robustness of cash flow sensitivity of investment as a measure of financial constraints on both theoretical and empirical grounds. This casts doubts about the proper interpretation of the results in Lins et al. (2005). Now, with the results based on payouts and WW index in our study, we can argue with more confidence that cross-listing does reduce financial constraints. Third, our results show that reducing financial constraint may be an important motive in cross-listing decisions for small firms, but not necessarily for large firms. Small firms and large firms may also benefit differently from cross-listing. By documenting these results, we provide more details to show that different motives for cross-listing have different importance for different firms.

The rest of the paper is organized as follows: in section 2, we review the relevant literature; in section 3, we describe the sample; in section 4, we examine the relationship between financial constraints and the probability of cross-listing; in section 5, we test the change in financial constraints around cross-listing; in section 6, we conclude the paper.

2.2 Relevant Literature

In the finance literature Mittoo (1992) is probably the first survey about managerial perceptions of the costs and benefits of cross-listing. She surveyed Canadian firms that have listed their securities on the foreign exchanges in the U.S. and U.K. and find that access to foreign capital markets and increased stock marketability are perceived to be the major benefits. The SEC reporting and compliance requirements are cited as the major costs of foreign listings. Overall, benefits are perceived to outweigh costs. Bancel and Mittoo (2001) survey European managers about the costs and benefits of foreign listing. Increase in prestige and visibility, and growth in shareholder base are perceived as the major benefits. The costs of public relations and legal fees are cited as the major costs by the managers. In their sample about 37.8% of the managers consider increased access to foreign capital markets as one of the major benefits of foreign listing. So both Mittoo (1992) and Bancel and Mittoo (2001) suggest that access to a larger, deeper market for capital may be one of the important motives for cross-listing. In this case, if a firm already has adequate access to capital (no financial constraint), cross-listing will have fewer benefit and the firm will be less likely to seek cross-listing. This leads to the constraint alleviation hypothesis.

The same implication regarding financial constraints can also be inferred from the leading theories about cross-listing. In the market segmentation hypothesis proposed by Brennan et al., (1977), Errunza and Losq (1985), Eun and Janakiramanan (1986), and Alexander et al., (1987), financial markets around the world are segmented because barriers including regulatory restrictions, costs and information problems prevent funds from flowing freely across borders. Models in these papers conduct comparative static analysis of different equilibria for firm valuation with and without access to global capital markets through cross-listing. Generally, when the barriers are higher, firms will have higher cost of capital in their local markets. These models predict that in this case firms can cross-list their shares across different markets to have broader global investor base, higher valuation and lower cost of equity capital. Because financial constraints are higher when the barriers are higher, the market segmentation hypothesis implies that these benefits of cross-listing are greater for financially constrained firms. Therefore, firms with higher financial constraints should be more likely to seek cross-listing.

The bonding hypothesis proposed by Stulz (1999) suggests that a firm's cost of capital is affected by its corporate governance system, including both the internal firm-specific controls, such as board independence, and the external market and institutional controls in place, such as the monitoring from bankers, analysts, auditors, institutional investors as well as the legal and regulatory authorities. Stulz (1999) argues that a firm can alter its corporate governance system by cross-listing its shares on a foreign exchange where the external market and institutional controls are more effective. Stulz (1999) does not directly relate financial constraints to cross-listing. However, when Doidge et al. (2004) develop the first formalized theoretical model for the bonding hypothesis, they show that entrepreneurs with significant private benefits of control, fewer binding financial constraints at home, and smaller future growth opportunities would be less likely to cross-list. Therefore, although the bonding hypothesis has a different focus, the same implication regarding alleviating financial constraints can also be inferred from the bonding hypothesis model in Doidge et al. (2004).

The market segmentation hypothesis, the bonding hypothesis and the constraint alleviation hypothesis all predict that firms can reduce their costs of capital and increase firm value through cross-listing. Consistent with this prediction, Miller (1999) find a positive average abnormal return of 1.15% for 181 ADR-initiating announcement dates between 1985 and 1995. The stock price reaction is related to the choice of exchange, geographical location (i.e., emerging or developed markets), and avenues for raising equity capital (i.e., public versus private offerings). Foerster and Karolyi (1999) uncover a listing-week abnormal return of 1% for 183 ordinary and ADR cross-listings. Hail and Leuz (2009) directly estimate the change in cost of capital as implied by market prices and analyst forecasts. They find that firms with cross-listings on U.S. exchanges see their cost of capital decrease significantly by between 70 to 120 basis points. Consistent with the bonding hypothesis, Hail and Leuz (2009) find smaller cost-of-capital reductions for firms that cross-list in the over-the-counter market and for exchange-listed firms from countries with stronger home-country institutions.

Doidge et al. (2004) compare the valuation of foreign companies cross-listed in the U.S. with that of non-cross-listed firms from the same country. They find that foreign companies with shares cross-listed in the U.S. had Tobin's q ratios that were 16.5% higher than the q ratios of non-cross-listed firms from the same country as of the end of 1997. The valuation difference is

statistically significant and reaches 37% for those companies that list on major U.S. exchanges, even after controlling for a number of firm and country characteristics. Consistent with the bonding hypothesis, Doidge et al. (2004) suggest that a U.S. listing reduces the extent to which controlling shareholders can engage in expropriation and thereby increases the firm's ability to take advantage of growth opportunities. They show that growth opportunities are more highly valued for firms that choose to cross-list in the U.S., particularly those from countries with poorer investor rights.

Reese and Weisbach (2002) examine whether shareholder protection in the home country affects the likelihood for a firm to cross-list in the U.S. markets. Their sample includes 1,148 foreign firms listed in the U.S. during the 1980s and 1990s and 17,000 purely domestic firms as benchmark. Using logistic regression analysis, Reese and Weisbach (2002) find that the legal system from which the firms come does influence the likelihood of listing. Companies from countries with poor legal protections for minority shareholders were more likely to cross-list in the U.S. and especially on a major stock exchange. The event of cross-listing on a U.S. major exchange increased the probability of an equity offering for the firm by over 100% (111 offerings within two years following compared to 46 offerings before). This increase was concentrated in the firms from countries with weaker legal systems. This evidence is consistent with the bonding hypothesis. The relation between financial constraints and cross-listing is not directly tested in Reese and Weisbach (2002).

Using a sample of 4000 firms from 32 countries around the world, Doidge et al. (2009a) study how the ownership structure of a firm influences its cross-listing decision. They employ both logistic regression and Cox proportional-hazard models to show that a U.S. listing is inversely related to the presence of a block holder and decreases with the wedge between the block holder's control rights and cash flow rights. These effects further impact the analyst coverage they achieve and valuations they earn upon listing. In their regression model Doidge et al. (2009a) include a financial flexibility index to control for financial constraints. The coefficient for the financial flexibility index is not statistically significant in the regression results.

Fernandes and Giannetti (2014) also examine the effects of investor protection on cross-listing. They use a sample of foreign listings for 29 exchanges in 24 countries starting from the early 1980s and consider many firm and market characteristics in their Cox proportional hazard

model. They show that although firms list in countries with better investor protection, they are less likely to list in countries with excessively stronger investor protection. Both ex ante firm and market characteristics and ex post listing outcomes show that their findings are due to lack of investor interest in firms from environments with much weaker investor protection. Fernandes and Giannetti (2014) did not include financial constraints among the determinants of cross-listing decisions.

Li et al. (2019) point out that the market segmentation hypothesis and the bonding hypothesis cannot explain why the number of listings fluctuate so widely overtime and why the valuation effects tend to be statistically significant in the short run but dissipate in the long run. For example, Foerster and Karolyi (1999) document a post-listing price decline of 9% for ADRs; Sarkissian and Schill (2009) and Sarkissian and Schill (2016) show that valuation gains are temporary for foreign listings on exchanges all around the world and dissipate in the long-run. Market timing has been offered as a plausible explanation for these results. Consistent with the market timing hypothesis, Li et al. (2019) document a high positive correlation between the valuation of existing ADRs and the number of new ADR listings next year. They find that ADR listing is more likely when existing ADRs are valued higher and the subsequent operating and stock performance of ADR firms listed in hot years is significantly worse than those of ADR firms listed in cold years. Li et al. (2019) also use a logistic regression model to examine the factors affecting cross-listing decisions. Financial constraints is not included among the factors.

Lins et al. (2005) attempt to examine how cross-listing affects financial constraints. They use cash flow sensitivity of investment as the measure of financial constraints and find that cross-listing in U.S. exchanges significantly reduces financial constraints, especially for firms from emerging economies and countries with weak investor protection. Charest et al. (2014) find similar results using the same measure of financial constraints. However, many papers suggest that cash flow sensitivity of investment may also be interpreted as a measure of agency problem or information asymmetry (Almeida and Campello, 2007; Alt, 2003; Cleary, 1999; Erickson and Whited, 2000; Kaplan and Zingales, 1997). Therefore, the results found in (Lins et al., 2005) and (Charest et al., 2014) are not necessarily evidence of decline in financial constraints after cross-listing.

2.3 Data and Sample Description

2.3.1 Sample Construction

We start from the population of all firm years covered in the Fundamentals Annual dataset of Compustat Global database. Our sample period is from 1987 to 2018 because the data in Security Daily section of Compustat Global database start from 1987. We are only interested in firms that are eligible for cross-listing at U.S. markets as Level II and III ADRs¹, so we drop all firms that do not meet the minimum listing requirements in Nasdaq based on income, stockholder's equity, operating history, market value, total assets and total revenue (see Appendix A for the relevant Nasdaq quantitative listing criteria). All financial firms are excluded because of the high leverage they use. If a country covered in Compustat Global has never had any company listed in the U.S. as ADRs, then we drop all firms from this country because there may be certain legal and/or institutional factors that make it impossible for firms from this country to list in the U.S. markets. To identify firms that cross-list in U.S. exchanges through ADRs during our sample period, we examine the data from Security Daily dataset. The first day that a company is marked as ADR in Security Daily is used as the cross-listing date. Only level II and level III ADRs are included in this dataset. Stock price data are obtained from Security Daily. Following the method in Pagano et al. (1998), we drop the firm year observations after ADR listing once the company is cross-listed in the U.S. exchanges. We collect country level data, including GDP growth rate and exchange rates, from the World Bank database. All financial and price data are first converted to U.S. dollars using exchange rates collected from data from World Bank and Federal Reserve. Then we conduct inflation adjustment so that all the dollar amounts are expressed in 2010 value. We end up with 285,101 firm year observations, among which there are 686 new ADR listings.

2.3.2 Variables

We estimate three measures of financial constraints: payout ratio (PR), payout level (PL), and WW index as proposed in Whited and Wu (2006). As explained in Fazzari et al. (1988) and Almeida et al. (2004), higher payout ratio/level is associated with lower level of financially constraint. We calculate PR as $(\text{dividend} + \text{stock repurchase}) / \text{operating income}$. Using this measure means we have to drop firm years with negative operating income. To include firm years with negative

operating income, we calculate PL as (dividend + stock repurchase)/total assets. The WW index is calculated using the following formula from Whited and Wu (2006):

$$WW\ Index = -0.091CF - 0.062DIVPOS + 0.021TLTD - 0.044LNTA + 0.102ISG - 0.035SG \quad (1)$$

where *CF* is the ratio of cash flow to total asset, *DIVPOS* is an indicator that equals to one if the firm pays cash dividends and zero otherwise, *TLTD* is the ratio of the long-term debt to total asset, *LNTA* is the natural log of total asset, *ISG* is firm's three-digit industry sales growth and *SG* is firm's sales growth. Whited and Wu (2006) show that higher WW index is associated with higher level of financial constraint. To eliminate the impact of unreliable outliers, payout ratio, payout level and WW index are all winsorized at 1% level.

Using data from our sample, we also estimate several additional variables measuring firm characteristics and market environment. The firm characteristic variables include return on assets (ROA), sales growth (GROWTH), and Investment. ROA is estimated as EBITDA/Total Assets. GROWTH is growth rate of sales relative to the previous year. It is winsorized at 1% level. Investment is calculated as Capital Expenditure + R&D + Acquisitions – Sales of Fixed Assets – Depreciation. The market environment variables include the average Tobin's Q of firms in the U.S. domestic market (USQ), the average Q of firms in home markets (HOMEQ), and GDP growth rate in the home country (GDPG). Tobin's Q is estimated as (Book value of total assets – Book value of equity + Market value of equity)/(Book value of total assets). Market value is based on closing price at the end of June each year.

2.3.3 Summary statistics

In Table 2.1 we report the descriptive statistics of the main variables in our sample. Panel A only includes the statistics for ADR firms in the year immediately before they cross-list. Panel B is for all non-ADR firm years. If we compare the total assets of ADR firms with that of non-ADR firms, we will notice that ADR firms have higher mean but lower median. Given similar levels of minimum and maximum value, it is not clear whether the size of ADR firms is significantly different from the size of non-ADR firms. ADR firms are more profitable (higher

ROA) and have higher sales growth rate. They also make more investments than non-ADR firm. We do not see significant differences in between ADR and non-ADR firms in USQ and HOMEQ. For financial constraint variables, ADR firms have lower payout ratio, suggesting that they may be more financially constrained. Their payout level (relative to total assets) is higher. This does not necessarily contradict the payout ratio result because ADR firms are more profitable. The WW index for ADR firms is lower than that for non-ADR firms.

Table 2.1 Summary Statistics for Main Variables

This table reports the descriptive statistics of main variables for both ADR firms and non-ADR firms in our sample. Investment is calculated as (Capital Expenditure + R&D + Acquisitions – Sales of Fixed Assets – Depreciation). Both Total Assets and Investment are measured in millions and inflation adjusted to 2010 US dollars dollars. The definitions of other variables are listed in Appendix B.

Variables	Mean	Median	Min	Max	Obs.
Panel A. ADR Firms					
Total Assets	2560.973	205.336	21.424	36043.719	686
ROA	0.119	0.112	-0.816	0.672	683
GROWTH	0.166	0.058	-0.644	2.675	632
Investment	112.835	4.247	-693.780	4627.058	686
USQ	0.620	0.609	0.563	0.760	686
HOMEQ	1.5363	1.511	0.743	2.883	682
GDPG	0.079	0.054	-0.060	1.493	650
PR	0.217	0	0	2.961	672
PL	0.016	0	0	0.123	685
WW index	-0.701	-0.787	-9.618	11.937	628
Panel B. Non-ADR Firm Years					
Total Assets	1364.140	288.835	20.432	36228.351	284,415
ROA	0.088	0.083	-8.783	4.306	283,769
GROWTH	0.111	0.045	-0.644	2.675	267,978
Investment	36.022	2.213	-3530.393	17646.886	284,415
USQ	0.616	0.593	0.563	0.760	284,415
HOMEQ	1.605	1.464	0.219	12.477	282,128
GDPG	0.074	0.050	-0.196	28.209	266,388
PR	0.259	0.095	0	2.961	272,077
PL	0.012	0.003	0	0.123	284,045
WW index	-0.229	-0.410	-9.618	11.937	267,111

2.3.4 Validity of Financial Constraints Measures

The three financial constraints measures described in section 2.3.2 have been used mostly for U.S. markets. Given the differences in financial regulations and financial development across different countries, it is not immediately clear whether they are valid in a cross-country sample like ours. However, the cash flow sensitivity of cash proposed in Almeida et al. (2004) seems to be a valid measure for financial constraints even in cross-country settings. Specifically, when operating cash flow is low, those firms with higher financial constraints will find it difficult to raise cash, so their cash holding will be more likely to decrease compared with other firms, increasing their liquidity risk. Being aware of this, those firms tend to hoard cash for the rainy day when their cash flow is high. This causes high cash flow sensitivity of cash for firms with high financial constraints. The rationale here applies irrespective of cross-country differences. The caveat is, cash flow sensitivity of cash cannot be estimated for a specific firm year. In the literature cash flow sensitivity of cash is always estimated using groups of firms to make sure there are enough observations. Therefore, we estimate cash flow sensitivity of cash for groups of firms in our sample and use it to verify whether the three measures in section 2.3.2. are valid financial constraints measures for our cross-country sample.

Based on payout ratio, we first divide the sample into two groups: Low and High. The Low group includes all firm year observations in the bottom 50% PR quantile in each year. High Group includes all firm year observations in the top 50% PR quantile in each year. Then we estimate the cash flow sensitivity of cash for each group using the method of Almeida et al. (2004) and report the results in column (1) of Table 2.2. Similarly, we divide the sample into Low and High groups based on payout level and WW index and report the estimates for cash flow sensitivity of cash for each group in column (2) and column (3) of Table 2.2 respectively.

Columns (1) and (2) of Table 2.2 shows that the cash flow sensitivity of cash for firms with low payout ratio/level (Low group) is positive and significant. In contrast, the cash flow sensitivity of cash for firms with high payout ratio/level (High group) is negative and significant. The differences between the Low group and the High group are highly significant. These results suggest that financial constraints decrease with payout ratio/level for firms in our cross-country sample. This is consistent with the way we interpret payout ratio/level in measuring financial

constraints. Column (3) shows that the cash flow sensitivity for the low WW group is significantly lower than that of the high WW group, indicating that WW index increase with the level of financial constraints for firms in our sample. Again this is consistent with how WW index is used in previous studies based on data from U.S. markets. Therefore we are confident that payout ratio/level and WW index are valid measures of financial constraints for our cross-country sample.

Table 2.2 Cash Flow Sensitivity of Cash and Three Financial Constraint Measures

This table reports the cash flow sensitivity of cash for groups with low PR/PL/WW index and high PR/PL/WW index. The Low (High) group includes all firm year observations in the bottom (top) 50% quantile in each year. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

Cash Flow Sensitivity of Cash Estimate			
	Groups based on Payout Ratio (PR)	Groups based on Payout Level (PL)	Groups based on WW index
Low	0.071***	0.072***	-0.030***
High	-0.153***	-0.100***	0.062***
Low-High	0.22405***	0.172***	-0.092***

2.4 Financial Constraints and the Probability of Cross-listing

2.4.1 Regression model

We apply a logistic regression model to test the relation between financial constraints and the likelihood of cross-listing through ADRs. The regression equation of the logistic model is as follows:

$$CL_{i,t} = \alpha + \beta_1 FC_{i,t-1} + \beta_2 USQ_{t-1} + \beta_3 HOMEQ_{t-2} + \beta_4 GDPG_{t-1} + \beta_5 SOX + \beta_6 ROA_{i,t-1} + \beta_7 GROWTH + \beta_8 INVEST_{i,t-1} + \beta_9 SIZE_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

The dependent variable $CL_{i,t}$ is a dummy that equals 1 if firm i cross-lists in the U.S. markets through ADR in year t and equals 0 if it doesn't. In this sample, the average probability of cross-listing in the U.S. markets is around 0.24%. Among the independent variables, the main explanatory variable is $FC_{i,t-1}$, the one-year lagged measure for financial constraints. In different regressions we use each of the three financial constraints measures estimated earlier: PR, PL, and WW index.

The rest of the independent variables in equation (2) are control variables. We include one-year lagged USQ to control for the market timing motive of cross-listing (Fernandes and Giannetti, 2014). The two-year lagged HOMEQ is included because Sarkissian and Schill (2012) find that the pre-listing Q at the home market two year prior to the cross-listing also contributes to the likelihood that a firm will choose to time the market. One-year lagged GDPG is included to control for economic condition. SOX is a dummy variable that equals one for years after 2002 and zero otherwise. It controls for the possible increase in listing cost caused by the Sarbanes-Oxley Act of 2002 (Zhang, 2007). Several firm-specific variables are included to control for the differences among individual firms. One-year lagged ROA and one-year lagged sales growth ($GROWTH_{i,t-1}$) for each firm year are included to control for profitability and growth opportunity. $SIZE_{i,t-1}$ represents firm size lagged by one year. It is calculated as the natural log of total assets for firm i . $INVEST_{i,t-1}$ measures investments lagged by one year. It is calculated as (capital expenditure and R&D + acquisitions – depreciation – sale of fixed assets)/ total assets. $INVEST_{i,t-1}$ is included to

control for capital needs. We also control for country-by-industry fixed effects. Doing so control for the fact that different countries may have different industrial organization and policies. It also controls for the benefits from better investor protection through cross-listing, as predicted by the bonding hypothesis.

2.4.2 Regression results

The first financial constraint measure we use to estimate regression equation (2) is payout ratio (PR). The regression results are reported in Table 2.3. As a preliminary test, in column (1) we estimate the regression with only PR and fixed effects. The coefficient of PR is negative and highly significant with p-value of 0.002, suggesting that non-U.S. firms with high payout ratio are less likely to cross-list in the U.S. markets. In column (2) we include all the control variables in equation (2). The magnitude of the negative coefficient of PR actually increases in column (2) and remain highly significant. This result implies that firms with lower financial constraint is less likely to cross-list through ADR and is consistent with the constraint alleviation hypothesis.

Table 2.3 The Probability to Cross-list and Payout Ratio

This table shows the results of logistic regressions relating the probability for a foreign firm to cross-list in the U.S. through ADR to the level of financial constraints as measured by dividend payout ratio. The dependent variable is a dummy variable that equals 1 if the foreign firm cross-lists through ADR and equal to 0 otherwise. All independent variables are defined in Appendix B. Regressions in columns (1) and (2) are estimated with the entire sample. The regression in column (3) is estimated using the large firm sub-sample that includes all firm year observations in the top 50% size quantile in each year. The regression in column (4) is estimated using the small firm sub-sample that includes all firm year observations in the bottom 50% size quantile in each year. p-values are reported in parentheses. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
PR	-0.340*** (<.001)	-0.372*** (<.001)	0.059 (0.769)	-0.546*** (<.001)
USQ		0.726 (0.387)	-0.448 (0.734)	5.857*** (<.001)
HOMEQ		-1.217*** (<.001)	0.026 (0.910)	-2.598*** (<.001)
GDPG		4.776*** (<.001)	-0.004 (0.986)	14.869*** (<.001)
SOX		-2.176*** (<.001)	-2.100*** (<.001)	-3.193*** (<.001)
ROA		-2.123*** (<.001)	-2.377** (0.013)	-1.493** (0.017)
GROWTH		-0.141 (0.199)	-0.152 (0.364)	-0.140 (0.356)
INVEST		-0.271*** (0.004)	-3.817*** (<.001)	-0.637 (0.380)
SIZE		-0.532*** (<.001)	-0.918*** (<.001)	0.017 (0.864)
Country-by- industry Fixed Effects	Yes	Yes	Yes	Yes
Obs.	268,357	234,621	122,582	112,039
Pseudo R-Square	0.416	0.490	0.501	0.567

The coefficients of control variables in column (2) of Table 2.3 are more or less consistent with our expectation. Although the coefficient of USQ is insignificant, the coefficient of HOMEQ is negative and significant, suggesting that non-U.S. firms are less likely to cross-list in the U.S. if they are valued higher in their home markets. This is consistent with the market timing hypothesis. The coefficient of GDPG is positive and significant, probably because firms have more profitable opportunities and tend to raise more capital through cross-listing when the economy in their home country grows faster. Or, maybe U.S. investors will become more optimistic about the future of non-U.S. firms and more willing to invest in these firms. The coefficient of SOX is negative and significant, suggesting that non-U.S. firms are less likely to list in the U.S. after the Sarbanes-Oxley Act passed. The negative coefficient of ROA implies that highly profitable firms are less likely to cross-list in the U.S. markets. The coefficient of GROWTH is negative but not very significant. The coefficient of INVEST is negative and significant. A possible explanation is like this: the fact that some firms have high levels of investment shows that these firms can raise enough financing, so probably they are not financially constrained and don't have an urgent need to raise additional financing through cross-listing.

The coefficient of SIZE is negative and highly significant, suggesting that large firms are less likely to cross-list. This is not surprising. Size has also been used as a proxy for financial constraints in the literature (Almeida et al., 2004). Smaller firms tend to have higher financial constraints. So this result is actually consistent with the constraint alleviation hypothesis. It also gives us inspiration for additional tests. Specifically, if large firms are less likely to be financially constrained, then they are less likely to seek cross-listing for the purpose of reducing financial constraint. They may still cross-list for other reasons. In this case the relation between cross-listing and financial constraint will be weak for large firms. In contrast, small firms are likely financially constrained, so relieving financial constraint is more likely to be the motive for cross-listing based on the constraint alleviation hypothesis. Therefore, the negative relation between payout and the probability of cross-listing should be stronger for small firms. To test this prediction, we divide our sample into two sub-samples based on total assets: large firm sub-sample and small firm sub-sample. The large firm sub-sample includes all firm year observations in the top 50% size quantile and the small firm sub-sample includes all firm year observations in the bottom 50% size quantile. To make sure that the two sub-samples are not dominated by observations from certain years, we

first find the observations in the top (bottom) 50% quantile for each year. Next we aggregate the 50% country-year quantiles to get the large (small) firm subsample. Then we estimate regression equation (2) using both of the two sub-samples.

Column (3) of Table 2.3 reports the regression results for the large firm sub-sample. Consistent with our expectation, the coefficient of payout ratio becomes insignificant. In contrast, in column (4), where regression results for the small firm sub-sample is reported, the coefficient of PR is negative and highly significant with higher absolute value than the full sample result results in column (2). These results are consistent with our expectation and support the constraint alleviation hypothesis.

Table 2.4 The Probability to Cross-list and Payout Level

This table shows the results of logistic regressions relating the probability for a foreign firm to cross-list in the U.S. through ADR to the level of financial constraints as measured by dividend payout level. The dependent variable is a dummy variable that equals 1 if the foreign firm cross-lists through ADR and equal to 0 otherwise. All independent variables are defined in Appendix B. Regressions in columns (1) and (2) are estimated with the entire sample. The regression in column (3) is estimated using the large firm sub-sample that includes all firm year observations in the top 50% size quantile in each year. The regression in column (4) is estimated using the small firm sub-sample that includes all firm year observations in the bottom 50% size quantile in each year. p-values are reported in parentheses. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
PL	-8.533*** (<.001)	-7.744*** (<.001)	0.342 (0.935)	-8.534*** (<.001)
USQ		0.629 (0.449)	-0.556 (0.667)	5.596*** (<.001)
HOMEQ		-1.191*** (<.001)	-0.009 (0.969)	-2.521*** (<.001)
GDPG		4.762*** (<.001)	0.003 (0.990)	14.311*** (<.001)
SOX		-2.213*** (<.001)	-2.127*** (<.001)	-3.266*** (<.001)
ROA		-1.546*** (0.003)	-2.179** (0.030)	-1.077 (0.107)
GROWTH		-0.143 (0.191)	-0.152 (0.364)	-0.130 (0.391)
INVEST		-0.254*** (0.005)	-3.670*** (<.001)	-0.622 (0.390)
SIZE		-0.548*** (<.001)	-0.926*** (<.001)	-0.050 (0.610)
Country-by- industry Fixed Effects	Yes	Yes	Yes	Yes
Obs.	280,095	246,119	128,343	117,776
Pseudo R-Square	0.418	0.491	0.500	0.569

The payout ratio used in Table 2.3 requires positive operating income, causing a loss of about 12,000 firm year observations. To explore whether our results are affected by these missing observations, we use payout level (PL) as the measure for financial constraints and redo the four regressions in Table 2.3. The results are reported in Table 2.4. In column (1) of Table 2.4, the coefficient of payout level is negative and highly significant when only payout level and fixed effects are considered. In column (2), the coefficient of payout level remain negative and significant after the control variables are included. Columns (3) shows that there is no significant relation between cross-listing and payout level. Column (4) shows highly significant negative relation between cross-listing and payout level, suggesting that the result for the full sample is driven by small firms. These results are similar to those in Table 2.3 and are consistent with the constraint alleviation hypothesis.

The financial constraint measures for results in both Table 2.3 and Table 2.4 are based on payouts. They are not perfect measures and may capture other firm characteristics such as growth opportunity. To make out tests more robust, we also redo the logistic regression using WW index as the measure of financial constraints. Because the estimate of WW index already includes cash flow to total asset, log of total asset, and firm's sales growth, we drop ROA, GROWTH, and SIZE from the regression model to avoid biases caused by mechanical correlation. The regression results are reported in Table 2.5.

When we consider only WW index and fixed effects in the regression, the coefficient of WW index is positive and highly significant in column (1) of Table 2.5. After we add the control variables, the coefficient of WW index remains positive and significant. Consistent with the constraint alleviation hypothesis, these results suggest that firms with higher financial constraints are more likely to cross-list in the U.S. markets. The coefficient of WW index becomes insignificant for the large firm sub-sample in column (3) but remain positive and significant for the small firm sub-sample in column (4). Again, the results are consistent with the prediction that financial constraint alleviation is an important motive for small firms to cross-list.

Table 2.5 The Probability to Cross-list and WW Index

This table shows the results of logistic regressions relating the probability for a foreign firm to cross-list in the U.S. through ADR to the level of financial constraints as measured by WW index. The dependent variable is a dummy variable that equals 1 if the foreign firm cross-lists through ADR and equal to 0 otherwise. All independent variables are defined in Appendix B. Regressions in columns (1) and (2) are estimated with the entire sample. The regression in column (3) is estimated using the large firm sub-sample that includes all firm year observations in the top 50% size quantile in each year. The regression in column (4) is estimated using the small firm sub-sample that includes all firm year observations in the bottom 50% size quantile for in each year. p-values are reported in parentheses. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
WW index	0.084*** (<.001)	0.061*** (<.001)	0.027 (0.308)	0.067*** (0.004)
USQ		0.757 (0.356)	-0.636 (0.609)	8.144*** (<.001)
HOMEQ		-1.285*** (<.001)	-0.091 (0.677)	-3.439*** (<.001)
GDPG		3.549*** (0.002)	0.004 (0.984)	14.057*** (<.001)
SOX		-1.741*** (<.001)	-1.587*** (<.001)	-2.981*** (<.001)
INVEST		-0.239*** (0.008)	-2.813*** (<.001)	-2.230*** (<.001)
Country-by- industry Fixed Effects	Yes	Yes	Yes	Yes
Obs.	263,386	245,925	125,459	120,466
Pseudo R-Square	0.419	0.466	0.451	0.571

2.5 Change in Financial Constraints after Cross-listing

2.5.1 Changes in Payout Ratio, Payout Level and WW Index

We have shown that non-U.S. firms with high financial constraints are more likely to cross-list in U.S. exchanges. If alleviation of financial constraints is indeed one of the motives for cross-listing, then ADR firms, which include most of the non-U.S. firms cross-listed in the U.S., should see their financial constraints decrease after cross-listing. To test this prediction, we construct a sample of firm years for all ADR firms in the Compustat Global database for both the years before cross-listing and years after cross-listing. The sample contains 9616 firm years. Then we calculate their payout ratio, payout level, and WW index in all the firm years. Next we estimate the following regression model to find out whether financial constraints decrease after cross-listing:

$$FC_{i,t} = \alpha + \beta_1 CL_{i,t} + \Sigma \beta_2 Control_{i,t} + \varepsilon_{i,t} \quad (3)$$

In this regression model the dependent variable $FC_{i,t}$ is again the measure of financial constraint. $CL_{i,t}$ is the dummy variable that equals 1 if a firm is cross-listed, otherwise 0. The change in financial constraints following cross-listing should be reflected in the coefficient of $CL_{i,t}$. $Control_{i,t}$ are other control variables, including Tobin's Q, market value scaled by GDP, GDP growth, ROA, sales growth, leverage, firm size, investment, and firm fixed effects. The regression results are reported in Table 2.6.

In Table 2.6, payout ratio is used as the measure of financial constraint. In column (1), we estimate regression (3) using the entire ADR sample. The coefficient of CL is positive and significant at 0.03. Given the average payout ratio of 0.217 for ADR firms in Table 1, this result suggests that ADR firms increase their payout ratio by about 13.8% after cross-listing.

Because the evidence in Tables 2.3, 2.4, and 2.5 suggests that alleviation of financial constraints is more likely to be the motive for small firms to cross-list, we also divide the ADR sample into two sub-samples: small firm sub-sample and large sub-sample, based on total assets in the cross-listing year. We first find the firms in the top (bottom) 50% quantile for each cross-listing year. Then we aggregate the 50% country-year quantiles to get the large (small) firm

subsample. We estimate regression equation (3) for both the large firm sub-sample and the small firm sub-sample. The results are reported in column (2) and column (3) of Table 6. The coefficient of CL is positive and significant in column (3), suggesting that only small firms increase payout ratio. This is consistent with the argument that only small firms benefit through cross-listing in terms of reducing financial constraint.

Table 2.6 Change in Financial Constraints after Cross-listing with Payout Ratio

This table reports the results of regressions testing the change in financial constraint measures after cross-listing in the U.S. through ADR. The dependent variable is payout ratio. CL is a dummy that equals 0 for firm years before cross-listing in the U.S. and 1 for firm years after cross-listing in the U.S. Other control variables are defined in Appendix B. The regression in column (1) is estimated with the sample of all firm year observations for companies cross-listed in the U.S. The regression in column (2) is estimated using the large firm sub-sample that includes all firm year observations in the top 50% size quantile each year. The regression in column (3) is estimated using the small firm sub-sample that includes all firm year observations in the bottom 50% size quantile in each year. The regressions in column (4) is estimated using the large firm sub-sample but excludes the cross-listing years. The regression in column (5) is estimated using the small firm sub-sample but excludes the cross-listing years. p-values are reported in parentheses. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
CL	0.030*** (<.001)	0.024* (0.060)	0.037*** (0.003)	0.015 (0.285)	0.032** (0.019)
Q	0.000 (0.893)	0.000 (0.985)	-0.000 (0.232)	0.000 (0.968)	-0.000 (0.262)
MAKTCAP/GDP	-0.000*** (0.007)	-0.000** (0.030)	0.104 (0.325)	-0.000** (0.021)	0.096 (0.371)
GDPG	-0.008 (0.130)	-0.008 (0.137)	-0.135 (0.226)	-0.008 (0.162)	-0.120 (0.303)
ROA	-0.011 (0.737)	-0.135** (0.040)	0.042 (0.277)	-0.111* (0.100)	0.034 (0.473)
GROWTH	-0.000 (0.474)	-0.001 (0.369)	-0.000 (0.934)	-0.001 (0.483)	-0.000 (0.928)
LEV	-0.078*** (<.001)	-0.149*** (<.001)	-0.041* (0.081)	-0.130*** (<.001)	-0.046* (0.053)
SIZE	0.022*** (<.001)	0.018*** (0.002)	0.027*** (0.004)	0.019*** (0.002)	0.027*** (0.004)
INVEST	0.030 (0.485)	-0.003 (0.971)	0.068 (0.194)	0.049 (0.535)	0.049 (0.377)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Obs.	7,893	4,161	3,732	3,932	3,478
Adj. R-Square	0.302	0.304	0.286	0.299	0.281

A possible caveat to the results above is that ADR firms may raise a lot of new capital through cross-listing itself. This relief of financial constraint may be temporary but may still drive our results. To address this concern, we delete the observations for the cross-listing year from our sample and redo the regressions for large and small firm sub-samples. The results are reported in columns (4) and (5). The two columns show that the coefficient of CL in column (5) remains positive and significant after deleting the cross-listing year observations, suggesting that the increase in payout ratio for small firms is permanent.

In Table 2.7 we redo the regressions using payout level as the measure of financial constraint. We get similar results. ADR firms significantly increase their payout level after cross-listing and only small firms see increase in payout level after cross-listing. The pattern holds after we drop the cross-listing year observations.

In Table 2.8 we report the regression results using WW index as the measure of financial constraint. Consistent with results in Table 2.6 and Table 2.7, the coefficient of CL is negative and significant in column (1), suggesting that ADR firms have lower financial constraints after cross-listing. Column (2) of Table 8 shows that large ADR firms also see their WW index decrease after cross-listing but only significant at 10% level. Consistent with earlier results for small firms, the coefficient of CL in column (3) is negative and significant at 1% level, implying that small firms benefit much more from cross-listing in terms of financial constraints alleviation. In column (4) and column (5), the cross-listing year observations are dropped. The coefficients of CL are both negative and significant, indicating that both large firms and small firms have decrease in financial constraints. However, small firms have larger decrease in WW index after cross-listing, again suggesting that small firms benefit more than large firms in terms of reducing financial constraints.

Table 2.7 Change in Financial Constraints after Cross-listing with Payout Level

This table reports the results of regressions testing the change in financial constraint measures after cross-listing in the U.S. through ADR. The dependent variable is payout level. CL is a dummy that equals 0 for firm years before cross-listing in the U.S. and 1 for firm years after cross-listing in the U.S. Other control variables are defined in Appendix B. The regression in column (1) is estimated with the sample of all firm year observations for companies cross-listed in the U.S. The regression in column (2) is estimated using the large firm sub-sample that includes all firm year observations in the top 50% size quantile each year. The regression in column (3) is estimated using the small firm sub-sample that includes all firm year observations in the bottom 50% size quantile in each year. The regression in column (4) is estimated using the large firm sub-sample but excludes the cross-listing years. The regression in column (5) is estimated using the small firm sub-sample but excludes the cross-listing years. p-values are reported in parentheses. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
CL	0.003*** (<.001)	0.001 (0.384)	0.005*** (<.001)	0.001 (0.594)	0.004*** (0.001)
Q	-0.000** (0.028)	-0.000** (0.020)	-0.000 (0.380)	-0.000** (0.018)	-0.000 (0.401)
MKTCAP/GDP	0.000 (0.149)	0.000 (0.245)	0.010 (0.328)	0.000 (0.256)	0.010 (0.340)
GDPG	-0.000 (0.776)	-0.000 (0.746)	-0.011 (0.290)	-0.000 (0.820)	-0.012 (0.266)
ROA	0.038*** (<.001)	0.064*** (<.001)	0.029*** (<.001)	0.064*** (<.001)	0.038*** (<.001)
GROWTH	-0.000 (0.624)	-0.000 (0.534)	-0.000 (0.913)	-0.000 (0.594)	-0.000 (0.873)
LEV	-0.008*** (<.001)	-0.015*** (<.001)	-0.005** (0.028)	-0.014*** (<.001)	-0.004* (0.078)
SIZE	-0.000 (0.816)	0.000 (0.885)	0.001 (0.431)	-0.000 (0.927)	0.001 (0.373)
INVEST	0.015*** (<.001)	0.007 (0.261)	0.017*** (<.001)	0.011* (0.097)	0.019*** (<.001)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Obs.	7,893	4,161	3,732	3,932	3,478
Adj. R-Square	0.159	0.238	0.155	0.238	0.168

Table 2.8 Change in Financial Constraints after Cross-listing with WW Index

This table reports the results of regressions testing the change in financial constraint measures after cross-listing in the U.S. through ADR. The dependent variable is WW index. CL is a dummy that equals 0 for firm years before cross-listing in the U.S. and 1 for firm years after cross-listing in the U.S. Other control variables are defined in Appendix B. The regression in column (1) is estimated with the sample of all firm year observations for companies cross-listed in the U.S. The regression in column (2) is estimated using the large firm sub-sample that includes all firm year observations in the top 50% size quantile each year. The regression in column (3) is estimated using the small firm sub-sample that includes all firm year observations in the bottom 50% size quantile in each year. The regression in column (4) is estimated using the large firm sub-sample but excludes the cross-listing years. The regression in column (5) is estimated using the small firm sub-sample but excludes the cross-listing years. p-values are reported in parentheses. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
CL	-0.431*** (<.001)	-0.182* (0.072)	-0.597*** (<.001)	-0.179 (0.105)	-0.597*** (<.001)
Q	0.000*** (<.001)	0.000*** (<.001)	-0.000 (0.517)	0.000*** (<.001)	-0.000 (0.578)
MKTCAP/G DP	-0.0004*** (<.001)	-0.000*** (<.001)	-1.625 (0.136)	-0.000*** (<.001)	-1.860* (0.090)
GDPG	0.210*** (<.001)	0.192*** (<.001)	10.245*** (<.001)	0.197*** (<.001)	9.434*** (<.001)
INVEST	-0.817** (0.031)	-0.364 (0.578)	-1.280*** (0.007)	-0.032 (0.963)	-1.214** (0.014)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Obs.	8,005	4,181	3,824	3,951	3,561
Adj. R- Square	0.166	0.144	0.202	0.143	0.204

2.5.2 Cash Flow Sensitivity of Cash

For now, all of our results are based on the same three measures of financial constraints: payout ratio, payout level, and WW index. The first two measures are both based on payouts. Even the estimates of WW index include inputs from an indicator that equals to one if the firm pays cash dividends and zero otherwise. If dividend is related to cross-listing through any channel other than financial constraints, then we cannot confidently interpret our results as evidence supporting the constraints alleviation hypothesis. Actually, because Aggarwal et al. (2012) provide evidence that ADR firms with poorer information environments have stronger incentives to adopt dividend increases as a credible signaling device, the results above can be interpreted as cross-listed firms' signal to show their quality improvements. However, this interpretation is not consistent with the results in the literature (Sarkissian and Schill, 2016, 2009) that firms tend to have lower stock returns after cross-listing. We address this issue from a different angle by using the cash flow sensitivity of cash from Almeida et al. (2004) to measure financial constraints without inputs from dividend. If cross-listing can reduce financial constraints, firms should have lower cash flow sensitivity of cash after cross-listing. So we construct the following regression model to examine the change in financial constraints around cross-listing:

$$\begin{aligned} \Delta CASH_{i,t} = & \alpha_0 + \beta_1(CL_{i,t} \times CF_{i,t}) + \beta_2 CF_{i,t} + \beta_3 CL_{i,t} + \beta_4 Q_{i,t} + \beta_5 MKTCAP/GDP_{i,t} + \\ & \beta_6 GDPG_{i,t} + \beta_7 ROA_{i,t} + \beta_8 GROWTH_{i,t} + \beta_9 LEV_{i,t} + \beta_{10} SIZE_{i,t} + \sum \beta_{11} INVEST_i + \varepsilon_{i,t} \end{aligned} \quad (4)$$

Model (4) is based on the cash flow sensitivity of cash model in Almeida et al. (2004). $\Delta CASH_{i,t}$ is the change in cash and marketable securities for firm i in year t , divided by total assets. $CF_{i,t}$ is cash flow to firm i in year t . Q is estimated as the market value divided by the book value of assets. $MKTCAP/GDP_{i,t}$ is calculated as the value of listed shares to GDP. $LEV_{i,t}$ is leverage, calculated as the sum of long-term debt and current liabilities, the divided by total assets. Other variables are defined the same way as in earlier regressions. We also control for firm fixed effects. Our focus is the interaction variable $CL_{i,t} \times CF_{i,t}$, whose coefficient should be negative and significant if ADR

firms have lower financial constraints after cross-listing. The regression results are reported in Table 2.9.

In column (1) of Table 2.9 we report the regression results using the whole ADR sample. The coefficient of CF*CL is negative and significant in column (1), suggesting that cash flow sensitivity of cash decreases after firms cross-list through ADR. Column (2) reports the regression results using the large firm sub-sample. The coefficient of CF*CL becomes insignificant in column (2). When we estimate the regression using the small firm sub-sample, the coefficient of CF*CL becomes significant again in column (3), suggesting that it is small firms that experience decrease in cash flow sensitivity of cash after cross-listing. If we drop the cross-listing year observations, we see the same pattern. Overall the results are consistent with the constraints alleviation hypothesis and suggest that small firms benefit more from cross-listing in terms of reducing financial constraints.

Table 2.9 Change in Cashflow Sensitivity of Cash after Cross-listing

This table reports the results of regressions testing the change in cashflow sensitivity of cash after cross-listing. The dependent variable is the year-over-year change in cash and marketable securities, divided by total assets. All independent variables are defined in Appendix B. The regression in column (1) is estimated with the sample of all firm year observations for companies cross-listed in the U.S. The regression in column (2) is estimated using the large firm sub-sample that includes all firm year observations in the top 50% size quantile each year. The regression in column (3) is estimated using the small firm sub-sample that includes all firm year observations in the bottom 50% size quantile in each year. The regression in column (4) is estimated using the large firm sub-sample but excludes the cross-listing years. The regression in column (5) is estimated using the small firm sub-sample but excludes the cross-listing years. p-values are reported in parentheses. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
CF*CL	-0.037** (0.049)	0.008 (0.784)	-0.067** (0.010)	0.011 (0.730)	-0.049* (0.076)
CF	0.130*** (0.002)	0.204*** (<.001)	0.066 (0.353)	0.195*** (<.001)	0.072 (0.320)
CL	-0.007** (0.026)	-0.006 (0.182)	-0.016*** (<.001)	-0.011** (0.027)	-0.022*** (<.001)
Q	0.006*** (<.001)	0.005*** (0.008)	0.005* (0.086)	0.005** (0.011)	0.006* (0.064)
MKTCAP/G DP	0.000** (0.041)	0.000*** (<.001)	0.386** (0.018)	0.000*** (<.001)	0.437*** (0.007)
GDPG	-0.026*** (<.001)	-0.024*** (<.001)	-0.047 (0.341)	-0.025*** (<.001)	-0.084* (0.095)
ROA	0.002 (0.957)	-0.077 (0.119)	0.064 (0.365)	-0.071 (0.161)	0.063 (0.378)
GROWTH	0.000 (0.237)	0.000 (0.390)	0.002** (0.044)	0.000 (0.414)	0.002** (0.032)
LEV	-0.011** (0.039)	-0.023*** (0.005)	-0.005 (0.485)	-0.024*** (0.005)	-0.002 (0.749)
SIZE	0.010*** (<.001)	0.004*** (0.007)	0.028*** (<.001)	0.005*** (0.002)	0.027*** (<.001)
INVEST	-0.207*** (<.001)	-0.173*** (<.001)	-0.240*** (<.001)	-0.180*** (<.001)	-0.252*** (<.001)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Obs.	8,058	4,293	3,765	4,019	3,491
Adj. R- Square	0.060	0.061	0.066	0.063	0.084

2.6 Conclusions

We examine the relation between financial constraints and cross-listing. Using a sample of 285,101 firm year observations from firms worldwide, we find that firms with higher financial constraints are more likely to cross-list in U.S. exchanges through ADR. This pattern is driven by small firms. After non-U.S. firms cross-list in the U.S., they experience decrease in financial constraints. Small firms see more decrease in financial constraints than large firms. These results are consistent with the hypothesis that reducing financial constraints is among the motives for cross-listing, especially for small firms.

2.7 Appendix

2.7.1 Appendix A. Nasdaq Quantitative Listing Criteria Relevant for ADRs¹

4420. Quantitative Listing Criteria

In order to be listed on the Nasdaq National Market, an issuer shall be required to substantially meet the criteria set forth in paragraphs (a), (b), (c), (d), (e), (f), (g), (h), (i), (j), (k) or (l) below.

(a) Entry Standard 1- First Class of Common Stock, Shares or Certificates of Beneficial Interest of Trusts, Limited Partnership Interests in Foreign or Domestic Issues and American Depositary Receipts

(1) The issuer of the security had annual income from continuing operations before income taxes of at least \$1,000,000 in the most recently completed fiscal year or in two of the last three most recently completed fiscal years.

(2) There are at least 1,100,000 publicly held shares.

(3) The market value of publicly held shares is at least \$8 million.

(4) The bid price per share is \$5 or more.

(5) The issuer of the security has stockholders' equity of at least \$15 million.

(6) The issuer has a minimum of 400 round lot shareholders.

(7) There are at least three registered and active market makers with respect to the security.

(b) Entry Standard 2- First Class of Common Stock, Shares or Certificates of Beneficial Interest of Trusts, Limited Partnership Interests in Foreign or Domestic Issues and American Depositary Receipts

(1) The issuer of the security has stockholders' equity of at least \$30 million.

(2) There are at least 1,100,000 publicly held shares.

(3) The market value of publicly held shares is at least \$18 million.

¹ Taken from Nasdaq Marketplace Rules available at https://www.sec.gov/rules/other/nasdaqllcf1a4_5/nasdaqllcamendrules4000.pdf

- (4) The bid price per share is \$5 or more.
 - (5) There are at least three registered and active market makers with respect to the security.
 - (6) The issuer has a two-year operating history.
 - (7) The issuer has a minimum of 400 round lot shareholders.
- (c) Entry Standard 3 - First Class of Common Stock, Shares or Certificates of Beneficial Interest of Trusts, Limited Partnership Interests in Foreign or Domestic Issues and American Depositary Receipts

An issuer listed under this paragraph does not also need to be in compliance with the quantitative criteria for initial listing in the Rule 4300 series.

- (1) There are at least 1,100,000 publicly held shares.
- (2) The market value of publicly held shares is at least \$20 million.
- (3) The bid price per share is \$5 or more.
- (4) There are at least four registered and active market makers with respect to the security.
- (5) The issuer has a minimum of 400 round lot shareholders.
- (6) The issuer has:
 - (A) a market value of listed securities of \$75 million (currently traded issuers must meet this requirement and the bid price requirement under Rule 4420(c)(3) for 90 consecutive trading days prior to applying for listing); or
 - (B) total assets and total revenue of \$75 million each for the most recently completed fiscal year or two of the last three most recently completed fiscal years.

2.7.2 Appendix B. Variable Definition

Variable Names	Variable Definitions
<i>CF</i>	Cash flow
<i>CL</i>	Dummy variable that equals 1 if a firm is cross-listed, otherwise 0.
<i>PR</i>	The payout ratio is calculated as (dividend + stock repurchase)/operating income. It is winsorized at 1% level. Firm years with negative payout ratio are dropped.
<i>PL</i>	The payout level is calculated as (total dividend + stock repurchase)/total assets, lagged by one year. It is winsorized at 1% level.
<i>GDPG</i>	GDP growth rate in the home country
<i>HOMEQ</i>	Average Tobin's Q of firms in home markets
<i>INVEST</i>	Capital Expenditure + R&D + Acquisitions – Sales of Fixed Assets - Depreciation, scaled by total assets.
<i>LEV</i>	Leverage, estimated as the sum of long-term debt and current liabilities, divided by total assets
<i>MKTCAP/GDP</i>	The value of listed shares to GDP
<i>ROA</i>	Return on assets, estimated as EBITDA/Total Assets
<i>GROWTH</i>	Growth rate of sales relative to the previous year. It is winsorized at 1% level.
<i>SIZE</i>	Natural log of total asset
<i>SOX</i>	Dummy that equals 1 for years after 2002, zero otherwise.
<i>Q</i>	Tobin's Q, estimated as $\frac{\text{Book value of total assets} - \text{Book value of equity} + \text{Market value of equity}}{\text{Book value of total assets}}$, market value is based on closing price at the end of June each year
<i>USQ</i>	Average Tobin's Q of firms in the U.S. market.
<i>WW index</i>	The Whited-Wu index is calculated as $(-0.091 * CF) - (0.062 * DIVPOS) + (0.021 * TLTD) - (0.044 * LNTA) + (0.102 * ISG) - (0.035 * SG)$ where CF is a ratio of cash flow divided by total assets; DIVPOS is dummy that equals to one if the firm pays a dividend, else zero; TLTD is long-term debt to total assets; LNTA is the natural log of total assets; ISG is the three digit SIC industry sales growth; and SG is the firm sales growth. The WW index is winsorized at 1% level. Higher values of the WW index imply greater levels of financial constraint.

Chapter 3 Near-term Cash Shortage and Post-IPO Long-run Stock Performance

3.1 Introduction

It is widely known that there are three important anomalies in the market of initial public offerings (IPOs). The first anomaly is that IPOs are generally underpriced, whether in developed markets or in emerging markets. The second anomaly is that IPO activity seems to follow cycles, hot and cold. A “hot issue” market refers to the period when the demand of IPOs is very high, making the offer price higher, IPO volume larger or both. The third anomaly in IPO market is the post-IPO long-run underperformance. A huge amount of studies has examined those subjects and obtained various evidence and explanations. This paper mainly focuses on the third anomaly-post-IPO long-run underperformance and investigate the contributing factors from a new perspective.

This study is initially motivated by the research of DeAngelo, DeAngelo and Stulz (2010). They suggest that most of the firms run out of cash after they issue seasonal equity offerings (SEOs) and therefore firms conduct SEOs primarily to meet a near-term need for cash. Because of the similarities between IPOs and SEOs, we propose our first research question: does a near-term cash shortage also exist for firms before IPO issue?

There is a large body of literature on long-run stock performance after new equity issuance. Two typical theories to explain this anomaly are divergence of opinion hypothesis (Miller, 1977; Houge et al., 2001; Bradley et al., 2001; Field and Hanka, 2001; Brav and Gompers; 2003) and market timing hypothesis (Schultz, 2003; Altı's; 2005). Other empirical studies also propose various factors that affect long-run underperformance after equity issuance, such as post-issue operating performance (Jain and Kini, 1994), discretionary accruals (Teoh, Welch and Wong, 1998), new cash raised from IPO offerings (Zheng, 2007), less prestigious underwriters and non-venture-backed feature (Chan et al., 2008). If IPO firms do have a near-term cash shortage before IPO issuance, it is worth questioning if that feature is correlated with long-run stock performance. Chen, Jacoby and Zheng (2016) provide evidence that SEO firms with short-term cash shortage before SEO have poor post-SEO long-run stock performance, which is explained by market underreaction hypothesis. This paper encourages us to investigate the relation between the cash status before IPO issuance and post-IPO long-run stock performance. Therefore, our second

research question is: if IPO firms do have near-term cash shortage prior to IPOs, will it affect post-IPO long-run stock underperformance?

Following DeAngelo, DeAngelo and Stulz's (2010) study, we construct a pro forma cash ratio (PFCASH) to measure the cash shortage situation for IPO firms before IPO issue. A negative PFCASH means the IPO firm will run out of cash if they don't receive the IPO proceeds after IPO issue, indicating there is a near-term cash shortage before IPO issue. In univariate analysis, we find that most IPO firms will run out of cash in the following three years after IPO issue if they don't receive IPO proceeds, suggesting that those IPO firms don't have enough cash to operate the firm so that most of the IPO proceeds are used for firm operation in the following three years after IPO issue. This result still holds even after we control for the impacts of capital expenditure change and external borrowing change. Next, we examine whether the near-term cash shortage before IPO issue will affect the post-IPO long-run performance. We use the three-year market-adjusted buy-and-hold returns after IPO issue as well as three-year size and book-to-market adjusted buy-and-hold returns to measure the post-IPO long-run stock performance. From univariate analysis, it is evident that the portfolio of IPO firms with negative PFCASH will have significantly lower long-term buy-and-hold abnormal returns than the portfolio of other IPO firms. This is also supported in regressions in which the coefficient of PFCASH is positive and statistically significant, showing the IPO firms with lower PFCASH will have worse post-IPO long-run performance. Our results can be explained by the market underreaction hypothesis, which seems to be a common phenomenon in financial market and documented by many researchers. The market underreacts to the negative information contained in the near-term cash shortage of IPO firms in the short-run. This underreaction is corrected in the long-run and is reflected in the post-IPO long-run underperformance. Further tests are also conducted to examine the relation between near-term cash shortage and operating performance. the results suggest that the near-term cash shortage is partly due to poor operating performance prior to IPOs and will negatively affect post-IPO operating performance.

This paper complements and extends the literature of IPO long-run underperformance. To the best of our knowledge, this is the first paper that directly addresses the relation between the near-term cash shortage and post-IPO long-run underperformance and provides empirical evidence of the above relationship. In addition, this paper also contributes to the literature of market

underreaction. The market inefficiency does exist during the process of IPO issue, but the non-reflected information will be finally reflected by the stock performance in the long-run.

The rest of the paper is organized as follows: in section 3.2 we review the relevant literature and propose our hypotheses; in section 3.3 we describe the process of sample selection and construction of variables; in section 3.4 we investigate the relation between the near-term cash shortage before IPO issue and post-IPO long-run stock performance; in section 3.5 we examine whether the near-term cash shortage is correlated with operating performance and in section 3.6 we conclude the paper.

3.2 Literature and Hypothesis

Since long-run underperformance is one of the three anomalies associated with IPO issues, a lot of researchers have put effort on this phenomenon and tried to figure out to what extent the IPO firms underperform the non-IPO firms in the long-run, why IPO firms have long-run underperformance after issuance, which economic or financial factors can contribute to the post-IPO long-run underperformance and so on. The influential findings from those previous theoretical or empirical literatures may comply with each other or contradict with each other, but all build a solid foundation for the research in this paper.

Based on a sample of 1,526 U.S. common stock IPOs during 1975-1984, Ritter (1991) find a 34.4% average holding period return in the 3 years after going public, comparing with the 61.86% for the control sample matched by industry and market value. It is evident that IPO firms underperform in the long-run. In consistent with Ritter's (1991) results, Levis (1993) also find long-run underperformance with UK IPO sample data, indicating it is a persistent feature of IPO issues and not just unique in U.S. IPO market. Similar conclusions are obtained by many other researchers who collect IPO data from different countries, such as Brazil (Aggarwal et al, 1993), Finland (Keloharju, 1993), Germany (Ljungqvist, 1997) and Singapore (Hin and Mahmood, 1993).

In contrast to the above significant post-IPO long-run underperformance, the studies after late 1990s cast doubt on those results and propose more comprehensive findings incorporating different measures of long-run performance and selection standards of matching firms. Brav and Gomper (1997) argue that the long-run underperformance measured by equally weighted returns of non-venture-backed IPO firms is attributable to the small growth firms which account for a large fraction of IPO firms. And this underperformance is significantly mitigated if they use value weighted returns. In Brav and Gomper's (1997) research, the Fama-French three factor model is also used to check the long-run performance and the results show that the portfolio of small growth firms does underperform (negative intercepts) no matter with or without IPO firms in the portfolio. Analyzing both IPO and SEO firms, Brav, Geczy and Gompers (2000) find that the long-run underperformance is mainly driven by small firms with low book-to-market ratios. Brav (2000) and Ritter and Welch (2002) both suggest that the poor long-run performance of IPO firms is similar to benchmark in which the firms are matched with market capitalization and book-to-market values. After controlling for the size and liquidity effect of matching firms, Eckbo and Norli (2001) also conclude that the benchmark performs as poorly as IPO firms do. In Ritter's

(2011) review paper, he documents two different measures of long-run abnormal returns. One is the difference of buy-and-hold returns between IPO firms and characteristic-matched firms, and the result exhibits a -7.1% average 3-year buy-and-hold abnormal returns (approximately -20 basis points per month). The other is calculated using Fama-French three-factor model which results in an average abnormal return of a -21bp/month (Ritter and Welch, 2002). Therefore, the post-IPO long-run performance is sensitive to the alternative measures of abnormal returns and to the alternative comparable benchmarks with different matching conditions.

Referring to the causes of the post-IPO long-run underperformance, there are several different explanations proposed by prior literatures. A very early theory that can be used to explain the long-run underperformance is introduced by Miller (1977). In his theory, it is assumed that there is a high heterogeneity on investors' expectations regarding the IPO values. And the investors who purchase the IPOs are most optimistic. As time goes on, more and more investors can attend the trading activities so that the pessimistic investors' expectation is reflected in the stock price and the optimistic investors also lower their valuations of the firms. As a result, IPO firm definitely underperform in the long run. Supporting Miller's (1977) proposal, Houge, Loughran, Suchanek, and Yan (2001) suggest that greater divergence of opinion or uncertainty about an IPO can lead to short-run overvaluation and long-run underperformance. Besides, Bradley et al. (2001), Field and Hanka (2001), and Brav and Gompers (2003) all find that stock price decreases significantly at the end of lockup period since the supply constraint is diminished and more shares are available to the public, which is also consistent with Miller's (1977) theory.

According to Ritter and Welch (2002), another semi-rational explanation for the post-IPO long-run underperformance is the pseudo market timing proposed by Schultz (2003). Schultz (2003) argues that following successful IPOs, more and more firms go public in order to receive higher share price and this doesn't stop until the price finally falls down. Apparently, ex post IPO volume is high before the period of negative abnormal returns and this will easily lead to underperformance even in efficient market. However, this theory is criticized by many researchers. For example, Ritter and Welch (2002) suggest that the pseudo market timing explanation cannot hold if each time period is equally weighted. Loughran, Ritter and Rydqvist (1994) and Baker and Wurgler (2000) show that Schultz's (2003) analysis doesn't applicable to the time-series regression which is used to capture long-run performance. And the fact that IPO volume process is generally stationary or mean reversion is also contrary to Schultz's (2003) arguments.

Other papers that find out variables predicting the post-IPO long-run underperformance also contribute to explain the source of that IPO anomaly as well. Jain and Kini (1994) relate the long-run underperformance to the substantial decline of post-issue operating performance relative to pre-issue ones. Teoh, Welch and Wong (1998) argue that discretionary accruals which can raise reported earnings relative to actual cash flows before IPO issue are significantly and negatively related to the cross-sectional variation in post-IPO long-run stock return performance. Firms with large earning management before IPO issue have low post-IPO long-run stock return performance. Similar results are also revealed with sample of seasonal equity offerings (SEOs) (Teoh, Welch and Wong, 1998). Both of Teoh, Welch and Wong's (1998) findings support the market over optimism view of Ritter (1991). Brav and Gomper (1997) find that venture-backed IPOs outperform non-venture-backed IPOs using equally weighted returns, while Ritter (2011) obtain opposite pattern that venture-backed IPOs underperform non-venture-backed IPOs during 2001-2008 no matter using market-adjusted returns or style-adjusted returns. Both papers indicate that whether the IPO firm is venture backed or not has a significant influence on the post-IPO long-run performance. Focusing on U.S. IPOs from 1980-2000, Chan, Cooney, Kim and Singh (2008) report that the most negative abnormal returns of IPOs are driven by high discretionary accruals, less prestigious underwriters and non-venture-backed feature. In addition, Zheng (2007) find out a significant negative relation between the new cash raised from IPO offering and IPO long-run performance, from the market underreaction view.

The motivation of this paper is actually based on the research of DeAngelo, DeAngelo and Stulz (2010). They find that most of the issue firms run out of cash after SEOs and therefore firms conduct seasonal equity offerings (SEOs) primarily to meet a near-term need for cash. Although market timing opportunities and corporate lifecycle stages have substantial influence on the decision of SEO issue, they can only be regarded as the motivations in the second place. Since IPOs and SEOs have many features in common, it is reasonable to doubt if the near-term cash shortage phenomena also exists for IPOs and therefore affects the long-run performance of IPOs.

Similar to IPOs, SEOs also has three main anomalies from the empirical view. For the underpricing anomaly, in 1977, Smith find the significant underpricing of SEOs in United States for the first time. Loderer, Sheehan, and Kadlec (1991) document that SEOs listed in NASDAQ market are significantly underpriced by 2.96 percent. Corwin (2003) report an average of 2.2 percent underpricing for SEOs during 1980s and 1990s, and the magnitude of the underpricing

increases substantially over time. For the offering cycle anomaly, Howe and Zhang (2010) show that SEOs has similar issue cycles with IPOs although it is less volatile. Their findings strongly support the demand of capital and market timing hypotheses when explaining SEO volume. For the long-run underperformance anomaly, Loughran and Ritter (1995) find that during 1970 to 1990, SEO firms have an average of 7 percent 5-year long-run return after the issue, which is slightly higher than the 5 percent for IPO firms. Spiess and Affleck-Graves (1995) show the SEO long-run underperformance persists even they control for the industry, firm size, firm age and book-to-market ratio.

With the above similarity between IPOs and SEOs and the research of DeAngelo, DeAngelo and Stulz (2010) in mind, we propose the first hypothesis that the near-term cash shortage also exists for IPO issue firms, and market underreacts to the negative information contained in the near-term cash shortage in the short-run.

Market inefficiency has been a very general phenomenon in financial market, and it has been certified in a lot of empirical literature. Watts (1978) show that market does underreact to the quarterly earnings announcements. Ikenberry et al. (1995) find that market underreacts to the open market share repurchase announcements during 1980-1990. Much information conveyed through those announcements are neglected by the markets. Taffler, Lu and Kausar (2004) also report market underreaction following going-concern audit report disclosures in UK markets. Fama (1998) investigate the relation between the market inefficiency and long-term return anomalies and demonstrate that pre-event abnormal returns will be reversed long time after the event because of market underreaction. Supporting Fama's (1998) research, Asquith et al. (1983) find five-year significantly negative abnormal returns for acquiring firms following merger announcements. Zheng (2007) also suggest IPO long-run underperformance is positively and significantly related to the new cash raised from the offerings, which is already mentioned before. The most important literature that is associated with our research is Chen, Jacoby and Zheng's (2016) working paper. They provide empirical evidence that firms that have short-term cash shortage prior to SEO have poor post-SEO long-run stock performance.

As a result, based on the first hypothesis, we also raise the second hypothesis that the near-term cash shortage will be negatively related to the post-IPO long-run stock performance. The firm with more cash need before IPO issue will highly underperform in the long-term.

To the best of our knowledge, there is no literature directly addressing the relation between

the near-term cash shortage and IPO long-run performance. This paper is the first one introducing the above gap and providing the empirical evidence to close that gap. In addition, this paper also contributes to literature of market underreaction theory. The market overlooks the near-term cash shortage of IPO firms and underreacts to the information conveyed in cash levels, which will be revealed and reflected by post-IPO long-run underperformance.

3.3 Data and Sample

3.3.1 Sample Selection

From the Thomson Financial SDC Platinum (SDC) database, there are total 9,967 IPO firms in U.S. from 1980 to 2012. The financial data and stock information of those IPO firms are obtained from Compustat database and the Center for Research in Security Prices (CRSP) database, respectively.

Several sample selection conditions should be satisfied before reaching to the final sample. As showed below, an IPO firm in the final sample must:

- (1) be listed in CRSP within 30 days since the IPO issue date;
- (2) not issue penny stocks (offer price less than 5 dollars);
- (3) issue ordinary common shares, i.e., not be a right issue, unit issue, unit investment issue, closed-end fund trust issue, real estate investment trust (REIT) issue or American depositary Receipt (ADR);
- (4) be a non-financial firm;
- (5) be a non-utility firm.

Table 3.1 illustrates the details about the sample selection process and relevant number of IPO firms remained in the sample. After applying the above conditions, there are 5,254 IPO firms left in the sample. Since most of the variables are calculated with financial data from Compustat database, the IPO firms should have GVKEY² available to merge with Compustat data. As a result, the IPO firms that have no GVKEY number are deleted and 4,794 IPO firms are remained in the sample. The whole sample shrinking procedures are consistent with prior IPO literature.

² The Global Company Key (GVKEY) is a unique six-digit number key assigned to each company (issue, currency, index) in the Capital IQ Compustat database.

Table 3.1 Sample Selection Procedure

This table summarizes the detailed steps in selecting the IPO sample by using Thomson Financial Securities Data Corporation (SDC) Platinum, Compustat and CRSP databases.

Description	# of firms
1. U.S. IPOs in SDC Global New Issue database during the period of 1980 to 2012	9967
2. Merge sample with CRSP and requiring firms to be listed in CRSP within 30 days since the IPO issue date	7611
3. Sample firms after removing penny stocks (offer price less than 5 dollars)	7256
4. Sample firms after removing right issues, unit issues, unit investment issues, depositary issues, closed-end fund trust issues, and REIT issues	6224
5. Sample firms after removing financial firms (SIC code between 6000 and 6799) and utility firms (SIC code from 4800 to 4999)	5254
6. Sample firms that have data available in Compustat database	4794
Final Sample	4794

3.3.2 Variables

Following DeAngelo, DeAngelo and Stulz (2010), we construct the main explanatory variable called Pro Forma Cash Ratio (PFCASH), which is calculated as the difference between the cash after IPO issue and the IPO proceeds divided by the total asset after IPO issue. Note that the IPO proceed is the product of offer price and primary issue shares. Therefore, the equation to calculate the PFCASH can be presented as $(\text{Cash} - \text{Offer Price} * \text{Primary Shares}) / \text{Total Assets (TA)}$. PFCASH measures the actual level of cash holdings for IPO firms in the year of IPO issue if the firm doesn't receive the IPO proceeds. A negative PFCASH indicates the IPO firm will run out of cash without the IPO proceeds, meaning the IPO firm is lack of cash prior to IPO.

According to previous literature, several control variables are also included for our analysis: LogME, Log (BE/ME), Market Return, LogAge, VC dummy, Hi-Tech dummy, Initial Return, Accrual and Underwriter Ranking. ME is the market value of the IPO firm in the first trading day and is simply calculated as price*shares outstanding. BE is the book value of the IPO firm in the first fiscal year after IPO issue. Several different ways can be used to compute BE and we choose the method that can obtain most BE available for IPO firms: $\text{BE} = \text{Total Asset} - \text{Total Liability} - \text{Redemption Value of Preferred Stock}$. Market Return is the buy-and-hold returns of market index. LogAge is the log of firm age. VC dummy is a dummy variable that is equal to 1 if the IPO firm is backed by venture capitals and 0 otherwise. Hi-Tech dummy is a dummy variable that is equal to 1 if the IPO firm belongs to Hi-Tech industry and 0 otherwise. Initial Return is the return in the first trading day and is calculated as $(\text{closing price in the first trading day} / \text{offer price} - 1)$. Underwriter Ranking is the average of underwriters' rankings which can be obtained from Professor Jay Ritter's website. According to Zheng (2007), Accrual is calculated as $(\text{income before extraordinary items} - \text{net cash flow from operating activities} + \text{cash flow from extraordinary item and discontinued operations})$ for fiscal years after 1987 and calculated as $(\text{change in current assets} - \text{change in cash} - \text{change in current liabilities} + \text{change in debt included in current liabilities} + \text{change in income taxes payable} - \text{depreciation and amortization})$ for fiscal years before 1987. The accruals are scaled by the average of the beginning and year-end total assets.

To measure aftermarket performance of IPO firms, we calculate buy-and-hold returns with different holding periods: from 6 months to 5 years following IPO issue. In addition to raw buy-and-hold returns, we also calculate market-adjusted buy-and-hold returns according to Purnanandam and Swaminathan (2004) and Zheng (2007). If an IPO firm is delisted during the

holding period, the returns are calculated up to the delisting day (Ritter, 1991). To control for size (ME) effect and value (book-to-market ratio) effect (Fama and French, 1992), we also calculate size-and-book-to-market (SBM) adjusted or style-adjusted buy-and-hold returns using the same method of Zheng's (2007) research.

Table 3.2 reports the means of raw buy-and-hold returns (BHRs), market-adjusted BHRs and SBM-adjusted BHRs for the whole sample with different holding periods. With 6-month holding period, the market-adjusted BHRs is positive (4.05%) indicating that IPO firms outperform the market in the first six months after IPO issue. As the holding period becomes longer (from 1-year to 5-year), however, the market-adjusted BHRs become negative and much lower, indicating that IPO firms are more underperformed in the long-run. The 5-year market-adjusted BHRs is as low as -24.32%. Those results are all consistent with Ritter (1991) and Purnanandam and Swaminathan (2004). For SBM-adjusted BHRs, the 3-year mean is 1.61% while the 5-year mean is -3.00%, showing that IPO firms don't underperform seriously after eliminating the size and value effect in the long-run (5-year holding period) comparing with market-adjusted BHRs. This is also consistent with previous literature.

Table 3.2 Summary Statistics of Post-IPO Stock Performance

This table reports three post-IPO buy-and-hold returns, including raw buy-and-hold returns (BHRs), market-adjusted buy-and-hold returns and style-adjusted (or size and book-to-market adjusted) buy-and-hold returns. Various types of holding period are concerned for each type of returns, ranging from 6-month to 5-year. All the buy-and-hold returns are calculated from the first trading day (IPO issue date).

	Raw BHRs	Market-adjusted BHRs	Style-adjusted BHRs
6-month	0.0915	0.0405	0.0384
1-year	0.0707	-0.0426	0.0161
2-year	0.1576	-0.0965	0.0277
3-year	0.2470	-0.1543	0.0161
4-year	0.3530	-0.1858	0.0127
5-year	0.3940	-0.2432	-0.0300

3.4 Cash Shortage and Aftermarket Performance

3.4.1 Univariate Analysis of Cash Shortage

To examine if near-term cash shortage exists prior to IPOs for IPO firms, we firstly estimate several cash ratios.

Table 3.3 reports the descriptive summary of those cash-related variables for sample IPOs, including Cash/TA, Excess Cash/TA, Pro Forma Cash/TA, Pro Forma Excess Cash/TA. Using the same method of DeAngelo, DeAngelo and Stulz (2010), the Excess Cash/TA equals to a firm's actual Cash/TA minus the estimated "normal" Cash/TA that is required to operate the firm for a given year. Therefore, the Pro Forma Excess Cash/TA is the difference between Pro Forma Cash/TA and "normal" Cash/TA. From row 2 in Table 3, we find that the median IPO firms' Cash/TA ratio increases from 10.24% in the year before IPO to 23.98% at the end of the first fiscal year after IPO issue, and decreases dramatically in the following two years. The median Excess Cash/TA ratio in row 3 increases from -0.15% in the year before IPO to 7.59% at the end of the first fiscal year after IPO issue, but decreases sharply to 1.50% at the end of the third fiscal year after IPO issue. Those results apparently indicate that generally those IPO firms don't have enough cash to operate the firm so that most of the IPO proceeds are used for firm operation in the following three years after IPO issue, which is also supported by the fact that the firms raise \$27.55 million median IPO proceeds but only have \$10.76 million median cash at the end of first fiscal year end after IPO issue.

Table 3.3 Descriptive Summary of Cash Related variables for IPO firms using annual data

This table represents actual and pro forma ratios of cash to total assets if the firm did not receive the primary proceeds from the IPO issues from the fiscal year before the IPO to the third fiscal year after the IPO.

	Before IPO	Year 1	Year 2	Year 3
1. Median Cash (in millions)	2.65	10.76	12.79	11.79
2. Median Cash/TA	10.24%	23.98%	20.04%	16.28%
3. Median Excess Cash/TA	-0.15%	7.59%	3.84%	1.50%
4. Median IPO Proceeds (in millions/primary only)		27.55		
5. Median <i>Pro forma</i> Cash/TA		-16.42%	-12.89%	-11.08%
6. Median <i>Pro forma</i> Excess Cash/TA		-35.16%	-28.29%	-24.75%
7. % with <i>pro forma</i> Cash/TA<0		74.25%	71.67%	69.79%
8. % with <i>pro forma</i> Excess Cash/TA<0		93.63%	90.18%	87.92%
No. of Observations	3644	4504	4348	3850

A very important finding in Table 3.3 is that majority of the IPO firms would immediately run out of cash assuming they had not received the IPO proceeds, other things equal. The median Pro Forma Cash/TA in row 5 is -16.42% in the first fiscal year after IPO issue, -12.89% and -11.08% in the second and third year respectively. The median Pro Forma Excess Cash/TA in row 6 is -35.16% in the first fiscal year after IPO issue, -28.29% and -24.75% in the second and third year respectively. Row 7 and Row 8 in Table 3.3 show that without IPO proceeds, about 70% of IPO issuers would have negative Cash/TA during the three years after IPO issue and about 90% of IPO issuer would have no enough cash to maintain firm operations.

There is one possibility that firms raise capitals through IPOs for the sake of new investment opportunities rather than cash shortage. To address this concern, we also calculate pro forma cash ratios that are similar with those in Table 3.3, but additionally assuming that the capital expenditures (CapEx) in the first fiscal year after IPO issue remain the same with the CapEx in the previous year of IPO issue. In Table 3.4, although the CapEx/IPO Proceeds ratio increases about 5% from the year before to the year after IPO in Row 1 of Panel A, the median Pro Forma Cash/TA and Pro Forma Excess Cash/TA without capital expenditure increases are still negative in Panel B (-8.36% and -28.59%, respectively). What's more, column (2) in Panel B also shows that 63.75% of those IPO sample firms would run out of cash and 89.05% of them would have subnormal Cash/TA ratio in the first fiscal year after IPO issue, providing no IPO proceeds received and no capital expenditure increased.

Table 3.4 Cash related variables with capital expenditures and debt variables

This table reports capital expenditures (CapEx) and incidence of debt changes in years surrounding IPOs and the hypothetical impact on the ratio of cash to total assets if the firm did not receive IPO proceeds and did not change capital expenditure or debt in the first year after IPO. There are 3,597 IPO firms in this sample.

	Before IPO	First year after IPO	
Panel A. Capital Expenditure and Debt in years surrounding IPO			
1. Median CapEx/IPO proceeds	4.50%	9.46%	
2. Median Liability/IPO proceeds	52.43%	59.60%	
3. Median Long-Term Debt/IPO proceeds	7.30%	4.09%	
Panel B. Cash holdings assuming no IPO proceeds are received and no other items changes made in the first fiscal year after IPO			
	No CapEx Change	No Total Liability Change	No Long-Term Debt Change
4. Median <i>pro forma</i> Cash/TA	-8.36%	-11.26%	-8.17%
5. Median <i>pro forma</i> Excess Cash/TA	-28.59%	-34.19%	-30.19%
6. % with <i>pro forma</i> Cash/TA <0	63.75%	68.11%	63.97%
7. % with <i>pro forma</i> Excess Cash/TA <0	89.05%	91.44%	89.77%

In addition to capital expenditure, we also consider about the impact of external borrowings such as total liabilities and long-term debt on the cash shortage situations. In column (3) of Panel B in Table 3.5, if the IPO sample firms don't receive IPO proceeds and keep total liabilities unchanged in the first fiscal year after IPO issue, their median Pro Forma Cash/TA and Pro Forma Excess Cash/TA are negative as well (-11.26% and -34.19%, respectively). Under the same conditions, 68.11% of the IPO sample firms would run out of cash and 91.44% would have subnormal Cash/TA ratio in the first fiscal year after IPO issue. If we look at the long-term debt in column (3) of Panel B, similar results will be obtained.

In conclusion, most of the IPO firms do have cash shortfalls if they don't receive the IPO proceeds. And this result remains the same even we control for the changes on capital expenditure, total liability and long-term debt.

3.4.2 Cash Shortage and Post-IPO Stock Performance

Our hypothesis suggests that firms with high level of cash shortage will have worse post-IPO long-run stock performance than firms with low level of cash shortage. Because a high level of cash shortage means a low pro forma cash, we expect that PFCASH will positively affect IPO long-run performance. Lower or even negative PFCASH will lead to worse IPO long-run performance, or vice versa.

Table 3.5 BHRs for the IPO sample without financial and utility firms, BV>0

This table shows post-IPO buy-and-hold returns (BHRs) with different types of holding periods. Panel A reports raw BHRs, market-adjusted BHRs and style-adjusted BHRs for the whole sample. Panel B reports style-adjusted BHRs for groups sorting by pro forma cash. Panel C reports style-adjusted BHRs for group with positive pro forma cash firms and group with non-positive pro forma cash firms. All BHRs in this table are all calculated with monthly data.

	(1)	(2)	(3)	(4)
	1 st Day to 1 st FYE	1 st FYE to 90 days after 1 st FYE	90 days after 1 st FYE to 3 Years after 1 st FYE	1 st Day to 3 Years after 1 st FYE
Panel A. BHRs for the whole sample				
Raw BHRs	0.0702	0.0127	0.2579	0.2600
Market Adjusted BHRs	0.0151	-0.0150	-0.1091	-0.2119
Style Adjusted BHRs	0.0518	-0.0045	0.0120	-0.0030
Panel B. Style Adjusted BHRs for Portfolios Sorted by Pro forma cash				
Low	-0.0492	-0.0183	-0.1747	-0.3145
Median	0.0393	0.0016	0.0246	-0.0014
High	0.1649	0.0005	0.1901	0.2883
Low – High	-0.2141	-0.0189	-0.3648	-0.6028
Emp p-value	0.000	0.113	0.000	0.000
Panel C. Style Adjusted BHRs for Portfolios Sorted by Pro forma cash				
Pfcash<0	-0.0024	-0.0077	-0.0787	-0.1549
Pfcash>=0	0.1735	-0.0002	0.2066	0.3143
Pfcash<0– Pfcash>=0	-0.1760	-0.0075	-0.2852	-0.4691
Emp p-value	0.000	0.496	0.002	0.000

Table 3.5 shows some univariate results between PFCASH and buy-and-hold returns that are calculated with monthly data from CRSP. Four different holding periods are considered so that we can figure out in which period the PFCASH will react on the IPO performance: (1) from the first trading day to the first fiscal year end (FYE) after IPO issue; (2) from the day after the first FYE to 90 days after the first FYE; (3) from 90 days after first FYE to 3 years after first FYE; (4) from the first trading day to 3 years after first FYE. In Panel A of Table 3.5, the market-adjusted BHRs are positive in very short-run in column (1) but negative over other holding periods, showing that the IPO sample firms outperform the market in short term after IPO issue but highly underperform the market in long-run starting 90 days after first FYE. Controlling for size and book-to-market ratio effect, the SBM-adjusted BHRs do not exhibit clear pattern on aftermarket performance.

In Panel B of Table 3.6, the IPO sample firms are divided into three equal size groups (low, median and high) based on the PFCASH. The firms in low PFCASH portfolio have high cash shortfall while the firms in high PFCASH portfolio have small or no cash shortage. SBM-adjusted BHRs are calculated for each group over the four different holding periods, and the return difference as well as relevant empirical p-value between low and high groups are also reported. Except for column (2), the results in other columns all indicate that the PFCASH is positively and significantly correlated with post-IPO stock performance. Over the holding period from 90 days after first FYE to 3 years after first FYE in column (3), for example, the low PFCASH portfolio significantly underperform the high PFCASH portfolio with more than 35% SBM-adjusted BHRs. Clearly, high level of cash shortage (low PFCASH) will significantly aggravate IPO long-run underperformance. In Panel C of Table 3.6, we divide the IPO sample firms into two groups: one includes the firms with cash shortage ($PFCASH < 0$) and the other one includes the firms without cash shortage ($PFCASH \geq 0$). The results are almost similar with that in Panel B. The relation between PFCASH and IPO aftermarket performance does not hold during the 90 days period after first FYE in column (2). The mean of SBM-adjusted BHRs for $PFCASH < 0$ group in column (3) is -7.87%, which is 28.52% significantly ($p\text{-value}=0$) lower than that for $PFCASH \geq 0$ group. With no doubt, the firms with cash shortage have significant worse IPO long-run performance than the firms without cash shortage.

Table 3.6 Univariate analysis of pro forma cash flow and aftermarket performance

This table reports post-IPO buy-and-hold returns that are calculated from 90 days after first fiscal year end. There are 4,175 IPO firms in Panel A, B, C, and 4,115 IPO firms in Panel D because of limited data availability.

	(1)	(2)	(3)	(4)	(5)
	1 Year	2 Years	3 Years	4 Years	5 Years
Panel A: BHRs for the Whole Sample					
Raw BHRs	0.0476	0.1483	0.3179	0.3298	0.3312
Market Adjusted BHRs	-0.0852	-0.1159	-0.0844	-0.1718	-0.1965
Style Adjusted BHRs	0.0066	-0.0006	-0.0159	-0.0014	-0.0600
Panel B: Raw BHRs for Portfolios Sorted by Pro forma cash					
Low	0.0102	0.0654	0.1309	0.1404	0.1208
Median	0.0498	0.1496	0.3847	0.3395	0.3474
High	0.0827	0.2298	0.4381	0.5095	0.5252
Low – High	-0.0726	-0.1644	-0.3071	-0.3691	-0.4044
Emp p value	0.029	0.018	0.004	0.000	0.000
Panel C: Market Adjusted BHRs for Portfolios Sorted by Pro forma cash					
Low	-0.1462	-0.2253	-0.3020	-0.3970	-0.4411
Median	-0.0943	-0.1403	-0.0493	-0.1987	-0.2202
High	-0.0153	-0.0178	0.0979	0.0801	0.0715
Low – High	-0.1309	-0.2431	-0.3999	-0.4771	-0.5125
Emp p value	0.001	0.000	0.000	0.000	0.000
Panel D: Style Adjusted BHRs for Portfolios Sorted by Pro forma cash					
Low	-0.1138	-0.1761	-0.2090	-0.3241	-0.3865
Median	-0.0044	-0.0106	-0.0156	-0.0021	-0.0673
High	0.1378	0.1847	0.1767	0.3217	0.2737
Low – High	-0.2516	-0.3608	-0.3857	-0.6458	-0.6602
Emp p value	0.000	0.000	0.000	0.000	0.000

We next calculate buy-and-hold returns including raw, market-adjusted and SBM-adjusted BHRs for groups formed in Table 3.5 with holding periods from 1-year to 5-year to further support the conclusion we derived above. Table 3.5 shows that the positive relation between PFCASH and aftermarket performance doesn't hold during the 90 days after first FYE, so the following BHRs are calculated from 90 days after first FYE. Table 3.6 reports all BHRs for low, median and high groups sorting by pro forma cash. Focusing on Panel C and Panel D, low PFCASH portfolio has significantly worse performance than high PFCASH portfolio, especially in the long-run. For example, in column (3) of Panel C, low PFCASH group has around 40% lower 3-year market-adjusted BHRs than high PFCASH group and this difference is significant at 1% level. In column (4) and column (5) of Panel C, the difference between low and high groups are even larger (47.71% and 51.25%, respectively) and still significant at 1% level. Similar results are obtained for SBM-adjusted BHRs. Therefore, those results support our hypothesis that near-term cash shortage negatively affects post-IPO stock performance, especially in the long run.

Table 3.7 reports all BHRs for $PFCASH < 0$ and $PFCASH \geq 0$ groups. For market-adjusted BHRs in Panel B and SBM-adjusted BHRs in Panel C, $PFCASH < 0$ portfolio has significantly lower post-IPO stock performance than $PFCASH \geq 0$ group. The longer the holding periods, the severer underperformance $PFCASH < 0$ group has. As a result, firms with cash shortage significantly underperform the firms without cash shortage, especially in the long run.

Table 3.7 Univariate analysis of pro forma cash flow and aftermarket performance

The buy-and-hold returns are calculated from 90 days after first fiscal year end. There are 4,175 IPO firms in Panel A and B, and 4,115 IPO firms in Panel C because of limited data availability.

	1 Year	2 Years	3 Years	4 Years	5 Years
Panel A: Raw BHRs for Portfolios Sorted by Pro forma cash					
Pfcash<0	0.0309	0.1076	0.2553	0.2411	0.2373
Pfcash>=0	0.0833	0.2352	0.4518	0.5195	0.5318
Pfcash<0– Pfcash>=0	-0.0523	-0.1276	-0.1964	-0.2783	-0.2945
Emp p value	0.072	0.029	0.038	0.001	0.000
Panel B: Market Adjusted BHRs for Portfolios Sorted by Pro forma cash					
Pfcash<0	-0.1197	-0.1829	-0.1783	-0.2960	-0.3269
Pfcash>=0	-0.0116	0.0275	0.1164	0.0937	0.0823
Pfcash<0– Pfcash>=0	-0.1081	-0.2104	-0.2948	-0.3897	-0.4091
Emp p value	0.001	0.002	0.002	0.000	0.000
Panel C: Style Adjusted BHRs for Portfolios Sorted by Pro forma cash					
Pfcash<0	-0.0620	-0.0928	-0.1140	-0.1653	-0.2262
Pfcash>=0	0.1510	0.1937	0.1907	0.3439	0.2904
Pfcash<0– Pfcash>=0	-0.2129	-0.2864	-0.3047	-0.5092	-0.5166
Emp p value	0.000	0.000	0.000	0.000	0.000

3.4.3 Multiple Regressions

The above univariate analysis strongly supports the hypothesis that a firm's cash shortage has a negative relation with post-IPO long-run performance. Next, we apply OLS regression model to further test if the hypothesis still holds. The dependent variables are 3-year market-adjusted BHRs and SBM-adjusted BHRs. In addition to the control variables already mentioned in section 3.3.2, other three variables - ΔCapxR , ΔLtR and ΔDlttR are also included to control for the effect of capital expenditure increase, total liability increases and long-term debt change. ΔCapxR is calculated as $(\text{CapEx in the first fiscal year after IPO issue} - \text{CapEx in the year before the IPO issue}) / \text{Total Asset in the first fiscal year after IPO issue}$. With the same method ΔLtR is the difference of total liabilities divided by total asset and ΔDlttR is the difference of long-term debt divided by total asset.

In summary, the multiple regression model is exhibited as follows:

$$\begin{aligned} BHRs_i = & \alpha + \beta_1 PFCASH_i + \beta_2 FirmAge_i + \beta_3 UWR_i + \beta_4 VC_i + \beta_5 HiTech_i + \beta_6 LogMV_i \\ & + \beta_7 MR_i + \beta_8 LogBM_i + \beta_9 IR_i + \beta_{10} Accrual_i + \beta_{11} \Delta\text{CapxR}_i + \beta_{12} \Delta\text{LtR}_i \\ & + \beta_{13} \Delta\text{DlttR}_i + \epsilon \end{aligned} \quad (1)$$

The definitions of all above variables are all listed in Appendix A of section 3.6.1.

Table 3.8 Regression Analysis of IPO Pro Forma Cash and Long-run Stock Performance

This table reports regression results between pro forma cash and post-IPO long-run stock performance. The dependent variable in model (1) to model (3) is 3-year market-adjusted buy-and-hold returns, and in model (4) to model (6) is style-adjusted buy-and-hold returns. Firm Age is the log of the firm age. ΔCapxR is calculated as (CapEx in the first fiscal year after IPO issue-CapEx in the year before the IPO issue)/Total Asset in the first fiscal year after IPO issue. With the same method, we calculate the ΔLtR , which is the difference of total liabilities divided by total asset, and ΔDlttR which is the difference of long-term debt divided by total asset. The market value of equity used in $\text{Log}(\text{MV})$ and $\text{Log}(\text{B/M})$ is the first trading day market value which is the shares outstanding times the closing price in the first trading day. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
PFCASH	0.4467*** [4.21]	0.3464** [2.20]	0.3893** [2.21]	0.5581*** [6.21]	0.5699*** [5.20]	0.6227*** [5.20]
Firm Age		-0.0761* [-1.74]	-0.0696 [-1.51]		-0.0440 [-1.45]	-0.0362 [-1.16]
UWR		0.0426* [1.88]	0.0453* [1.94]		0.0390** [2.47]	0.0423*** [2.66]
VC Backed		0.1208 [1.32]	0.1240 [1.34]		0.0540 [0.85]	0.0467 [0.74]
Hi Tech		0.3064*** [2.85]	0.2505** [2.30]		0.1367* [1.83]	0.0794 [1.07]
Log(MV)		0.0355 [0.75]	0.0264 [0.55]		-0.0411 [-1.21]	-0.0550 [-1.63]
Market Return					0.3337*** [4.08]	0.2863*** [3.54]
Log (B/M)		-0.0563 [-0.74]	-0.0688 [-0.88]		-0.0990* [-1.88]	-0.1038** [-1.96]
Initial Return		-0.1857 [-1.63]	-0.1740 [-1.50]		-0.2606*** [-3.29]	-0.2513*** [-3.20]
Accrual		-0.0905 [-0.55]	-0.0936 [-0.56]		0.0136 [0.12]	0.0187 [0.16]
ΔCapxR			-0.3996 [-0.77]			-0.4371 [-1.23]
ΔLtR			0.2422 [0.79]			0.1727 [0.83]
ΔDlttR			-0.5761 [-1.38]			-0.5960** [-2.11]
<i>N</i>	4175	3826	3724	4115	3830	3728
adj. <i>R</i> ²	0.0040	0.0097	0.0095	0.0090	0.0182	0.0189

The results of multivariate regressions are exhibited in Table 3.8. Model (1) to model (3) use 3-year market-adjusted BHRs as dependent variable, and model (4) to model (6) use 3-year SBM-adjusted BHRs as dependent variable. In model (1) and model (4), only PFCASH is included as an independent variable. The coefficients of PFCASH in both models are positive and statistically significant at 1% significance level, stating that lower PFCASH (higher cash shortage) is followed by worse post-IPO long-run performance. With control variables added, PFCASH is still positively and significantly correlated with 3-year market-adjusted BHRs at 5% significance level in column (2) and correlated with 3-year SBM-adjusted BHRs at 1% significance level in column (5). Controlling for the impacts of capital expenditure, total liability and long-term debt in column (3) and column (6), the coefficient of PFCASH is still positive and significant at least 5% level. Take column (6) as an example, we can see that the coefficient of PFCASH is 0.6227. It is statistically significant at 1% level because if a firm's PFCASH decreases by 1%, the 3-year post-IPO SBM-adjusted BHRs will decrease by 0.6227%. Those regression results are all consistent with previous univariate analysis and strongly support our hypothesis that there exist near-term cash shortages for IPO firms prior to IPOs and the level of cash shortage has adverse effect on post-IPO long-run performance.

3.4.4 Robustness Test

In the previous analysis, we use only buy-and-hold returns to measure post-IPO long-run stock performance. As a robustness test, we next utilize Fama-French five-factor model to estimate stock return to proxy for the post-IPO stock performance. Following Fama and French (2015), the five-factor model is showed as follows:

$$R_{it} - r_{ft} = \alpha_i + \beta_{im}(R_{mt} - r_{ft}) + \beta_{iSMB}SMB_t + \beta_{iHML}HML_t + \beta_{iRMW}RMW_t + \beta_{iCMA}CMA_t + \varepsilon_i \quad (2)$$

In our study, $R_{it} - r_{ft}$ is the monthly excess return of firm i over risk-free rate that is proxied by one-month T-bill return; $R_{mt} - r_{ft}$ is the market risk premium; SMB_t is the size premium that accounts for the difference between portfolio of small cap firms and portfolio of large cap firms;

HML_t is the value premium that accounts for the difference between portfolio of high book-to-market ratio firms and portfolio of low book-to-market ratio firms; RMW_t is the profitability premium calculated as the return spread of most profitable firms (Robust profitability) minus least profitable firms (Weak profitability); and CMA_t is the investment premium calculated as the return spread of firms that invest conservatively minus firms that invest aggressively. The alpha (α_i) in this model denotes the excess return that an active manager can achieve beyond the expected return from the Fama-French 5-factor model, which is used to proxy for the post-IPO long-run stock performance in this paper. The data of the above five factors are obtained from the website of Kenneth R. French data library.

With the excess return calculated from Fama-French 5-factor model, we replicate model (1) and the regression results are exhibited in Table 3.9. Since the excess return (alpha) is already adjusted for market risk, size risk and value risk, we do not need to control for market return, market value of equity or book-to-market ratio here. Therefore, the control variables – market return, Log(MV) and Log(B/M) are excluded in the regression of Table 3.9. In column (1) of Table 3.9, the coefficient of PFCASH is positive and significant at 1% level, indicating that firms with higher PFCASH result in higher long-run stock returns. In other words, firms with higher level of near-term cash shortage underperform firms with lower level of near-term cash shortage. The result remains the same even we include some control variables in column (2). After controlling for the changes in capital expenditure, total liability and long-term debt in column (3), the PFCASH is still positively and significantly related with long-term stock performance. As a result, using alpha of Fama-French 5-factor model as a measure of post-IPO long-term stock performance, the regression results are still consistent with findings in section 3.4.3 that the level of near-term cash shortage of IPO firms has significantly negative impact on post-IPO long-run stock performance.

Table 3.9 Regression Analysis with Alpha of Fama-French Five-Factor Model

This table reports regression results between pro forma cash and post-IPO long-run stock performance. And the dependent variable is the excess return (alpha) from Fama-French 5-factor model. Definitions of all variables are listed in Appendix 3.7.1. Standard deviations are showed in square brackets. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)
PFCASH	0.1088*** [8.48]	0.0415*** [2.98]	0.0681*** [4.35]
Firm Age		0.0130*** [3.18]	0.0084* [1.95]
UWR		0.0130*** [7.33]	0.0132*** [7.20]
VC Backed		0.0136 [1.60]	0.0084 [0.97]
Hi Tech		0.0266*** [2.69]	0.0248** [2.46]
Initial Return		0.0374*** [4.05]	0.0389*** [4.13]
Accrual		-0.1450*** [-9.54]	-0.1414*** [-9.17]
Δ CapxR			-0.1361*** [-2.77]
Δ LtR			-0.0779*** [-2.70]
Δ DlttR			-0.0420 [-1.07]
<i>N</i>	4,106	3,822	3,720
adj. <i>R</i> ²	0.0170	0.0679	0.0789

3.5 Operating Performance

To figure out whether the near-term cash shortage of IPO firms is caused by bad operating activities, we next investigate the operating performance before the IPO issue year and further test the relationship between the near-term cash shortage and post-IPO operating performance. According to Brown and Caylor (2009) and Loughran and Ritter (1997), three measures are used to proxy for the operating performance: return on asset (ROA), return on equity (ROE) and new investment ratio (INV). We first calculate the operating performance for the three years prior to and after the IPO issue year and take 3-year average before and after IPO year, respectively. Panel A shows the means of 3-year average operating performance with whole sample. Except for INV, the operating performance after IPO issue is greater than that before IPO issue.

In Panel B, the whole sample is divided into three groups (low, median and high) sorting by PFCASH. Low group includes IPO firms in the bottom 33.3% of PFCASH while high group includes IPO firms in the top 33.3% of PFCASH. Therefore, the IPO firms in the low group have higher level of near-term cash shortage while those in the high group have lower level of near-term cash shortage. Prior to IPOs, the low group has higher ROA, ROE but lower INV than the high group, and the difference is only significant for INV. As a result, it is not conclusive whether the operating performance before IPOs cause the near-term cash shortage. After IPOs, however, all the three measures of low group are lower than those of high group although the difference is significant only for INV, indicating that higher level of near-term cash shortage will lead to worse operating performance. In Panel C, we further divide the whole sample into two groups: one includes IPO firms with negative PFCASH and the other one includes IPO firms with nonnegative PFCASH. The IPO firms with negative PFCASH will definitely run out of cash if they don't receive the IPO proceeds. From the statistics in Panel C, the IPO firms with negative PFCASH have significantly higher ROA but lower INV than those with non-negative PFCASH prior to IPOs. Similar results are obtained after IPOs. The results here are not consistent with each other.

Table 3.10 Operating Performance for Groups Sorted by Pro Forma Cash

This table shows the operating performance of IPO firms around IPO issue year. We use return on asset (ROA), return on equity (ROE) and new investment ratio (INV) to measure operating performance. During the three years right before and after the IPO issue year, we calculate each measure for each year and then take 3-year average before and after IPO year, respectively. Panel A reports the mean of 3-year average with whole sample. In Panel B, the whole sample is divided into three groups sorted by pro forma cash, and the mean of 3-year average is calculated for each group. The difference between low and high groups as well as empirical p-value are also reported. Similarly in Panel C, we divide the whole sample into two groups: one includes all IPO firms with pfcash <0 and the other one includes IPO firms with pfcash >=0. The mean difference as well as empirical p-value are also reported. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

	3-year average before IPO			3-year average after IPO		
	ROA	ROE	INV	ROA	ROE	INV
Panel A. Operating Performance for Whole Sample						
All	-0.0858	0.2281	0.2723	-0.0057	0.4894	0.1670
Panel B. Operating Performance for Three Groups Sorted by Pro Forma Cash						
Low	-0.1080	0.5461	0.2384	-0.0318	0.1236	0.1636
Median	-0.0026	-0.1697	0.2288	0.0426	0.2294	0.1494
High	-0.1469	0.3126	0.3496	-0.0275	1.1155	0.1880
Low – High	0.0389	0.2335	-0.1112***	-0.0043	-0.9918	-0.0244***
Emp p	0.3681	0.7605	<.0001	0.8366	0.3900	<.0001
Panel C. Operating Performance for Two Groups Sorted by Pro Forma Cash						
Pfcash<0	-0.0573	0.1641	0.2343	0.0055	0.1758	0.1566
Pfcash>=0	-0.1452	0.3611	0.3524	-0.0290	1.1511	0.1889
Pfcash<0 – Pfcash>=0	0.0879***	-0.1970	-0.1181***	0.0345***	-0.9753	-0.0323***
Emp p	0.0014	0.7296	<.0001	0.0060	0.4095	<.0001

We next use ordinary regression model to examine the relation between near-term cash shortage and operating performance. We first regress PFCASH on operating performance prior to IPO in order to investigate whether the near-term cash shortage is caused by poor operating performance. The regression model is simply showed as follows:

$$PFCASH_i = \alpha + \beta_1 OP_i + \epsilon \quad (2)$$

where OP_i is proxied by 3-year average of ROA, ROE and INV.

To examine the relation between near-term cash shortage and post-IPO operating performance, we then use 3-year average of post-IPO operating performance as dependent variable and near-term cash shortage as main explanatory variable. The regression model is exhibited below:

$$OP_i = \alpha + \beta_1 PFCASH_i + \beta_2 FirmAge_i + \beta_3 UWR_i + \beta_4 VC_i + \beta_5 HiTech_i + \beta_6 LogMV_i + \beta_7 LogBM_i + \beta_8 IR_i + \beta_9 Accrual_i + \epsilon \quad (3)$$

where OP_i is proxied by 3-year average of post-IPO ROA, ROE and INV. Other control variables are listed in Appendix A.

Panel A of Table 3.10 shows the regression results of model (2). From column (1) and (2), we will find that both ROA and INV are positively and significantly related to PFCASH, indicating that higher ROA or INV leads to higher PFCASH and thus lower level of near-term cash shortage. In other words, the firm with better operating performance will have lower near-term cash shortage before IPO issue while firm with poorer operating performance will have higher near-term cash shortage. This provides evidence that the occurrence of near-term cash shortage is at least partly due to the poor operating performance prior to IPO issue.

The regression results of model (3) are reported in Panel B of Table 3.10. When using ROA and INV as dependent variable, the coefficient of PFCASH is always significantly positive no matter the control variables are included or not. The higher PFCASH, the higher ROA and INV. This suggests that an IPO firm with lower level of near-term cash shortage will have higher post-IPO operating performance and vice versa. The existence of near-term cash shortage prior to IPOs will negatively affect the post-IPO operating performance.

Table 3.10 Near-term Cash Shortage and Operating Performance

This table exhibits the regression results between near-term cash shortage and operating performance. Panel A shows the regression results of near-term cash shortage on pre-IPO operating performance. 3-year average of ROA, ROE and INV prior to IPOs are used to measure operating performance in column (1), (2) and (3). Panel B reports the regression results of post-IPO operating performance on near-term cash shortage. Operating performance is measured by ROA in column (1) and (2), ROE in column (3) and (4), and INV in column (5) and (6). Other control variables are also included in the regressions. The definitions of those control variables are listed in Appendix A. t-statistics are reported in parentheses. *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Near-term Cash Shortage and Pre-IPO Operating Performance						
	(1)	(2)	(3)			
ROA	0.0098**					
	[2.00]					
ROE		-0.0001				
		[-0.68]				
INV					0.0317***	
					[2.94]	
<i>N</i>	4,057	4,042			4,114	
Adj. R ²	0.0455	0.0000			0.0019	
Panel B. Near-term Cash Shortage and Post-IPO Operating Performance						
	ROA		ROE		INV	
	(1)	(2)	(3)	(4)	(5)	(6)
PFCASH	0.1361***	0.1757***	1.5234	1.2386	0.0169**	0.0229***
	[5.71]	[6.62]	[1.18]	[0.79]	[2.27]	[2.72]
Firm Age		0.0663***		0.6194		-0.0203***
		[9.01]		[1.42]		[-8.70]
UWR		0.0088**		0.1305		0.0001
		[2.31]		[0.58]		[0.45]
VC Backed		-0.1055***		0.3012		0.0529***
		[-6.88]		[0.33]		[10.88]
Hi Tech		0.0157		-2.1372**		-0.0133**
		[0.87]		[-2.00]		[-2.33]
Log(MV)		0.0220***		-0.3891		-0.0122***
		[2.77]		[-0.83]		[-4.84]
Log (B/M)		0.0757***		-1.5240**		-0.0433***
		[5.92]		[-2.02]		[-10.68]
Initial Return		0.0147		4.5503***		-0.0426***
		[0.77]		[4.03]		[-7.04]
Accrual		0.5508***		2.7517*		-0.1160***
		[19.85]		[1.68]		[-13.18]
<i>N</i>	4,051	3,827	4,051	3,827	4,051	3,830
Adj. R ²	0.0077	0.1705	0.0001	0.0071	0.0010	0.1531

3.6 Conclusion

This paper mainly discusses the relation between the near-term cash shortage before IPO issue and the post-IPO long-run underperformance. We first examine if IPO firms are lack of cash before IPO issue. Our results show that most IPO firms (around 70%) will run out of cash if they don't receive the IPO proceeds, indicating the near-term cash shortage does exist for most IPO firms before IPO issue. Those IPO proceeds are used to operate the firm during the three years following IPOs. In addition, the regression results also suggest that the near-term cash shortage will negatively and significantly affect post-IPO long-run performance. Firms with higher level of cash shortage will experience worse post-IPO long-run stock performance. This is explained by the market underreaction hypothesis in financial market. The market overlooks the fact that IPO firms will run out of cash if the IPO proceeds are not received and underreacts to the cash shortage situation. After IPO issuance, however, the market gradually realizes that those IPO firms don't operate as they expect so that the stocks underperform in the long term. In addition, further tests also show that the near-term cash shortage is partly due to poor operating performance before IPOs and will negatively affect post-IPO operating performance.

3.7 Appendix

3.7.1 Appendix A. Variable Definition

Variable Names	Variable Definitions
<i>PFCASH</i>	Pro Forma Cash Ratio. It is calculated as the difference between the cash after IPO issue and the IPO proceeds divided by total asset after IPO issue: $(\text{Cash} - \text{Offer Price} * \text{Primary Shares}) / \text{Total Asset}$.
<i>Firm Age</i>	Firm Age is calculated as the log of firm age.
<i>UWR</i>	Underwriter Ranking. It is the average of underwriters' rankings that is obtained from Professor Jay Ritter's website.
<i>VC</i>	Venture capital backed dummy that equals to 1 if the IPO firm is backed by venture capitals and 0 otherwise.
<i>HiTech</i>	Hi-Tech industry dummy that equals to 1 if the IPO firm belongs to hi-tech industry and 0 otherwise.
<i>LogMV</i>	Log of market equity in which the market equity is the market value of the IPO firm in the first trading day.
<i>MR</i>	Market Return. It is the buy-and-hold returns of market index.
<i>LogBM</i>	Log of Book-to-Market Ratio. Book equity is calculated as: $\text{Total Asset} - \text{Total Liability} - \text{Redemption Value of Preferred Stock}$.
<i>IR</i>	Initial Return. It is the return in the first trading day and is calculated as $(\text{closing price in the first trading day} / \text{offer price} - 1)$.
<i>Accrual</i>	It is calculated as $(\text{income before extraordinary items} - \text{net cash flow from operating activities} + \text{cash flow from extraordinary item and discontinued operations})$ for fiscal years after 1987 and calculated as $(\text{change in current assets} - \text{change in cash} - \text{change in current liabilities} + \text{change in debt included in current liabilities} + \text{change in income taxes payable} - \text{depreciation and amortization})$ for fiscal years before 1987. The accruals are scaled by the average of the beginning and year-end total assets.
ΔCapxR	The change in Capital expenditure. It is calculated as $(\text{CapEx in the first fiscal year after IPO issue} - \text{CapEx in the year before the IPO issue}) / \text{Total Asset in the first fiscal year after IPO issue}$.
ΔLtR	The change in total liability. It is calculated as $(\text{total liability in the first fiscal year after IPO issue} - \text{total liability in the year before the IPO issue}) / \text{Total Asset in the first fiscal year after IPO issue}$.
ΔDlttR	The change in long-term debt. It is calculated as $(\text{long-term debt in the first fiscal year after IPO issue} - \text{long-term debt in the year before the IPO issue}) / \text{Total Asset in the first fiscal year after IPO issue}$.
<i>BHRs</i>	3-year market-adjusted and style-adjusted buy-and-hold returns.

Chapter 4 The value of cash holdings: a study with cash windfall firms

4.1 Introduction

The amount of cash holding in a company reveals a lot of information to shareholders, debtholders, bankers, and investors. To a large extent, the cash position signals whether the firm has strong ability to cover current liabilities when the operating performance is not good and whether and how much the firm can invest in good projects with internal funds when the firm is unable to raise external funds. When the cash position is abnormally high, investors may worry about whether the management can take full advantage of cash holdings without incurring a lot of agency costs. All these considerations affect the value of cash holding. Although a large body of literature addresses the importance of corporate cash holding, there are only a few studies that empirically evaluate the value of cash holdings.

Faulkender and Wang (2006) conduct a relatively comprehensive study that estimates the marginal value of cash. They develop a regression methodology in which the dependent variable is annual excess return and the main independent variable is the change in cash holdings. The coefficient of the change in cash holdings is interpreted as the value of one dollar increase in cash holdings. Faulkender and Wang (2006) suggest that their results show that one extra dollar of cash is worth less than \$1 on average, and the marginal value of cash is higher for firms with lower leverage, lower level of cash holdings or higher level of financial constraint. Following the same methodology, Dittmar and Mahrt-Smith (2007), Liu and Mauer (2011), Louis, Sun and Urcan (2012) and Tong (2008) explore the cross-sectional variations in the value of cash holdings.

However, I am concerned about the methodology of Faulkender and Wang (2006) because there may be an endogeneity issue in the relation between firm value and the change of cash holdings. It is well documented in the literature that corporate cash holdings are determined by various firm and industry characteristics. For example, Opler et al. (1999) find evidence that the level of cash holdings is correlated with firms' growth opportunities, volatility of cash flows, firm size and the ability of raising external funds. They suggest that this supports a static tradeoff model in which optimal cash holding level is chosen to maximize shareholders' wealth. Other scholars,

including Afza and Adnan (2007), Gill and Shah (2012), Lee and Powell (2011), and Ozkan and Ozkan (2004), find similar results using samples from different countries. Because firm characteristics vary over time, the optimal level of cash holding will also fluctuate with firm characteristics and firms will adjust the actual cash holdings accordingly. At the same time, the variation in firm characteristics will also affect firm value. This causes endogeneity in the regression proposed by Faulkender and Wang (2006): both the dependent variable (firm value) and the explanatory variable (the change in cash holdings) are driven by changes in firm characteristics. In this case the coefficient on the change in cash holdings may be determined by the endogeneity instead of the contribution of cash to firm value. Although Faulkender and Wang (2006) calculate three estimates of unexpected change in cash holdings to substitute for the actual change in cash holdings in robustness tests, their estimation of the expected level of cash holding is far from incorporating most of the factors affecting optimal cash holdings, therefore the endogeneity issue remains largely unresolved.

Another possible issue in Faulkender and Wang (2006)'s methodology is related to the market underreaction to information contained in the level of cash holdings. As documented in Chen, Jacoby and Zheng (2016) and the previous chapter of this dissertation, the market may take a few years to fully reflect the information contained in the level of cash holdings. In this case, if we only examine the effects of change in cash holdings on the excess return in the concurrent year, we may under-estimate the value of cash because it may also affect the excess return in the following years. This potential bias will be further complicated by the endogeneity issue above if the market under-reacts to any of the determinants of optimal cash holding. Actually, when we estimate Faulkender and Wang (2006)'s baseline regression using excess return in the following year as the dependent variable using a sample similar to theirs, the change in cash holdings has a significant positive relation with excess return next year, suggesting that Faulkender and Wang (2006)'s method does underestimate the marginal value of cash.

The main objective of this paper is to address the endogeneity problem and under-reaction problem in Faulkender and Wang (2006)'s methodology and re-estimate the marginal value of cash. To avoid the endogeneity problem, the change in cash holdings has to be exogenous. In the literature, cash windfalls are usually considered as exogenous because they are unpredictable and are not associated with firm characteristics. A typical example of cash windfall is the large amounts

of cash oil-and-gas firms receive when positive exogenous oil price shock occurs. A lot of studies about cash windfall have been done using oil and gas firms in the period of oil price shock after 2000 (Abdo, 2010; Andrén and Jankensgård, 2015; Lazzari and Pirog, 2008; van den Bremer and van der Ploeg, 2013). Therefore, I decide to examine the relation between firm value and change in cash holding using a sample of oil-and-gas firms during the period of 2000-2007. To avoid sample selection bias, we also include equal number of non-oil-and-gas firm-year observations between 2000-2007 as our control group, financial firms and utility firms excluded. Through nearest propensity score matching method, we match each oil-and-gas firm year with a non-oil-and-gas firm-year based on the factors mentioned in Opler et al. (1999) that more or less affect the level of corporate cash holdings. Our final sample consists of 822 oil-and-gas firm-year observations (treatment group) and 822 non-oil-and-gas firm-year observation (control group) during 2000-2007.

Using the same baseline model in Faulkender and Wang (2006), we find that one extra dollar of cash will increase shareholders' value by \$1.401 if the impacts of leverage and current level of cash holdings on marginal value of cash are ignored. However, it is nearly impossible that firms have neither cash nor leverage. Consistent with previous literature, our results show that both current level of cash holdings and leverage have negative impact on the value of one dollar increase in cash holdings. For firms with mean level of cash holdings and mean leverage, the marginal value of cash is about \$1.918 to shareholders, which is much higher than the findings in Faulkender and Wang (2006) that suggest that one additional dollar of cash is valued less than \$1. Furthermore, we investigate whether having access to capital markets matters when evaluating marginal value of cash. Using four different measures of financial constraints (Almeida et al., 2004), we create four pairs of financially constrained subsample and financially unconstrained subsample. The results of each pair of subsamples are not completely consistent with each other, but at least the findings under three of four financial constraint criteria indicate that the marginal value of cash for financially constrained firms is significantly higher than that for financially unconstrained firms. Specifically, one extra dollar of cash is worth around \$2 to shareholders in financially constrained firms with mean level of cash holdings and leverage. In addition to the variables that are included in Faulkender and Wang (2006), we further add two more control variables to proxy for future growth opportunities and repeat all the regressions. Similar results are obtained.

To explore whether the value of change in cash holdings is fully incorporated in the stock prices in the same fiscal year, we calculate annual excess return after fiscal year end as the dependent variable to conduct post stock performance tests. Unlike the case for Faulkender and Wang's sample, we do not see any significant relationship between the change in cash holdings and post stock performance for our oil-and-gas sample. This result supports our previous conclusion that the marginal value of cash is greater than \$1 on average when endogeneity issue is largely addressed.

This study contributes to the finance literature in at least three ways. First, we are the first empirical study that uses cash windfall firms to resolve the endogeneity problem when estimating marginal value of cash. Although Faulkender and Wang (2006) provide comprehensive analysis, the endogeneity issue makes their results unreliable. Other literature that adopts the same methodology of Faulkender and Wang (2006) is obsessed with the same problem. Second, we provide distinct estimates for the marginal value of cash as well as supportive evidence with regards to the effects of current level of cash holdings, leverage and financial constraint. Unlike the previous literature, our findings show that one extra dollar of cash is more than fully valued by shareholders. Consistent with previous literature, however, current level of cash holdings, leverage and having access to capital markets do have negative impact on the marginal value of cash. Third, we are the first one to examine the market underreaction hypothesis to see if the change in cash holdings is associated with post stock performance, employing Faulkender and Wang's (2006) sample and ours, respectively. The results clearly indicate that Faulkender and Wang's (2006) underestimate the marginal value of cash while our study does not, strongly supporting our conclusions.

The rest of the paper is organized as follows: in section 2, we review the relevant literature; in section 3, we describe the data, variables and methodologies; in section 4, we examine the relationship between the change in cash holdings and the stock performance, and investigate if this relationship differs for financially constrained and unconstrained subsample; in section 5, we test the market underreaction hypothesis in terms of marginal value of cash on post stock performance; in section 6, we make a conclusion.

4.2 Literature Review

There is relatively little literature discussing the marginal value of cash holdings. Pinkowitz and Williamson (2002) find that a marginal dollar of cash that firm holds is worth about \$0.97 to shareholders and mainly investigate the cross-sectional differences in terms of firm's investment opportunity set, financial distress as well as capital market access. They use similar specifications of Fama and French (1998) and the method of Fama and MacBeth (1973) to run all the regressions in which the dependent variable is the market value of equity deflated by book value of assets and the main explanatory variable to be examined is the current level of cash holdings whose coefficient measures the market value of one extra dollar of cash. Consistent with their expectations, the results show that firms with good growth opportunities, low probability of financial distress or unstable investment programs will have higher marginal value of cash. However, the evidence regarding to the capital market access indicates that the cash is valued more in financially unconstrained instead of constrained firms, contrary to the expectation. As an extension of this study, Pinkowitz, Stulz and Williamson (2006) examine if the marginal value of cash varies across different countries and find that the cash holdings are less valuable to shareholders in countries with poor investor protection, in line with the prediction of agency theories.

Faulkender and Wang (2006) adopt a quite different methodology to estimate what an extra dollar of cash is worth to shareholders and explore how the marginal value of cash is affected by the level of financial constraint. Using the size-and-book-to-market adjusted excess return over the same fiscal year as dependent variable, they deflate all the independent variables by the market value of equity at the beginning of fiscal year so that the coefficient estimates can be used directly to measure how much the shareholders' value changes due to \$1 change of corresponding independent variables. The primary cash-related explanatory variable is the real change of cash holdings, and other two interaction terms that interact the change in cash holdings with current level of cash holdings and leverage are also included to test if the marginal value of cash is sensitive to those two firm-specific characteristics. Their findings indicate that one dollar increase in cash holdings is valued less than \$1 to shareholders and both the current level of cash holdings and leverage have significantly negative impact on the marginal value of cash. Mathematically, the

marginal value of cash for firms with mean level of cash holdings and mean leverage is \$0.94. Through four financial constraint schemes, Faulkender and Wang (2006) also find strong evidence that shareholders in financially constrained firms place a higher value on one extra dollar of cash, in contrast to the empirical results of Pinkowitz and Williamson (2002). As robustness tests, two estimates of unexpected change in cash holdings are calculated to replace the real change in cash, and similar results are obtained.

Still focusing on the financial constraints and value of cash holdings, Denis and Sibilkov (2010) investigate why cash holdings are more valuable in financially constrained firms and why some constrained firms keep very low level of cash holdings. They first use the same methodology of Faulkender and Wang (2006) to replicate their regressions, confirming that one additional dollar of cash holdings is valued higher in financially constrained firms than in unconstrained firms. The reason is that higher cash holdings can help constrained firms make more investments in good opportunities that would otherwise be gave up due to difficulty in accessing capital markets. Further findings show that persistently low and declining free cash flow make constrained firms unable to cumulate cash holdings and the current cash flows are generally used for investment expenditures, leading to very little cash held by some constrained firms. Following the similar approach in Faulkender and Wang (2006), some other literature study the cross-sectional variation towards the value of cash holdings. Dittmar and Mahrt-Smith (2007) report a significantly positive relationship between corporate governance and the value of cash holdings that one dollar of cash is only valued \$0.42 in poorly governed firms and this value is almost doubled in well-governed firms. Liu and Mauer (2011) suggest that greater CEO risk-taking incentives are associated with lower value of cash holdings to shareholders, supporting the costly contracting hypothesis. Louis, Sun and Urcan (2012) find evidence that the marginal value of cash holdings increases in accounting conservatism with which the cash holdings will be used more efficiently. Tong (2008) documents that cash holdings are valued lower in diversified firms than single-segment firms, regardless of whether the firm is financially constrained or not.

Most of the above literature use the same methodology in Faulkender and Wang (2006) to measure the marginal value of cash. However, there is probably a very serious endogeneity problem with this methodology. Another series of literature introduce the determinates of corporate cash holdings and provide strong evidence that cash holdings are significantly affected

by some specific characteristics, causing the change in cash holdings endogenous. Kim, Mauer and Sherman (1998) utilize the cost-benefit tradeoff of holding liquid asset to explore the optimal level of investments in liquid assets. As predicted by their model, the level of liquidity is higher due to higher cost of external financing, higher volatility of future cash flows or higher returns from future investment projects. In other words, the cash that firm holds will increase when the firm is small, has larger market-to-book ratio, has more volatile earnings, or has lower return spread and better future economic conditions. Supporting the static tradeoff theory as well as a target adjustment model, Opler et al. (1999) show that firms will maintain a higher level of cash holdings if they have stronger growth opportunities, riskier activities, or hardest access to the capital markets. Small firms also hold more cash than large firms do. Those results suggest that corporate cash holdings are determinable through several firm-specific or industry characteristics to some extent, although some firms accumulate more cash than expected by the static tradeoff theory. Extending to a global scale, some literature examine the determinates of cash holdings using firms in other countries instead of U.S., such as United Kingdom (Ozkan and Ozkan, 2004), Pakistan (Afza and Adnan, 2007), Australia (Lee and Powell, 2011) and Canada (Gill and Shah, 2012). The findings of those studies all indicate that the corporate cash holdings are affected by market-to-book ratio, cash flow, net working capital, leverage, and firm size, consistent with Opler et al. (1999).

In order to eliminate the endogeneity issue that may encounter when estimating the marginal value of cash in the previous literature, we need to find out cash windfall firms such as oil and gas firms during a period with sudden oil price change because the price shock induces an unpredictable change in cash holdings. A bunch of literature address the oil price shock and choose the period after 2000's to do relevant research. Krichene (2008) analyzes the variability of oil prices during 2000-2007 and find that it keeps a relatively stable track during 2000-2003 but a rapid upward trend during 2003-2007. Hamilton (2009) investigate the oil price shock of 2007-2008 that is caused by standstill of oil production, reporting that the oil price increases progressively beginning 2001 and becomes tripled in the middle of 2007. From late 2007 to the middle of 2008, the real oil price even rises sharply. Pokrivčák and Rajčaniová (2011) also examine how crude oil prices vary during 2000-2009 and how the variability of crude oil price statistically impacts ethanol and gasoline prices. The crude oil price trend they show is similar

with Krichene (2008) and Hamilton (2009). With a sample period starting from 2000, Fakhri (2010) explores the relationship between real oil price and real exchange rate in Azerbaijan; Reed and Zhang (2008) conduct a research of whether and how the crude oil price is associated with prices of corn, soybean and pork in China; Chang and Su (2010) document a significant price spillover effect of crude oil future on corn and soybean futures; Serra (2011) also show that shocks on crude oil prices lead to higher volatility of ethanol price. In addition, a lot of studies use oil-and-gas firms in the period of oil price shock after 2000 to do research of cash windfall. Abdo (2010) explores the failure of government policies on oil and gas production when cash windfall incurs during periods of oil price shocks. Andrén and Jankensgård (2015) investigate the relationship between the investment and cash flow under the circumstance that the liquidity becomes abundant. They use oil and gas industry between 2000-2008 as their research sample because the cash windfall due to the exogenous oil price shock decreases a firm's leverage and the cost of external financing, leading to abundant availability for both debt and equity. Lazzari and Pirog (2008) examine the windfall profit tax with oil industry particularly from 2003-2008. And van den Bremer and van der Ploeg (2013) conduct research on the management of oil windfalls with intergenerational, liquidity and investment funds.

4.3 Data and Sample

4.3.1 Sample Construction

To identify cash windfall firms, we choose to use U.S. oil-and-gas firms between 2000 and 2007. Beginning from the soaring of crude oil price in 1999, it remains an upward trend afterwards. By the middle of 2007, the real oil price was almost tripled, and it even increased sharply to \$145 per barrel on July 2008 (Hamilton, 2009). Therefore, the cash flows for oil-and-gas firms during the oil price run-up period should be highly beyond expectation, in which case those firms can be regarded as cash windfall firm in our study. To be consistent with previous oil price shock literature (Fakhri, 2010; Krichene, 2008; Pokrivčák and Rajčaniová, 2011; Reed and Zhang, 2008; Segal, 2007), we collect data of U.S. listed oil and gas firms between 2000 and 2007 as our research sample.

We start from the population of all oil-and-gas firm years covered in Fundamentals Annual section of Compustat North America database. According to Fama-French 49-industry classification standard, the firms with one of the following SIC codes are recognized as oil and gas firms: 1300, 1310-1339, 1370-1382, 1389, 2900-2912 and 2990-2999. The financial data are all collected from Compustat database. The stock prices and returns are obtained from The Centre for Research in Security Prices (CRSP) and the firm-years that are not listed in CRSP are dropped. Following Faulkender and Wang (2006), we also eliminate firm-years if net assets are negative, the market value of equity is negative, or dividends are negative. The 2010 consumer price index (CPI) is collected from World Bank database to ensure that all data are inflation-adjusted.

4.3.2 Methodology and Variables

To be comparable with Faulkender and Wang (2006), our fundamental regression model is as follows:

$$\begin{aligned}
AR_{i,t} &= \alpha_0 + \beta_1 \Delta C_t + \beta_2 C_{t-1} + \beta_3 \Delta E_t + \beta_4 \Delta NA_t + \beta_5 \Delta RD_t + \beta_6 \Delta I_t + \beta_7 \Delta D_t + \beta_8 NF_t \\
&\quad + \beta_9 L_t + \beta_{10} C_{t-1} * \Delta C_t + \beta_{11} L_t * \Delta C_t + \beta_{12} \Delta SALE_t + \beta_{13} BM_t + \epsilon_{i,t} \\
&= \alpha_0 + \beta_1 \frac{\Delta C_{i,t}}{M_{i,t-1}} + \beta_2 \frac{C_{i,t-1}}{M_{i,t-1}} + \beta_3 \frac{\Delta E_{i,t}}{M_{i,t-1}} + \beta_4 \frac{\Delta NA_{i,t}}{M_{i,t-1}} + \beta_5 \frac{\Delta RD_{i,t}}{M_{i,t-1}} \\
&\quad + \beta_6 \frac{\Delta I_{i,t}}{M_{i,t-1}} + \beta_7 \frac{\Delta D_{i,t}}{M_{i,t-1}} + \beta_8 \frac{NF_{i,t}}{M_{i,t-1}} + \beta_9 L_{i,t} + \beta_{10} \frac{C_{i,t-1}}{M_{i,t-1}} * \frac{\Delta C_{i,t}}{M_{i,t-1}} \\
&\quad + \beta_{11} L_{i,t} * \frac{\Delta C_{i,t}}{M_{i,t-1}} + \beta_{12} \frac{\Delta SALE_{i,t}}{SALE_{i,t-1}} + \beta_{13} \frac{BE_{i,t}}{M_{i,t}} + \epsilon_{i,t} \tag{1}
\end{aligned}$$

We first collect data from Compustat to calculate variables that are covered in Faulkender and Wang (2006). The main explanatory variable we focus on is the change of cash holdings: ΔC_t . Specifically, $\Delta C_t = \frac{\Delta C_{i,t}}{M_{i,t-1}}$ where $\Delta C_{i,t}$ is equal to $C_{i,t} - C_{i,t-1}$, one-year change of cash holdings for firm i at year t . Cash holdings for firm i at year t ($C_{i,t}$) are equal to cash plus marketable

securities and the market value of equity for firm i at year t ($M_{i,t}$) is defined as the number of shares multiplied by the stock's closing price at the fiscal year-end. With the same methodology, we can also calculate other independent variables that may be correlated with cash holdings. $C_{i,t-1}$ are one-year lagged cash holdings. Total dividends ($D_{i,t}$) are measured by common dividends paid. Leverage ($L_{i,t}$) is proxied by market debt ratio, which is calculated as total debt divided by the sum of total debt and the market value of equity. Note that the total debt equals to total long-term debt plus total debt in current liabilities. Net financing ($NF_{i,t}$) is measured as total equity issuance minus repurchases plus debt issuance minus debt redemption. Interest expense ($I_{i,t}$) is also considered as a firm-specific variable. To control for the changes of firm's profitability, we include earnings before interest and extraordinary items ($E_{i,t}$). According to Fama and French (1998), Pinkowitz and Williamson (2002) and Faulkender and Wang (2006), $E_{i,t}$ is calculated as the sum of earnings before extraordinary items, interest, deferred tax credits and investment tax credits. To control for firm's investment policy, we include net assets ($NA_{i,t}$) and R&D expenditure ($RD_{i,t}$). Net assets ($NA_{i,t}$) are total assets minus cash holdings. It is important that except for leverage ($L_{i,t}$), other independent variables mentioned so far are all deflated by one-year lagged market value of equity ($M_{i,t-1}$) to eliminate the impact of firm size. In model (1), two interaction variables are added to additionally test the value of cash. $C_{t-1} * \Delta C_t$ is one interaction term of one-year lagged cash level and changes of cash holdings. It is used to estimate how the levels of cash holdings affect the effect of changes in the value of cash. Another interaction term is $L_t * \Delta C_t$, the product of leverage and changes of cash holdings. It is used to verify whether and how the levels of leverage affect the marginal value of cash holdings.

In addition to the above independent variables that are adopted by Faulkender and Wang (2006), we include two other firm-specific variables to proxy for firm's future growth opportunities. One is sales' growth ($\Delta SALE_t$), which equals to $\frac{\Delta SALE_{i,t}}{SALE_{i,t-1}}$. This is one-year percentage change of sales for firm i at year t . The other one is book-to-market ratio ($BM_t = \frac{BE_{i,t}}{M_{i,t}}$). Following Daniel and Titman (2006), the book value of equity ($BE_{i,t}$) for firm i at fiscal year t is first calculated as shareholders' equity minus preferred stock value. To obtain shareholders' equity, we use stockholders' equity, if not missing. If it is missing, we use total common equity plus preferred stock par value, if both are available. Otherwise, we use total assets minus the sum of

total abilities and minority interest, if all exist. If none of these three measures are valid, the shareholders' equity is set to be missing for that firm year. As for preferred stock value, we use redemption value, liquidating value or carrying value, in that order if available. If all these three values are missing, then the preferred stock value is treated as missing for that firm year. As the last step, if not missing, we add the balance sheet deferred taxes and subtract off the FASB106 adjustment to achieve the final book value of equity. The definitions of all independent variables are summarized in Appendix A.

The dependent variable $AR_{i,t}$ in model (1) is size and book-to-market adjusted excess return for firm i at fiscal year t , using the method of Fama and French (1993). With all variables available, we end up with 822 oil and gas firm-year observations between 2000-2007.

4.3.3 Propensity Score Matching

The sample with only oil-and-gas firms involved will probably cause sample selection bias, making our empirical results unreliable. To get rid of this issue, we apply propensity score matching method (Austin, 2011; Rosenbaum and Rubin, 1983) to find a control sample group to match with our treatment sample group (oil-and-gas firm-year sample).

Opler et al. (1999) show that the level of cash holdings for public traded firms is determined by some firm-specific factors, supporting the static tradeoff model of cash holdings. Therefore, the changes of cash holdings are endogenous and meet firms' expectations. Because of oil price run-up shock, however, the cash flows of oil-and-gas firms are unpredictable, making the changes of cash holdings beyond expectation. This is the reason why the oil-and-gas firms are selected as our treatment sample group, maximumly eliminating the endogenous issue. Now to find out the control sample group, the determinates of cash holdings that are identified and investigated by Opler et al. (1999) are used to calculate propensity scores. Each oil-and-gas firm-year in treatment sample group is matched with a non-oil-and-gas firm-year through nearest neighbor matching.

We first collect all the firm-year observations between 2000-2007 from the Fundamentals Annual section of Compustat North America database, excluding the oil-and-gas firm-year

observations for the preparation of control group sample selection. The observations of financial firms (SIC code between 6,000 and 6,999) and utility firms (SIC code between 4,900 and 4,999) are dropped. According to Appendix A, we calculate all independent variables in model (1) as well as the dependent variable so that the firm-years with all variables available are remained in the sample. To mitigate the impact of outliers, we delete firm-years of which the independent and dependent variables are at 1% tails. To be consistent with treatment group, the firm-years with negative net assets, negative market value of equity or negative dividends are also eliminated.

The next important step is to calculate the firm characteristics that affect the level of cash holdings for both treatment group and non-oil and gas sample in accordance with Opler et al. (1999). Data are also obtained from Compustat database. Real size is the natural logarithm of total assets, in which the total assets are deflated using CPI to 2010 dollars. The market-to-book ratio is measured as the total assets, less the book value of equity, plus the market value of equity, divided by total assets. The cash flow ratio is the ratio of cash flow to net assets. The cash flow is proxied by earnings after interest, taxes, and dividends, but before depreciation and amortization. The net asset is simply equal to total assets minus cash and marketable securities. The potential of financial distress is measured as R&D expenditure divided by sales. To measure liquid assets besides cash, we calculate the ratio of net working capital to net assets, in which the net working capital equals total current assets minus the sum of total current liability and cash & marketable securities. The capital expenditure ratio is the capital expenditure divided by net assets. The leverage is measured by debt-to-asset ratio that is defined as the sum of long-term debt and short-term debt divided by total assets. The acquisitions ratio is the ratio of acquisitions over net assets. The effect of dividend payout is distinguished by a payout dummy that equals one if the firm pays dividends and zero otherwise. To identify the impact of industry regulations, a regulation dummy is also created, which is equal to one if the firm belongs to regulated industries and zero otherwise. The regulated industries include railroads (SIC code 4011), trucking (SIC codes 4210 or 4213), airlines (SIC code 4512), and telecommunications (SIC codes 4812 or 4813). The last factor is industry sigma that is used to measure cash flow riskiness. For each firm, we compute the standard deviations of cash flows for the previous 20 years since 1979; and then we take average across the 2-digit SIC codes of the cash flow standard deviations as industry volatility of cash flows.

For every firm-year observation in both the treatment sample group and non-oil-and-gas sample, we calculate the propensity score based on the above firm characteristics. Each oil-and-gas firm-year observation is matched with one non-oil-and-gas firm-year observation through nearest neighbor matching. Our final sample includes 822 oil-and-gas firm-years (treatment group) and 822 non-oil-and-gas firm-years (control group). Table 4.1 reports the descriptive statistics of the main variables for all the firm-year observations in our sample. Panel A shows the statistics for all oil-and-gas firm-years in the treatment group while Panel B is for all non-oil-and-gas firm-years in the control group. If we look at the change of cash holdings (ΔC_t) for both groups, we will find that the treatment group has positive mean while the control group has negative mean, indicating that the cash holdings of oil-and-gas firms keep increasing on average between 2000 and 2007, which is comply with the fact of oil price run-up shock during that period. The median of change of cash holding for treatment group is also higher than that for control group. With similar levels of standard deviation, the treatment group has much higher minimum and maximum value of change of cash holdings than control group does, again supporting the cash windfall feature of oil-and-gas firms between 2000 and 2007. As for some other control variables, the treatment group also has positive means that are higher than those of control group, including the change of earnings (ΔE_t), the change of net asset (ΔNA_t), net financing (NF_t) and sales growth rate ($\Delta SALE_t$).

Table 4.1 Summary Statistics of Main Variables

This table reports the descriptive statistics of main variables for both treatment group (oil and gas firm-years) and control group (non-oil and gas firm-years). The definitions of those variables are listed in Appendix A.

Variables	Mean	Median	Min	Max	Std Dev	Obs.
Panel A. Treatment Group (oil and gas firm-years)						
ΔC_t	0.022	0.003	-0.760	1.736	0.163	822
C_{t-1}	0.104	0.041	0.000	1.760	0.174	822
ΔE_t	0.052	0.026	-3.903	13.037	0.602	822
ΔNA_t	0.214	0.116	-7.341	19.221	0.980	822
ΔRD_t	0.000	0.000	-0.113	0.449	0.017	822
ΔI_t	0.002	0.000	-1.014	0.333	0.052	822
ΔD_t	0.001	0.000	-0.109	0.090	0.008	822
L_t	0.236	0.201	0.000	0.959	0.189	822
NF_t	0.110	0.009	-1.546	16.379	0.690	822
$\Delta SALE_t$	0.331	0.207	-1.000	18.750	0.973	822
BM_t	0.682	0.550	0.011	8.719	0.711	822
Panel B. Control Group (non-oil and gas firm-years)						
ΔC_t	-0.004	0.001	-1.739	1.138	0.159	822
C_{t-1}	0.156	0.072	0.000	2.476	0.266	822
ΔE_t	0.026	0.004	-1.126	9.755	0.477	822
ΔNA_t	0.002	0.024	-7.472	1.853	0.436	822
ΔRD_t	-0.001	0.000	-0.140	0.069	0.011	822
ΔI_t	0.001	0.000	-0.326	0.189	0.027	822
ΔD_t	-0.000	0.000	-0.089	0.110	0.008	822
L_t	0.276	0.225	0.000	0.987	0.237	822
NF_t	0.021	0.001	-1.926	1.853	0.229	822
$\Delta SALE_t$	0.104	0.047	-1.000	34.080	1.212	822
BM_t	0.814	0.537	0.033	19.502	1.128	822

4.3.4 Constraint and Unconstraint Subsamples

In addition to testing the marginal value of cash, Faulkender and Wang (2006) also investigate whether the marginal value of cash holdings is more valuable in financially constrained firms. To be consistent with their research and be comparable with their results, we divide our full sample before propensity score matching into constraint group and unconstraint group. The oil-and-gas firm-years in constraint (unconstraint) group is our constraint (unconstraint) treatment group. For each oil-and-gas firm-year in constraint treatment group, we match with a non-oil-and-gas constraint firm-year; and for each oil-and-gas firm-year in unconstraint treatment group, we match with a non-oil-and-gas unconstraint firm-year. Finally, we have two subsamples: one is constraint subsample that includes firm-years of both constraint treatment group and constraint control group; the other one is unconstraint subsample that includes firm-years of both unconstraint treatment group and unconstraint control group. According to Almeida et al. (2004) as well as Faulkender and Wang (2006), four different methods are used to measure financial constraints.

1. Payout ratio: The first method to identify financially constrained (unconstrained) firms is payout ratio that is calculated as total dividends divided by earnings (Compustat item 18). Total dividends are the sum of total common dividends and stock repurchase (Compustat item 21 + Compustat item 220). Firms with lower (higher) payout ratio are classified as financially constrained (unconstraint) firms, which is also documented by Fazzari et al. (1988). Specifically, for every year between 2000 and 2007, we rank all the firms including oil-and-gas firms and non-oil-and-gas firms together based on their annual payout ratios. The firms in the top three deciles of annual payout distribution are regarded as financially constrained firms while those in the bottom three deciles are regarded as financially unconstrained firms.
2. Sales (Firm size): The second method to distinguish financially constrained and unconstrained firms is firm size. Large firms have better access to capital markets than small firms do so that it is easier for large firms to raise capitals, making large firms less likely to be financially constrained. Following Faulkender and Wang (2006), we use sales (Compustat item 12) to measure firm size. For each year from 2000 to 2007, all firms are ranked by their sales of previous fiscal year end. Those in the top three

- deciles of sales distribution are identified as financially unconstrained firms while those in the bottom three deciles are financially constrained firms.
3. Long-term bond rating: The third method is related to bond rating data that is obtained from Ratings section of Compustat North America database. When firms report positive total debt (Compustat item 34 + Compustat item 9), the firm-years with long-term bond rating available are assigned to financially unconstrained group while the firm-years with missing long-term bond rating are assigned to financially constrained group. We treat firms with no debt and no long-term bond rating as financially unconstrained firms. The intuition behind bond rating is documented by Faulkender and Petersen (2006), and similar approaches are also adopted by some other scholars, including Whited (1992), Kashyap et al. (1994) and Gilchrist and Himmelberg (1995).
 4. Commercial paper rating: The utilization of the fourth method is the same with the third one but now we use commercial paper rating (short-term credit rating) instead of long-term bond rating. With positive total debt, if the firm-years have commercial paper ratings, we assign them to financially unconstrained group; however, if the firm-years do not have commercial paper ratings, we assign them to financially constrained group. The firm-years with no debt and no commercial paper ratings are financially unconstrained firm-year observations.

4.4 Empirical Results

4.4.1 Marginal Value of Cash

To measure marginal value of cash, we run regression of model (1) with our cash windfall firm-year sample that consists of 822 oil-and-gas firm-years and 822 non-oil-and-gas matching firm-years from 2000 to 2007. We first use the same variables of Faulkender and Wang (2006) to compare the results fairly between their results and ours so that Table 4.2 shows the baseline regression results without sales growth and book-to-market ratio. White heteroscedastic-consistent standard errors are calculated to correct correlation across observations of a given firm (White,1980). In column I of Table 4.2, the interaction terms between change of cash holdings and other two variables are not included. We will see that the coefficient for change of cash holdings (ΔC_t) is 1.40, simply indicating that one dollar increase of cash holdings will also lead to an

increase in shareholders' wealth by \$1.401. This number is nearly twice as the result (\$0.751) in Faulkender and Wang (2006). To examine whether the current level of cash holdings and leverage affect the marginal value of cash, the two interaction variables ($C_{t-1}*\Delta C_t$ and $L_t*\Delta C_t$) are added to the regression and the results are presented in column II of Table 4.2. The coefficient of ΔC_t is still significantly positive but much higher than that in column 1. Both two interaction variables have significantly negative coefficients, suggesting that the cash holdings on hand and the existence of debt will decrease the marginal value of cash. For a firm with no cash on hand and no debt issued, one dollar increase of cash holdings will be valued at \$2.408, more than twice as its own value. Since the current level of cash holdings or say the cash holdings at the beginning of year t (C_{t-1}) is deflated by the market value of equity, the coefficient of the interaction term between change of cash holding and the current level of cash holding ($C_{t-1}*\Delta C_t$), which equals -0.754, means that the marginal value of cash is 7.54 cents lower if the percentage of current cash holdings to the firm's market value of equity is 10% higher, other things equal. This is consistent with Faulkender and Wang (2006). For all-equity firms (no debt), if the current cash holding is 5% of the market value of equity, then the firm value will increase by \$2.370 ($=\$2.408+(-0.754*5\%)$) from one extra dollar increase of cash; if the current cash holding is 15% of the market value of equity, then the firm value will increase by \$2.295 ($=\$2.408+(-0.754*15\%)$) from one extra dollar increase of cash. The higher the current level of cash holdings, the lower the marginal value of cash. From Table 4.1, the mean of the current cash holdings on hand is 0.130 ($= (0.104+0.156)/2$). Therefore, on average, the marginal value of cash for all-equity firms in our sample is 2.310 ($=\$2.408+(-0.754*13\%)$), which is almost \$1 higher than the results in Faulkender and Wang (2006).

Table 4.2 Regression Results for the Energy Sample from 2000 – 2007: I

This table presents the results of regressing the annual excess return on changes in firm characteristics over the fiscal year. The full sample includes 1,644 firm-year observations of which 822 firm-year observations are from oil and gas industry and other 822 firm-year observations are matching firm-years from other industries (financial firms and utility firms are excluded). The regression III is only on the subset of firms with positive earnings and positive payout in the corresponding fiscal year, resulting in 850 firm-year observation in the subsample. The definitions of all independent variables are listed in Appendix A. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White,1980).

Independent Variables	I	II	III
ΔC_t	1.401*** (0.188)	2.408*** (0.325)	0.799 (0.554)
C_{t-1}	0.186** (0.094)	0.187** (0.086)	0.230* (0.128)
ΔE_t	0.120** (0.050)	0.132** (0.060)	0.327** (0.164)
ΔNA_t	0.247*** (0.070)	0.281*** (0.073)	0.112** (0.052)
ΔRD_t	5.586** (2.415)	4.652** (1.950)	5.401 (5.737)
ΔI_t	-2.260*** (0.577)	-2.619*** (0.639)	0.113 (0.741)
ΔD_t	3.428** (1.498)	2.772* (1.473)	3.740** (1.574)
L_t	-0.669*** (0.076)	-0.612*** (0.073)	-0.477*** (0.095)
NF_t	-0.178* (0.094)	-0.222** (0.095)	-0.095 (0.066)
$C_{t-1}*\Delta C_t$		-0.754*** (0.225)	0.582 (0.547)
$L_t *\Delta C_t$		-1.531*** (0.556)	-0.974 (0.740)
Re_t			-0.021 (0.035)
$Re_t*\Delta C_t$			0.193 (0.548)
Intercept	0.203*** (0.027)	0.178*** (0.026)	0.160*** (0.034)
Observations	1,644	1,644	850
Adj R ²	0.194	0.213	0.109

Similarly, the leverage also has a negative impact on the marginal value of cash but with a larger magnitude than the current level of cash holdings does. The coefficient of the leverage interaction term ($L_t * \Delta C_t$) in column II of Table 4.2 is significant at 1% and is equal to -1.531. Compared with all-equity firms, the firms with total debt equal to 10% of the market value of equity will be valued 15.31 cents lower with one dollar increase in cash holdings, which supports part of the findings in Faulkender and Wang (2006). When firms have higher leverage ratio, they will be more likely to default. However, as firms hold more and more cash, their ability of paying debt becomes stronger so that the debtholders will benefit more from the cash that firms receive. As a result, the marginal value of cash to shareholders is reduced because of the existence of debt. The higher the leverage ratio, the greater the negative impact on the value of one-dollar additional cash.

In general, most firms have some cash on hand to keep daily operation and issue debt to raise new capitals. So when we estimate the marginal value of cash, we need to combine the coefficients of change of cash holdings as well as the two interaction variables together. In our sample, the mean of the cash holdings at the beginning of fiscal year t is 13% of market value of equity and the mean of total debt is 25.6% ($= (0.236+0.276)/2$) to the market value of equity. For a mean firm in our full sample, one extra dollar of cash is worth \$1.918 ($= \$2.408+(-0.754*13\%) + (-1.531*25.6\%)$) to shareholders' wealth. This finding contrasts with the results in Faulkender and Wang (2006) that show the marginal value of cash to shareholders for the mean firm is only \$0.94. Their results suggest that the value of one extra dollar of cash is not fully incorporated into stock prices because the cash that firms hold is valued after taxes. However, our results indicate that nearly twice the value of one extra dollar is reflected in stock prices. This is probably because our sample selection maximumly eliminates the endogenous issue so that the change of cash holdings is not correlated with firm-specific characteristics, making the stock prices truly reflect how shareholders respond to the increase in cash holdings that they do not expect at the beginning. For oil-and-gas firms, we can also easily figure out the marginal value of cash on average that is equal to \$1.968 ($= \$2.408+(-0.754*10.4\%) + (-1.531*23.6\%)$), which is only slightly higher than that in the full sample.

In column III of Table 4.2, we restrict our sample observations to those firm-years that have positive earnings and positive dividend payout in corresponding fiscal year, in order to examine if

the distribution methods of cash to shareholders affect the marginal value of cash. Two more variables are included in the regression: one is repurchase ratio (Re_t) that is calculated as repurchase divided by the sum of repurchase and dividend; the other one is an interaction term between the repurchase ratio and the change in cash holdings ($Re_t*\Delta C_t$). There are 425 oil-and-gas firm-years and 425 non-oil-and-gas matching firm-years remained in the regression of column III. Different from Faulkender and Wang's (2006) conclusion, our results do not show any significant relationship between the repurchase ratio and the marginal value of cash. The coefficient of change in cash holdings becomes insignificant and the three interaction terms are also insignificant. It seems for firms already paying dividends to shareholders, the increase of cash holdings will not bring significantly additional value to the firms. The current level of cash holdings, the leverage ratio and the repurchase ratio are obviously irrelevant with the marginal value of cash under this circumstance.

As mentioned in section 3.2, we add two more control variables-sales growth ($\Delta SALE_t$) and book-to-market ratio (BM_t) to proxy for firms' future growth opportunities, comparing with Faulkender and Wang's (2006) study. Therefore, the three regressions in Table 4.2 are repeated with those two variables and the results are exhibited in Table 4.3. Controlling for the effects of firms' future growth opportunities, the estimates of column I and II in Table 4.3 are very close to those in Table 4.2, supporting our findings that more than full value of one extra dollar of cash is incorporated into stock prices, and both the cash holdings on hand and the leverage have significantly negative impact on the marginal value of cash. In column III, the coefficient of change in cash holdings is still positive (0.927) although it is only significant at 10% level, indicating that the marginal value of cash to shareholders is slightly less than \$1 for firms that have already paid dividends. Only the leverage ratio negatively affects the marginal value of cash. The channels through which the firms return cash to shareholders do not influence how shareholders value the increase of cash holdings, consistent with the result in Table 4.2.

Table 4.3 Regression Results for the Energy Sample from 2000 – 2007: II

This table presents the results of regressing the annual excess return on changes in firm characteristics over the fiscal year. The full sample includes 1,644 firm year observations in which 822 firm year observations are from oil and gas industry and other 822 firm year observations are matching firm year from other industries. Sales growth ($\Delta SALE_t$) and book-to-market ratio (BM_t) are included to control for future growth opportunities. The regression III is only on the subset of firms with positive earnings and positive payout in the corresponding fiscal year, resulting in 850 firm year observation in the subsample. The definitions of all independent variables are listed in Appendix A. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White, 1980).

Independent Variables	I	II	III
ΔC_t	1.399*** (0.186)	2.303*** (0.323)	0.927* (0.510)
C_{t-1}	0.262*** (0.096)	0.235*** (0.084)	0.297** (0.120)
ΔE_t	0.113** (0.049)	0.122** (0.057)	0.220 (0.164)
ΔNA_t	0.206*** (0.068)	0.241*** (0.072)	0.030 (0.060)
ΔRD_t	5.113** (2.281)	4.511** (1.833)	4.235 (5.876)
ΔI_t	-1.933*** (0.564)	-2.326*** (0.629)	0.061 (0.848)
ΔD_t	3.450** (1.430)	2.867** (1.395)	2.826* (1.441)
L_t	-0.406*** (0.081)	-0.355*** (0.080)	-0.241** (0.122)
NF_t	-0.150* (0.091)	-0.196** (0.092)	-0.006 (0.075)
$\Delta SALE_t$	-0.000*** (0.000)	-0.000*** (0.000)	0.109*** (0.031)
BM_t	-0.144*** (0.023)	-0.142*** (0.024)	-0.158*** (0.050)
$C_{t-1} * \Delta C_t$		-0.811*** (0.201)	0.527 (0.501)
$L_t * \Delta C_t$		-1.142** (0.537)	-1.366** (0.686)
Re_t			-0.033 (0.033)
$Re_t * \Delta C_t$			0.200 (0.504)
Intercept	0.236*** (0.027)	0.213*** (0.026)	0.204*** (0.033)
Observations	1,644	1,644	850
Adj R ²	0.224	0.241	0.163

4.4.2 Financial Constraint Subsamples

According to each of the four alternative financial constraint criteria, we form one financially constrained subsample and one financially unconstrained subsample separately. Every subsample consists of equal number of oil-and-gas firm-year observations and non-oil-and-gas matching firm-year observations. The summary statistics of the main independent variables are presented in Table 4.4 for those financially constrained and unconstrained subsamples. The financially constrained subsample is marked as capital letter C and the financially unconstrained subsample is marked as capital letter U. For each variable in each subsample, we report the mean value first as well as the median value in the bracket below the mean.

Table 4.4 Summary statistics of constraint and unconstraint subsamples from 2000-2007

This table shows the summary statistics of main independent variables for financially constrained (C) and unconstrained (U) subsamples that are formed through four alternative schemes. Each subsample includes equal number of oil-and-gas firm-year observations and non-oil-and-gas matching firm-year observations. For each variable, the numbers of the first row are the mean values and the numbers in the bracket below are the median values. The definitions of all independent variables are listed in Appendix A.

Financial Criteria	Payout Ratio		Firm Size		Bond Ratings		Comm. Paper Ratings	
	(C)	(U)	(C)	(U)	(C)	(U)	(C)	(U)
ΔC_t	0.0135	0.0072	0.0173	0.0144	0.0159	0.0100	0.0146	0.0088
	[0.0023]	[0.0019]	[0.0009]	[0.0045]	[0.0007]	[0.0031]	[0.0017]	[0.0048]
C_{t-1}	0.1591	0.0762	0.1902	0.0747	0.1289	0.1289	0.1203	0.1402
	[0.0701]	[0.0403]	[0.0889]	[0.0379]	[0.0562]	[0.0534]	[0.0567]	[0.0521]
ΔE_t	0.0356	0.0294	0.0500	0.0151	0.0390	0.0251	0.0314	0.0186
	[0.0093]	[0.0111]	[0.0083]	[0.0085]	[0.0091]	[0.0080]	[0.0093]	[0.0065]
ΔNA_t	0.1119	0.1174	0.1211	0.1176	0.0908	0.1290	0.1048	0.0881
	[0.0653]	[0.0570]	[0.0520]	[0.0508]	[0.0616]	[0.0524]	[0.0679]	[0.0409]
ΔRD_t	0.0004	0.0002	0.0015	0.0001	0.0005	-0.0009	0.0000	-0.0006
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
ΔI_t	0.0027	0.0011	0.0029	0.0017	0.0020	0.0021	0.0013	-0.0005
	[0.0002]	[0.0002]	[0.0004]	[0.0001]	[0.0005]	[0.0000]	[0.0005]	[0.0000]
ΔD_t	-0.0001	0.0027	0.0006	0.0004	-0.0002	0.0007	0.0007	0.0010
	[0.0000]	[0.0004]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
L_t	0.2832	0.2009	0.2282	0.2600	0.2409	0.2532	0.2737	0.1495
	[0.2344]	[0.1716]	[0.1686]	[0.2121]	[0.1817]	[0.2148]	[0.2234]	[0.1175]
NF_t	0.1040	0.0104	0.1437	0.0169	0.0965	0.0504	0.0781	0.0124
	[0.0107]	[-0.0074]	[0.0113]	[-0.0118]	[0.0082]	[0.0012]	[0.0096]	[-0.0012]
$\Delta SALE_t$	0.2823	0.1531	0.4245	0.1251	0.2372	0.2007	0.2535	0.1426
	[0.1043]	[0.0748]	[0.1263]	[0.0694]	[0.1016]	[0.0849]	[0.1006]	[0.0709]
BM_t	0.8342	0.6108	0.8392	0.7113	0.8035	0.6986	0.7680	0.6511
	[0.5459]	[0.5249]	[0.5322]	[0.5504]	[0.5375]	[0.5360]	[0.5383]	[0.5100]
Obs.	1,068	456	486	480	768	876	1,320	324

Under all four financial constraint criteria, both mean and median of change in cash holdings are positive, which consists with the fact of oil price run-up shock during the period of 2000-2007. The mean change in cash holdings for financially constrained subsample is higher than that for financially unconstrained subsample. However, the median change for financially constrained subsamples is lower than that for financially unconstrained subsamples under three of the four criteria (except for payout ratio criterion), suggesting that financially constrained firms do not have easy access to capital markets and are more dependent on internal funds so that the cash inflows due to oil price increase shock will be mostly used by financially constrained firms. As for the level of cash holdings at the beginning fiscal year t , we can also find that the mean cash holdings of financially constrained firms are higher than or at least equal to the mean of unconstrained firms except for commercial paper rating criterion, and the median cash holdings of constrained firms are higher than those of unconstrained firms under all four criteria. This also provides evidence to support that financially constrained firms keep relatively high level of cash holdings so that it is easy for them to use the internal funds when needed.

We still use model (1) to run regressions for financially constrained and unconstrained subsamples, respectively. In Table 4.5, we will find that the coefficient of change in cash holdings for financially constrained firms is positive and statistically significant at 1% level under all four criteria, whereas the coefficient for financially unconstrained firms is also positive but only significant under two rating criteria. Comparing with unconstrained subsample, the financially constrained firms have larger coefficient of change in cash holdings and thus higher marginal value of cash. The difference between the coefficients of change in cash holdings for constrained and unconstrained subsamples is significant at 1% level, regardless of which financial constraint criterion is used. Financially unconstrained firms have better access to capital markets and can raise external funds more easily, therefore it is not necessary for them to hold a lot of cash, resulting in low marginal value of cash. On the contrary, financially constrained firms rely on internal funds when additional cash are requested so that one dollar increase in cash holdings is valued more for those firms.

Regarding to the interaction term between the change in cash holdings and the cash holdings at the beginning fiscal year, the coefficients for constrained and unconstrained subsamples under four criteria cannot lead to unified conclusions. However, using payout ratio and firm size as

financial constraint measures, the constrained firms do have a significantly negative coefficient with a larger magnitude than the insignificant coefficient of unconstrained firms. When financially constrained firms have no cash or little cash on hand, it would be difficult for them to expand business or make investment in good projects without easy access to capital markets so that the marginal value of cash is highest under this situation. As the cash in the account increases and is more than enough to meet demand, the ability of raising external capitals is not that important even the firm is financially constrained, making one extra dollar of cash less valuable. To figure out whether the leverage has different impacts on the marginal value of cash between financially constrained and unconstrained groups, we move to the interaction term of change in cash holdings with the leverage ratio. The coefficient in constrained subsample is statistically and significantly negative at least 5% level under all four criteria, whereas the coefficient in unconstrained subsample is not significant under three of four criteria. Although it is significantly negative with bond rating criterion, the absolute value of the estimate is still lower than that in constrained subsample, indicating that leverage has less or no impact on the marginal value of cash for financially unconstrained firms. For firms that are financially constrained, higher leverage causes higher default risk so that the debtholders will benefit more from the increase in cash holdings because of their priority in bankruptcy, lowering the marginal value of cash to shareholders.

With the summary statistics in Table 4.4 as well as the coefficient estimates of three variables that relates to change in cash holdings, we can figure out the marginal value of cash for mean firms in constrained and unconstrained subsamples, respectively. Take the payout ratio criterion for example, one extra dollar of cash is worth \$2.148 ($= \$2.865 + (-0.727 * 15.91\%) + (-2.125 * 28.32\%)$) for mean financially constrained firms while it is only worth \$1.331 to shareholders for mean financially unconstrained firms. Apparently, the marginal value of cash is more than \$1 for both constrained and unconstrained groups, and it is higher for financially constrained firms than that for unconstrained firms. Under firm size criterion, marginal value of cash seems insignificant in unconstrained subsample but is equal to \$1.050 ($= \$1.997 + (-1.378 * 19.02\%) + (-3.000 * 22.82\%)$) in constrained subsample, suggesting that one dollar increase in cash holdings will increase shareholders' wealth by a value of more than one dollar. Similarly, the estimate of marginal value of cash is \$2.116 ($= \$2.712 + (-2.475 * 24.09\%)$) for constrained group and \$1.885 ($= \$2.382 + (-1.962 * 25.32\%)$) for unconstrained group under bond rating criterion, \$2.212 ($= \$2.960 + (-$

2.733*27.37%)) and \$2.590 ($=\$2.825+(-1.675*14.02\%)$) under commercial paper rating criterion. Except for the last constraint measure, the results with other three measures all show that the increase in cash holdings will add more value to shareholders of financially constrained firms. Controlling for sales growth and book-to-market ratio, the results in Table 4.6 are quite similar with those in Table 4.5, strongly supporting our conclusions above.

Table 4.5 Regressions for Constrained and Unconstrained Groups for Energy Sample from 2000-2007: I

This table shows the regression results for financially constrained (C) and unconstrained (U) subsamples according to four alternative financial constraint criteria. The dependent variable is annual size and book-to-market adjusted excess return for fiscal year t . All independent variables are listed in Appendix A. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White, 1980).

Indep. Var.	Payout Ratio		Firm Size		Bond Ratings		Comm. Paper Ratings	
	(C)	(U)	(C)	(U)	(C)	(U)	(C)	(U)
ΔC_t	2.865*** (0.450)	1.331* (0.707)	1.997*** (0.351)	0.739 (0.481)	2.712*** (0.849)	2.382*** (0.295)	2.960*** (0.617)	2.825*** (0.294)
<i>p-value (C-U)</i>	<.0001		<.0001		<.0001		<.0001	
C_{t-1}	0.242* (0.128)	0.297* (0.170)	-0.285* (0.147)	0.881*** (0.260)	0.274 (0.217)	0.187** (0.087)	0.306** (0.150)	0.018 (0.147)
<i>p-value (C-U)</i>	<.0001		<.0001		<.0001		<.0001	
ΔE_t	0.187** (0.084)	0.473 (0.295)	0.038 (0.050)	0.602*** (0.209)	0.150* (0.078)	0.539*** (0.122)	0.191** (0.092)	0.473** (0.189)
ΔNA_t	0.272*** (0.087)	0.263*** (0.086)	0.151** (0.075)	0.076 (0.048)	0.342** (0.144)	0.155*** (0.043)	0.245*** (0.087)	0.303*** (0.100)
ΔRD_t	4.457*** (1.619)	-1.276 (3.765)	5.037*** (1.896)	8.895 (8.665)	5.992*** (1.909)	1.152 (0.975)	2.948 (3.326)	1.911 (1.695)
ΔI_t	-2.622*** (0.631)	5.874 (4.143)	-0.886 (0.608)	0.860 (1.103)	-3.348*** (1.031)	-0.372 (1.282)	-3.282*** (0.806)	0.027 (3.240)
ΔD_t	6.452 (11.048)	1.616 (1.188)	2.136 (2.017)	1.817 (2.506)	-1.645* (0.946)	3.956** (1.766)	0.801 (0.780)	0.743 (2.948)
L_t	-0.605*** (0.092)	-0.630*** (0.139)	-0.935*** (0.140)	-0.513*** (0.106)	-0.721*** (0.139)	-0.400*** (0.093)	-0.705*** (0.086)	-0.373** (0.148)
NF_t	-0.224** (0.113)	-0.567* (0.315)	-0.029 (0.109)	-0.272*** (0.095)	-0.277 (0.177)	-0.284*** (0.105)	-0.209* (0.111)	-0.283 (0.219)
$C_{t-1}*\Delta C_t$	-0.727** (0.362)	-0.456 (1.516)	-1.378*** (0.474)	-0.588 (1.527)	-0.200 (0.453)	-0.504 (0.330)	-0.449 (0.500)	-1.675*** (0.460)
$L_t*\Delta C_t$	-2.125*** (0.623)	-0.676 (2.168)	-3.000*** (0.754)	0.710 (0.871)	-2.475** (1.219)	-1.962*** (0.467)	-2.733*** (0.892)	-3.068 (2.531)
<i>Intercept</i>	0.170*** (0.038)	0.153*** (0.036)	0.336*** (0.067)	0.155*** (0.032)	0.206*** (0.046)	0.136*** (0.028)	0.219*** (0.032)	0.071* (0.039)
Obs.	1,068	456	486	480	768	876	1,320	324
Adj R ²	0.215	0.149	0.214	0.247	0.182	0.255	0.198	0.351

Table 4.6 Regressions for Constrained and Unconstrained Groups for Energy Sample from 2000-2007: II

This table shows the regression results for financially constrained (C) and unconstrained (U) subsamples according to four alternative financial constraint criteria. The dependent variable is annual size and book-to-market adjusted excess return for fiscal year t . Sales growth ($\Delta SALE_t$) and book-to-market ratio (BM_t) are additionally included to control for future growth opportunities. All independent variables are listed in Appendix A. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White, 1980).

Indep. Var.	Payout Ratio		Firm Size		Bond Ratings		Comm. Paper Ratings	
	(C)	(U)	(C)	(U)	(C)	(U)	(C)	(U)
ΔC_t	2.787*** (0.445)	1.723*** (0.441)	1.880*** (0.370)	0.852* (0.449)	2.735*** (0.854)	2.327*** (0.302)	2.892*** (0.608)	2.711*** (0.322)
<i>p-value</i> (C-U)	<.0001		<.0001		<.0001		<.0001	
C_{t-1}	0.252** (0.120)	0.643*** (0.156)	-0.217 (0.151)	1.025*** (0.258)	0.280 (0.211)	0.245*** (0.087)	0.340** (0.143)	0.382** (0.161)
<i>p-value</i> (C-U)	<.0001		<.0001		<.0001		<.0001	
ΔE_t	0.181** (0.081)	0.479** (0.206)	0.040 (0.051)	0.561*** (0.180)	0.154** (0.077)	0.520*** (0.106)	0.190** (0.092)	0.269 (0.184)
ΔNA_t	0.236*** (0.087)	0.104 (0.090)	0.122* (0.073)	0.028 (0.053)	0.280* (0.149)	0.143*** (0.040)	0.216** (0.086)	0.312** (0.131)
ΔRD_t	4.172** (1.622)	-0.345 (3.745)	4.860** (1.950)	6.237 (8.036)	5.795*** (1.884)	1.429 (0.909)	3.030 (3.193)	-1.341 (2.989)
ΔI_t	-2.504*** (0.612)	3.430 (3.741)	-0.811 (0.555)	1.140 (1.219)	-3.289*** (1.080)	-0.515 (1.200)	-3.137*** (0.820)	-3.072 (3.539)
ΔD_t	6.071 (10.353)	0.724 (1.026)	1.929 (1.889)	1.577 (2.392)	-1.983** (0.959)	3.617** (1.697)	0.137 (0.686)	0.783 (2.618)
L_t	-0.413*** (0.096)	0.081 (0.133)	-0.727*** (0.147)	-0.226* (0.122)	-0.548*** (0.138)	-0.178* (0.097)	-0.455*** (0.096)	0.089 (0.165)
NF_t	-0.202* (0.111)	-0.383 (0.275)	-0.019 (0.106)	-0.210** (0.097)	-0.239 (0.179)	-0.276*** (0.100)	-0.193* (0.110)	-0.266 (0.222)
$\Delta SALE_t$	-0.000*** (0.000)	0.144** (0.061)	-0.000*** (0.000)	0.111** (0.056)	0.135*** (0.039)	-0.000*** (0.000)	-0.000*** (0.000)	0.033 (0.054)
BM_t	-0.100*** (0.022)	-0.520*** (0.058)	-0.121*** (0.036)	-0.141*** (0.032)	-0.069** (0.034)	-0.133*** (0.036)	-0.127*** (0.025)	-0.292*** (0.074)
$C_{t-1}*\Delta C_t$	-0.810** (0.337)	-0.620 (0.944)	-1.397*** (0.503)	-0.433 (1.480)	-0.300 (0.444)	-0.932*** (0.313)	-0.611 (0.470)	-1.350*** (0.506)
$L_t*\Delta C_t$	-1.806*** (0.610)	-2.083 (1.301)	-2.359*** (0.826)	0.306 (0.820)	-2.431* (1.242)	-1.236*** (0.456)	-2.363*** (0.870)	-2.460 (2.455)
<i>Intercept</i>	0.198*** (0.037)	0.300*** (0.037)	0.380*** (0.069)	0.160*** (0.031)	0.188*** (0.046)	0.163*** (0.028)	0.246*** (0.032)	0.139*** (0.046)
Obs.	1,068	456	486	480	768	876	1,320	324
Adj R ²	0.231	0.302	0.228	0.303	0.204	0.294	0.220	0.399

4.5 Long-run Performance

The dependent variable we used so far is one-year size and book-to-market adjusted excess return in the fiscal year t , the same year for change in cash holdings. To examine whether the market reacts to the change in cash holdings in a sufficient manner, we next calculate one-year size and book-to-market adjusted excess return after fiscal year end t as a dependent variable to see if the change in cash holding also has impact on post stock performance.

In order to make a fair comparison between our results and Faulkender and Wang's (2006) because of different sample selections and endogeneity issue, we first use the same sample of Faulkender and Wang's (2006) to investigate whether and how the change in cash holdings affect the post stock performance. By applying exactly the same sample selection conditions, we obtain 78,582 firm-year observations from 1971 to 2001, a sample size very close to that in Faulkender and Wang's (2006). With the annual excess return after fiscal year end t as the dependent variable and the same independent variables in Table 4.2, the regression results are presented in column I and column II of Table 4.7. It is not surprising that the coefficient of change in cash holdings in both column I and column II is statistically and significantly positive at 1% level, suggesting that the increase in cash holding will still positively affect stock returns in the next year. The interaction terms that interact the change in cash holdings with cash holdings on hand and the leverage do not have any significant relationship with post excess return, indicating that both the level of cash holdings at beginning fiscal year t and the leverage at fiscal year t do not have impact on the marginal value of cash on the stock performance in the year after the fiscal year end t . Therefore, the results in column I and II are quite consistent with each other that one extra dollar of cash in fiscal year t is still worth around 23 cents to shareholders in next fiscal year $t+1$. In the study of Faulkender and Wang's (2006), the market apparently underestimates the marginal value of cash so that partial value of increase in cash holdings is incorporated into stock prices in the next year $t+1$. The possible reason is that how much cash should be held by the firm is determined by some firm-specific characteristics that also affect the stock performance at the same time, making the change in cash holdings not exogenous.

Table 4.7 Regression Results for Long-run Performance

This table presents the results of regressing the annual excess return after fiscal year end on changes in firm characteristics over the fiscal year t . Column I and column II use the sample that is derived through the same method of Faulkender and Wang (2006), resulting 78,582 firm-year observations. Column III and Column IV use our own sample that includes 1,626 firm-year observations in which 813 firm-year observations are from oil and gas industry and other 813 firm-year observations are matching firm-year from other industries. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White (1980)).

Independent Variables	I	II	III	IV
ΔC_t	0.243*** (0.017)	0.233*** (0.030)	0.115 (0.108)	-0.130 (0.173)
C_{t-1}	0.078*** (0.010)	0.080*** (0.010)	-0.006 (0.079)	-0.015 (0.081)
ΔE_t	0.153*** (0.014)	0.154*** (0.014)	0.011 (0.037)	0.008 (0.035)
ΔNA_t	0.022*** (0.007)	0.022*** (0.007)	-0.029 (0.048)	-0.036 (0.050)
ΔRD_t	-0.014 (0.147)	-0.014 (0.147)	-1.843** (0.893)	-1.562* (0.895)
ΔI_t	-0.258*** (0.086)	-0.260*** (0.086)	0.205 (0.608)	0.270 (0.589)
ΔD_t	0.770*** (0.261)	0.770*** (0.261)	1.889 (1.242)	2.049* (1.241)
L_t	0.015* (0.009)	0.014 (0.009)	0.147 (0.116)	0.134 (0.117)
NF_t	-0.190*** (0.012)	-0.189*** (0.012)	0.039 (0.056)	0.048 (0.058)
$C_{t-1} * \Delta C_t$		0.041 (0.053)		0.150 (0.129)
$L_t * \Delta C_t$		-0.015 (0.064)		0.436 (0.378)
Intercept	-0.023*** (0.003)	-0.023*** (0.003)	0.035 (0.032)	0.042 (0.033)
Observations	78,582	78,582	1,626	1,626
Adj R ²	0.012	0.012	0.000	0.000

To eliminate the endogeneity issue to the utmost extent, we select oil-and-gas firm-year observations during the oil price run-up period between 2000-2007 as well as equal number of matching non-oil-and-gas firm-year observations to keep a clean sample. The regression results involving post stock performance are exhibited in column III and column IV of Table 4.7. In contrast to the findings in column I and II, the coefficient of change in cash holdings in both column III and IV is insignificant and the coefficients of the two interaction terms are not significant in column IV either, meaning the change in cash holdings does not have influence on post stock performance next year. In other words, there is no market underreaction towards the change in cash holding in our sample, supporting our previous findings that the marginal value of cash is worth more than \$1 and this one extra dollar of cash is valued correctly and accurately by shareholders in the fiscal year t . Faulkender and Wang (2006) find that less than full value of one extra dollar of cash is incorporated into stock prices, but they do not consider if the post stock performance is affected by the change in cash holdings. Combining their findings with the results in Column I and II, the value of one additional dollar of cash is greater than \$1, consistent with our previous conclusions.

We also test the post long-run stock performance for financially constrained and unconstrained subsamples, respectively. Panel A of Table 4.8 uses the same subsamples of Faulkender and Wang (2006) and the results show that the change in cash holdings is positively related to post long-run stock performance except for the unconstrained subsample under commercial paper criterion. This is consistent with the results in column I and II of Table 4.7 and further indicate that the marginal value of cash is underestimated for both financially constrained firms and unconstrained firms in the study of Faulkender and Wang (2006). In Panel B, we use our own subsamples to test the market underreaction hypothesis and the results seem interesting. For financially constrained firms, there is no significant relationship between change in cash holdings and post long-run stock performance; for financially unconstrained firms under three of four financial criteria, however, the change in cash holdings is still positively correlated with long-run stock performance, suggesting that shareholders in financially unconstrained firms underestimate the marginal value of cash in the same fiscal year and this will be corrected by the market in the long-run.

Table 4.8 Long-run stock performance for Constrained and Unconstrained Subsamples

This table shows the regression results of long-run stock performance for financially constrained (C) and unconstrained (U) subsamples according to four alternative financial constraint criteria. The dependent variable is the first-year excess return after fiscal year end t. All independent variables are included in the regression but are not all reported in the Table. Panel A uses the sample of Faulkender and Wang (2006) and Panel B use the full sample in this paper. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White, 1980).

Panel A. Sample in Faulkender and Wang (2006)								
Indep. Var.	Payout Ratio		Firm Size		Bond Ratings		Comm. Paper Ratings	
	(C)	(U)	(C)	(U)	(C)	(U)	(C)	(U)
ΔC_t	0.332*** (0.066)	0.306*** (0.061)	0.198*** (0.049)	0.201*** (0.062)	0.269*** (0.050)	0.046 (0.069)	0.240*** (0.046)	0.046 (0.092)
$C_{t-1}*\Delta C_t$	-0.120 (0.114)	-0.143 (0.105)	0.104 (0.088)	-0.113 (0.108)	-0.017 (0.092)	0.357*** (0.115)	0.009 (0.081)	0.479*** (0.157)
$L_t*\Delta C_t$	-0.026 (0.131)	-0.089 (0.142)	0.032 (0.116)	0.121 (0.143)	-0.055 (0.118)	0.133 (0.146)	0.003 (0.104)	0.111 (0.360)
<i>Control Var.</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Intercept</i>	-0.068*** (0.008)	-0.003 (0.004)	-0.059*** (0.006)	-0.000 (0.005)	-0.031*** (0.005)	-0.003 (0.007)	-0.032*** (0.005)	0.005 (0.009)
Obs.	13,191	22,325	23,565	23,569	32,333	14,251	37,614	8,970
Adj R ²	0.0124	0.0094	0.0116	0.0105	0.0128	0.0125	0.0136	0.0077
Panel B. Oil-and-gas sample								
ΔC_t	0.240 (0.242)	1.122** (0.489)	-0.084 (0.199)	1.164*** (0.401)	0.499 (0.397)	0.406** (0.168)	0.308 (0.288)	0.235 (0.261)
$C_{t-1}*\Delta C_t$	-0.067 (0.267)	1.066 (1.157)	-0.194 (0.313)	0.323 (1.530)	0.095 (0.245)	-0.153 (0.391)	0.311 (0.333)	-0.006 (0.528)
$L_t*\Delta C_t$	0.256 (0.472)	-3.118*** (1.199)	0.762 (0.747)	-1.734 (1.139)	-0.727 (0.745)	-0.444 (0.464)	-0.202 (0.561)	-0.344 (2.611)
<i>Control Var.</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Intercept</i>	0.033 (0.045)	0.034 (0.040)	0.146** (0.068)	0.008 (0.031)	0.063 (0.059)	-0.054 (0.035)	0.043 (0.041)	0.068* (0.041)
Obs.	1,058	450	484	474	762	864	1,300	322
Adj R ²	0.0068	0.0244	0.0000	0.0648	0.0056	0.0421	0.0063	0.0155

4.6 Robustness Test

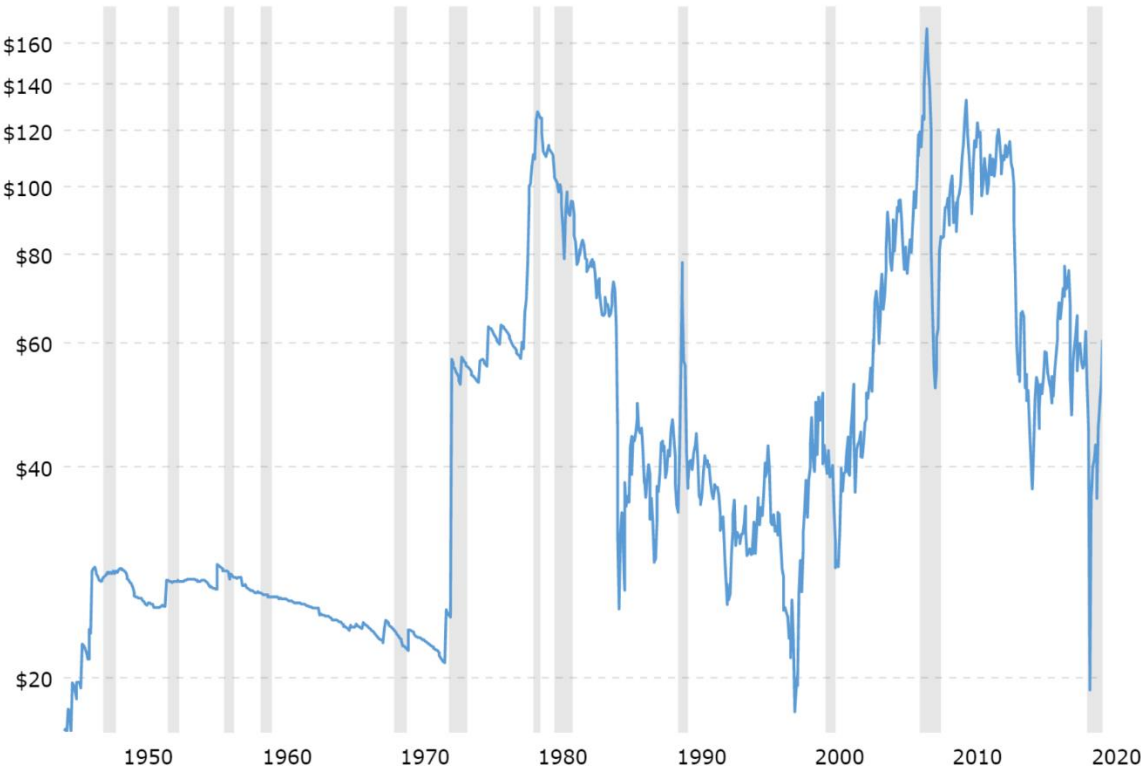
4.6.1 Selected Positive Oil Price Shock Years

Since the sample period in this paper is 2000-2007, it is concerned that the cash increases during the years after 2000 are probably expected, making the change of cash holdings still endogenous. To maximumly eliminate this concern, we select some individual positive oil price shock years to do further robustness tests.

According to West Texas Intermediate (WTI) crude oil price history in Figure 1, the following years are selected as our new sample years in which the oil price increases at least 30%: 1974, 1979, 1990, 1999, 2002, 2007, 2009, 2016. With same data processing method, we end up with 917 oil-and-gas firm-years observations as well 917 non-oil-and-gas matching firm-year observations during those selected sample years.

We first run regressions of model (1) to examine the marginal value of cash holdings with new sample. The results are exhibited in column (1) to column (3) of Table 4.9. From column (1), the coefficient of change in cash holdings is 1.351 and significant at 1% level, indicating that one dollar increase in cash holding will cause shareholders' value increase by \$1.351. Two interaction terms are included in column (2) to incorporate the effects of existing level of cash and leverage. Different from the results in Table 4.3, the coefficient of change in cash holdings is only 0.628, which is less than 1. However, the coefficient of the interaction between existing cash level and change in cash holdings is only significant at 10% level while the coefficient for the interaction between leverage and change in cash holdings is even insignificant, suggesting that both existing cash level and leverage have no moderation effect on the marginal value of cash with the whole sample of new cash windfall firms. This is also supported by the results in column (III) using the subsample of firms with positive earnings and payout. In addition to the previous two interaction terms, the one between repurchase and change in cash holdings is also insignificant, showing that the method of cash distribution to shareholders will not affect the marginal value of cash either. As a result, without the effect of interaction terms, one extra dollar of cash is worth more than one dollar to shareholders, which is consistent with our main results in section 4.4.

Figure 1 West Texas Intermediate (WTI) crude oil price history



Note: Figure source: <https://www.macrotrends.net/1369/crude-oil-price-history-chart>

Table 4.9 Robustness check with new selected positive oil price shock years

This table reports the regression results with new selected sample years. The full sample includes 1,834 firm-year observations of which 917 firm-year observations are from oil and gas industry and other 917 firm-year observations are matching firm-years from other industries (financial firms and utility firms are excluded). The dependent variable in column (I) to (III) is the annual excess return in the same fiscal year t . Column (IV) uses the subset of firms with positive earnings and positive payout in the corresponding fiscal year, resulting in 916 firm-year observation in the subsample. The dependent variable in column (V) and (VI) is the first-year excess return after fiscal year t . The definitions of all independent variables are listed in Appendix A. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White,1980).

Independent Variables	I	II	III	IV	V
ΔC_t	1.351*** ($<.001$)	0.631** (0.039)	0.628*** (0.009)	0.095 (0.469)	0.031 (0.847)
C_{t-1}	0.651*** ($<.001$)	0.678*** ($<.001$)	0.381*** ($<.001$)	-0.049 (0.462)	-0.138* (0.073)
ΔE_t	0.159** (0.011)	0.118 (0.005)	0.372*** (0.004)	0.055 (0.104)	0.065* (0.067)
ΔNA_t	0.086** (0.024)	0.072** (0.037)	0.078 (0.219)	-0.002 (0.949)	0.007 (0.838)
ΔRD_t	0.526 (0.594)	1.422 (0.239)	-1.176 (0.380)	-0.004 (0.996)	-0.103 (0.910)
ΔI_t	0.296 (0.558)	0.206 (0.650)	1.455** (0.024)	0.540 (0.233)	0.501 (0.261)
ΔD_t	0.147 (0.717)	0.107 (0.779)	-0.347 (0.369)	0.400 (0.429)	0.552 (0.298)
L_t	-0.562*** ($<.001$)	-0.570 ($<.001$)	-0.361*** ($<.001$)	0.209** (0.027)	0.223** (0.019)
NF_t	-0.249** (0.023)	-0.187** (0.011)	-0.112 (0.326)	0.010 (0.783)	-0.039 (0.333)
$\Delta SALE_t$	0.073* (0.086)	0.069* (0.073)	0.107 (0.128)		
BM_t	-0.086*** (0.008)	-0.087*** (0.006)	-0.134*** ($<.001$)		
$C_{t-1}*\Delta C_t$		0.381* (0.065)	0.059 (0.674)		0.031 (0.847)
$L_t *\Delta C_t$		0.538 (0.472)	-0.692 (0.250)		-0.138* (0.073)
Re_t			-0.114*** (0.003)		
$Re_t*\Delta C_t$			0.026 (0.937)		
Intercept	0.241*** ($<.001$)	0.247*** ($<.001$)	0.295*** ($<.001$)	0.008 (0.807)	0.015 (0.627)
Obs	1,834	1,834	916	1,800	1,800
Adj R ²	0.298	0.319	0.176	0.006	0.010

We next examine whether the change in cash holdings affects the long-run stock performance with the new oil price shock sample using the first-year excess return after fiscal year end t . To be consistent with previous results in section 4.5, sales growth and book-to-market ratio are still not included in the regression. The statistics in column (IV) and column (V) shows that the change in cash holdings in fiscal year t is not related with long-run stock performance after fiscal year t and therefor the coefficient of ΔC_t in column (1) fully reflects the marginal value of cash, consistent with our conclusions in section 4.5. In other words, the results using cash windfall firms estimate the marginal value of cash more accurately, comparing with the results in Faulkendar and Wang (2006).

Robustness tests for financially constrained and unconstrained subsamples are also conducted with new selected positive oil price shock years. Panel A of Table 4.10 reports the regression results for subsamples based on four alternative financial constraint criteria, using the annual excess return in the concurrent fiscal year t as dependent variable. The interaction terms are not statistically significant for financially constrained firms under all four criteria. However, the results for financially unconstrained firms are quite complicated. The interaction between current level of cash and change in cash holdings is significantly positive for unconstrained firms under firm size and bond rating criteria while the interaction between leverage and change in cash holdings is significantly negative under payout and firm size criteria. Therefore, the marginal value of cash for financially unconstrained firms may somehow be affected by the existing level of cash and leverage. Given the mean of those variables, we will find that the marginal value of cash for constrained subsample will be higher than that for unconstrained subsample under all financial constraint criteria, except for payout ratio. This also support our conclusion in section 4.4.

Regarding robustness tests of long-run stock performance for financially constrained and unconstrained subsamples, the results in Panel B of Table 4.10 suggest that the impact of change in cash holdings on stock performance is not extended to the year after fiscal year t , indicating that there is no market underestimation for marginal value of cash when using cash windfall samples.

Table 4.10 Regressions for constrained and unconstrained subsamples with new selected positive oil price shock years

This table shows the regression results for financially constrained (C) and unconstrained (U) subsamples according to four alternative financial constraint criteria with new selected positive oil price shock years. The dependent variable in Panel A is annual excess return for fiscal year t . The dependent variable in Panel B is first-year excess return after fiscal year t . Other control variables are also included. All independent variables are listed in Appendix A. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White, 1980).

Panel A. Regression with concurrent annual excess return								
Indep. Var.	Payout Ratio		Firm Size		Bond Ratings		Comm. Paper Ratings	
	(C)	(U)	(C)	(U)	(C)	(U)	(C)	(U)
ΔC_t	0.936*** (0.010)	1.511*** (<.001)	1.117** (0.017)	1.151** (0.014)	0.997*** (0.006)	0.796** (0.027)	0.689* (0.068)	0.679** (0.046)
$C_{t-1}*\Delta C_t$	0.350* (0.081)	0.533 (0.272)	-0.490 (0.124)	0.893*** (<.001)	-0.221 (0.510)	0.506** (0.011)	0.393* (0.064)	0.040 (0.966)
$L_t*\Delta C_t$	0.218 (0.789)	-2.649** (0.029)	-0.510 (0.505)	-2.458*** (0.002)	-0.163 (0.811)	-0.308 (0.634)	0.456 (0.616)	0.234 (0.907)
<i>Control Var.</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Intercept</i>	0.251*** (<.001)	0.203*** (<.001)	0.378*** (<.001)	0.252*** (<.001)	0.307*** (<.001)	0.241*** (<.001)	0.299*** (<.001)	0.038 (0.479)
Obs.	1,098	456	544	542	1116	716	1,562	266
Adj R ²	0.333	0.208	0.168	0.814	0.191	0.664	0.357	0.205
Panel B. Regression for long-run stock performance								
ΔC_t	-0.126 (0.310)	0.087 (0.869)	-0.236 (0.297)	0.972*** (0.001)	-0.027 (0.927)	-0.170 (0.530)	-0.051 (0.767)	0.168 (0.758)
$C_{t-1}*\Delta C_t$	-0.029 (0.677)	-0.911 (0.178)	-0.015 (0.913)	0.338 (0.359)	-0.051 (0.697)	0.072 (0.700)	-0.153* (0.077)	0.583 (0.363)
$L_t*\Delta C_t$	0.257 (0.375)	2.878 (0.160)	0.663 (0.303)	-1.194 (0.235)	0.586 (0.208)	0.502 (0.317)	0.487 (0.197)	1.530 (0.520)
<i>Control Var.</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Intercept</i>	0.037 (0.437)	-0.084* (0.061)	0.200** (0.012)	-0.030 (0.411)	0.071 (0.175)	-0.072* (0.070)	-0.006 (0.880)	0.004 (0.947)
Obs.	1,068	454	520	540	1,086	710	1,528	264
Adj R ²	0.000	0.062	0.000	0.065	0.008	0.030	0.015	0.006

4.6.2 Agency Cost

Jensen (1986) indicates that the interest conflicts between managers and shareholders cause agency problems and are especially severe in firms with higher free cash flows, suggesting that firms should carry less cash. However, in the other hand, some recent papers provide evidence supporting the value of financial flexibility by holding cash (DeAngelo and DeAngelo, 2007; Gamba and Triantis, 2008; Meier, Bozec and Laurin, 2013). In this study, the firms receiving cash windfalls seem to incur higher agency costs so that it is necessary to control for the agency cost when evaluating the marginal value of cash.

According to Ang, Cole and Lin (2000), Singh and Davidson (2003) and Sajid et al (2012), we use two measures to proxy for agency cost. One is expense ratio that is operating expense scaled by annual sales, measuring how effectively the firm's management control operating costs in which direct agency costs are included. The other one is the asset utilization ratio that is annual sales divided by total assets, measuring how effectively the firm's management deploys its assets. With agency cost controlled, we replicate the baseline regression modal (1). The agency cost ($AgencyC_{t-1}$) in column (1) and (2) of Table 4.11 is proxied by expense ratio in previous year t-1 and that in column (3) and (4) is proxied by asset utilization ratio in previous year t-1. Even controlling for agency costs, the coefficients of change in cash holding in Table 4.11 are very similar to those in column (1) and (2) of Table 4.3, indicating that our estimation of marginal value of cash is not affected by the agency problem that may incur due to cash windfalls. In column (1) and (2) with expense ratio as a measure of agency cost, the coefficient of expense ratio is significantly and negatively correlated with concurrent annual excess return of fiscal year t, suggesting that higher agency cost has significantly negative effect on the shareholders' wealth, consistent with agency theory of Jensen (1986). In column (3) and (4), we do not find any significant relation between asset utilization ratio and stock excess return. In conclusion, the marginal value of cash with cash windfall firms is not affected by the agency problem, regardless of which measure of agency costs is used.

Table 4.11 Baseline Regression Controlling for Agency Cost

This table presents the results of baseline regression model (1) with agency cost controlled. The full sample includes 1,644 firm-year observations of which 822 firm-year observations are from oil and gas industry and other 822 firm-year observations are matching firm-years from other industries (financial firms and utility firms are excluded). Two measure of agency costs ($AgencyC_{t-1}$) are used: one is expense ratio which is operating expense scaled by annual sales in column (1) and (2); the other one is asset utilization ratio which is annual sales divided by total assets in column (3) and (4). The definitions of other variables are listed in Appendix A. White heteroscedastic-consistent standard errors, corrected for correlation across observations of a given firm, are in parentheses (White,1980).

Agency Cost Independent Variables	Expense Ratio		Asset Utilization Ratio	
	I	II	III	IV
ΔC_t	1.362*** (<.001)	2.281*** (<.001)	1.386*** (<.001)	2.300*** (<.001)
C_{t-1}	0.270*** (0.005)	0.243*** (0.004)	0.261*** (0.007)	0.235*** (0.006)
ΔE_t	0.114** (0.019)	0.123** (0.031)	0.113** (0.019)	0.122** (0.031)
ΔNA_t	0.162** (0.026)	0.197** (0.010)	0.194*** (0.006)	0.229*** (0.002)
ΔRD_t	5.189** (0.024)	4.568** (0.013)	5.201** (0.024)	4.581** (0.014)
ΔI_t	-2.011*** (<.001)	-2.409*** (<.001)	-1.976*** (<.001)	-2.371*** (<.001)
ΔD_t	3.277** (0.021)	2.681* (0.052)	3.285** (0.026)	2.687* (0.061)
L_t	-0.399*** (<.001)	-0.348*** (<.001)	-0.406*** (<.001)	-0.355*** (<.001)
NF_t	-0.117 (0.206)	-0.163* (0.086)	-0.146 (0.109)	-0.193** (0.039)
$\Delta SALE_t$	0.113*** (<.001)	0.115*** (<.001)	0.037 (0.242)	0.037 (0.245)
BM_t	-0.140*** (<.001)	-0.137*** (<.001)	-0.142*** (<.001)	-0.139*** (<.001)
$AgencyC_{t-1}$	-0.010*** (<0.001)	-0.010*** (<.001)	-0.029 (0.129)	-0.032* (0.093)
$C_{t-1}*\Delta C_t$		-0.819*** (<.001)		-0.811*** (<.001)
$L_t *\Delta C_t$		-1.171** (0.027)		-1.169** (0.029)
Intercept	0.221*** (<.001)	0.197*** (<.001)	0.255*** (<.001)	0.235*** (<.001)
Observations	1,644	1,644	1,644	1,644
Adj R ²	0.237	0.254	0.228	0.246

4.7 Conclusions

This paper examines the marginal value of cash to shareholders using a sample of oil-and-gas firm-year observations as well as equal number of non-oil-and-gas firm-year observations during the period of 2000-2007 when there is oil price shock occurring. With endogeneity issue eliminated, shareholders place a value of more than \$1 to one extra dollar of cash on average, contradicting the findings of existing literature. However, the current level of cash holdings and leverage are still significantly and negatively correlated with marginal value of cash, consistent with previous literature. Further market underreaction tests show that Faulkender and Wang (2006) do underestimate the value of one dollar increase in cash holdings while our paper does not with full sample, supporting the reliability of our results.

4.7 Appendix

4.7.1 Appendix A. Variable Definition

Variable Names	Variable Definitions
$M_{i,t}$	Market value of equity for firm i at fiscal year t is the number of shares (54) multiplied by the stock's closing price at the fiscal year-end (199).
ΔC_t	$= \frac{\Delta C_{i,t}}{M_{i,t-1}}$. It is one-year change of cash holdings divided by one-year lagged market value of equity. Cash Holdings ($C_{i,t}$) is equal to cash plus marketable securities (1).
C_{t-1}	$= \frac{C_{i,t-1}}{M_{i,t-1}}$. It is one-year lagged cash holdings divided by one-year lagged market value of equity.
ΔNA_t	$= \frac{\Delta NA_{i,t}}{M_{i,t-1}}$. It is one-year change of net assets divided by one-year lagged market value of equity. Net assets ($NA_{i,t}$) is equal to total assets (6) minus cash holdings (1).
ΔD_t	$= \frac{\Delta D_{i,t}}{M_{i,t-1}}$. It is one-year change of dividends divided by one-year lagged market value of equity. Dividends ($D_{i,t}$) is common dividends paid (21).
ΔE_t	$= \frac{\Delta E_{i,t}}{M_{i,t-1}}$. It is one-year change of earnings divided by one-year lagged market value of equity. Earnings ($E_{i,t}$) is calculated as the sum of earnings before extraordinary items (18), interest (15), deferred tax credits (50) and investment tax credits (51).
L_t	$= L_{i,t}$. Leverage ($L_{i,t}$) for firm i at fiscal year t is equal to total debt (9+34) divided by the sum of total debt and the market value of equity.
NF_t	$= \frac{NF_{i,t}}{M_{i,t-1}}$. It is net financing divided by one-year lagged market value of equity. Net financing ($NF_{i,t}$) is total equity issuance (108) minus repurchases (115) plus debt issuance (111) minus debt redemption (114).
ΔRD_t	$= \frac{\Delta RD_{i,t}}{M_{i,t-1}}$. It is one-year change of R&D expenditure divided by one-year lagged market value of equity. $RD_{i,t}$ is R&D expenditure (46), which equals zero if missing.
ΔI_t	$= \frac{\Delta I_{i,t}}{M_{i,t-1}}$. It is one-year change of interest expense divided by one-year lagged market value of equity. $I_{i,t}$ is interest expense (15).
$\Delta SALE_t$	$= \frac{\Delta SALE_{i,t}}{SALE_{i,t-1}}$. It is one-year percentage change of sales. $SALE_{i,t}$ is sales (12) for firm i at year t .

Appendix A. Continued

Variable Names	Variable Definitions
	$= \frac{BE_{i,t}}{M_{i,t}}$ It is book value of equity divided by market value of equity.
	Book value of equity ($BE_{i,t}$) is calculated as shareholders' equity – preferred stock value + balance sheet deferred taxes (if available) – FASB106 adjustment (if available).
BM_t	Shareholders' equity is equal to stockholders' equity (216), total common equity (60) + preferred stock par value (130), or total asset (6) – total liability (181) – minority interest (38), in that order if available. Otherwise, it is treated as missing.
	Preferred stock value is proxied by redemption value (56), liquidating value (10) or carrying value (130), in that order if available. Otherwise, it is set to be missing.
Re_t	It is the ratio of repurchase (115) divided by the sum of repurchase (115) and total common dividends (21).

Note: The numbers in parentheses are COMPUSTAT data item numbers.

Chapter 5 General Conclusion

This dissertation includes three topics on corporate finance: 1) the relation between financial constraints and probability of cross-listing; 2) the impact of near-term cash shortage on post-IPO long-run stock performance; and 3) the marginal value of cash holdings as well as cross-sectional variants. In chapter 2, we test the hypothesis that firms with higher level of financial constraints are more likely to cross-list in U.S markets through ADRs. Three measures are used to proxy for financial constraints: payout ratio, payout level and WW index (Whited and Wu, 2006). Low payout ratio, low payout level or high WW index implies high level of financial constraints. Consistent with the hypothesis, our results show that firms with higher level of financial constraints have higher probability of cross-listing in U.S. markets through ADRs. And this is mainly driven by small firms. We next investigate how the financial constraints will change after cross-listing in U.S. markets. Our results suggest that the financial constraints decrease after cross-listing for those non-U.S. firms, especially for small firms. In conclusion, all the above evidences indicate that alleviating financial constraints is one of the motives for non-U.S. firms to cross-list in U.S. stock markets through ADRs.

In chapter 3, we explore the near-term cash shortage situation prior to IPOs and the relation between cash shortage and post-IPO long-run stock performance. Following DeAngelo, DeAngelo and Stulz (2010), a pro forma cash ratio (PFCASH) is constructed to measure the level of cash holdings of IPO firms assuming no IPO proceeds are received. We find that around 75% of IPO firms have negative PFCASH in the first fiscal year end after IPO issuance, implying that most of IPO firms will run out of cash if IPO proceeds are not received. We then examine if this near-term cash shortage will affect post-IPO long-run stock underperformance. With 3-year market-adjusted buy-and-hold return and size-and-B/M adjusted buy-and-hold returns as long-run stock performance measures, our results indicate that near-term cash shortage have a significantly negative impact on post-IPO long-run stock performance. This is robust after controlling for changes of capital expenditure, total liability and long-term debt. Our findings are consistent with market underreaction hypothesis that the market underreacts to the negative information conveyed in the cash shortage, which will be corrected gradually through post-IPO stock performance in the long run. Further tests are conducted to explore the operating performance is correlated with near-

term cash shortage. It is supported that the occurrence of near-term cash shortage is partly due to poor operating performance before IPOs and that near-term cash shortage is negatively related with post-IPO operating performance.

In chapter 4, we investigate the value of one extra dollar of cash holdings to shareholders, using cash windfall firms - oil-and-gas firms in a period of oil price shock occurring. Our objective is to solve the endogeneity issue that previous literature may have especially Faulkender and Wang (2006) and re-estimate the marginal value of cash holdings. To be consistent with Faulkender and Wang (2006), we also examine whether the value of one extra dollar of cash is influenced by the current level of cash holdings, leverage, and the ability of raising external funds. Our findings suggest that on average one additional dollar of cash is worth more than \$1 to shareholders although the current level of cash holdings and leverage have significantly negative impact on the marginal value of cash. Shareholders in firms with worse access to financial markets place a higher value to one extra dollar of cash since they are more dependent on internal funds. We further explore whether the change in cash holding is correlated with post long-run stock performance, using our sample as well as the sample in Faulkender and Wang (2006), respectively. By comparison, it is show that our study is more accurately estimate the marginal value of cash, especially for financially constrained firms.

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